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SCI/NASS COMBINATION CASE REPORT

CASE NUMBER - NASS-98-41-004A
LOCATION - Florida
VEHICLE - 1998 MERCURY TRACER
CRASH DATE - January 1998

Submitted:

June 13, 2000

Revised:
October 17, 2002

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

1. *Report No.* NASS-98-41-004A	2. *Government Accession No.*	3. *Recipient's Catalog No.*
4. *Title and Subtitle* Combination SCI/NASS Air Bag Deployment Investigation Vehicle - 1998 Mercury Tracer 4-door sedan Location - Florida		5. *Report Date:* June 13, 2000 6. *Performing Organization Code*
7. *Author(s)* Special Crash Investigations Team #2		8. *Performing Organization Report No.* Task # 0195
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: January 1998 14. *Sponsoring Agency Code*

15. *Supplementary Notes*
Combination SCI/NASS investigation involving a 1998 Mercury Tracer equipped with manual safety belts and dual redesigned front air bags that impacted a concrete bridge pillar.

16. *Abstract*

This combination SCI/NASS investigation concerns an air bag deployment crash involving a 1998 Mercury Tracer (case vehicle) that impacted a concrete bridge pillar. This case is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of the collision events and the unrestrained driver (36-year-old male) was killed. There was no other occupant. The case vehicle was traveling west at high speed in a westbound, two-lane, one-way entrance ramp where the ramp merged from the left with another two-lane limited-access roadway to create an urban interstate with four westbound lanes. The case vehicle failed to negotiate the area where the two roadways merged and traveled essentially straight down the ramp, crossed the gore and the two lanes of the joined roadway, departed the right (north) road edge, traveled across the shoulder onto the roadside and impacted a large bridge pillar, causing the driver and front right passenger air bags to deploy. There is no evidence that the case vehicle driver attempted any avoidance actions. This was a crash of overwhelming violence. The case vehicle sustained massive intrusion across the entire front seat row. The driver's injuries included a laceration of the midbrain, atlanto-occipital dislocation, complete transection of the aorta, bilateral fractured ribs, lacerations of the liver, multiple comminuted fractures of the pelvis and lower extremities, and numerous contusions and abrasions. He was declared dead at the scene. The case vehicle was towed due to disabling damage.

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* 8	22. *Price* $2,500

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BACKGROUND

NASS-98-41-004A

This combination SCI/NASS investigation was brought to the NHTSA's attention by NASS/CDS sampling activities and a review of the 1998 Fatality Analysis Reporting System (FARS) in February 1999. The crash involved a 1998 Mercury Tracer (case vehicle) that impacted a concrete bridge pillar. The crash occurred in January 1998 at 1:26 p.m. in Florida and was investigated by the applicable state police. This case is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of the collision events and the case vehicle's unrestrained driver (36-year-old male) was killed. There was no other occupant in the case vehicle. A copy of the NASS electronic case was received in May 2000. This report is based on the Police Crash Report, the autopsy report, police photographs, occupant kinematic principles, the coded NASS case and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling west at high speed in a westbound, two-lane, one-way entrance ramp where the ramp merged from the left with another two-lane limited-access roadway to create an urban interstate with four westbound lanes. The case vehicle failed to negotiate the area where the two roadways merged and traveled essentially straight down the ramp, crossed the gore and the two lanes of the joined roadway, departed the right (north) road edge and traveled across the shoulder onto the roadside (**Figure 1**). There is no evidence that the case vehicle driver attempted any avoidance actions.

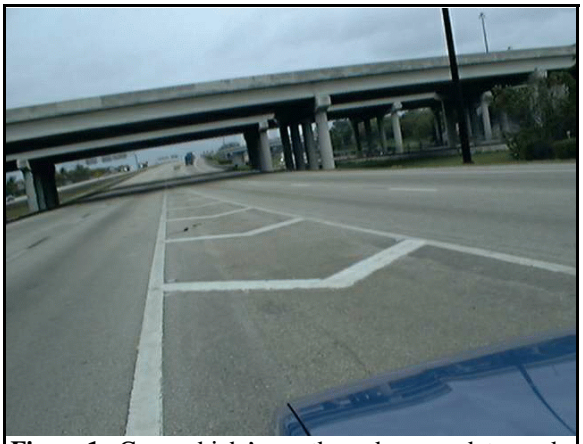


Figure 1: Case vehicle's westbound approach toward impact with bridge pillar on right

The crash occurred on the roadside, under an overpass for another roadway (**Figure 2**). The front of the case vehicle impacted a very large concrete bridge pillar, causing the case vehicle's driver and front right passenger air bags to deploy. The case vehicle rotated a few degrees counterclockwise and came to rest lodged against the bridge pillar. The Police Crash Report includes an estimate that the case vehicle was traveling approximately 113 km.p.h. [70 m.p.h.] at impact. The coroner's report includes witness statements that the case vehicle had been traveling 48 - 64 km.p.h. [30 - 40 m.p.h.] and appeared to accelerate toward the bridge pillar.

Figure 2: On-scene, case vehicle's off-road path into impact and final rest

CASE VEHICLE

The case vehicle was a front-wheel-drive 1998 Mercury Tracer four-door, five-passenger sedan (VIN: 1MEFM13P8WW------) with a 2.0 liter gasoline engine and an automatic transmission with a console-mounted selector lever. Four-wheel anti-lock brakes were an option for this model vehicle, but it is not known if the case vehicle was so equipped. The case vehicle's wheelbase was 250 centimeters [98.4 inches]. The odometer reading was not reported. The case vehicle was a rental vehicle.

Figure 3: On-scene, left side of case vehicle at final rest, prior to extrication of victim

CASE VEHICLE DAMAGE

The case vehicle sustained heavy direct contact damage across the entire front plane (**Figures 3 - 5**), with maximum crush 120 centimeters [47.2 inches] at the center of the front bumper. The front bumper was pushed back against the front wheels, the wheels were pushed against the left and right lower A-pillars and the pillars were displaced rearward. The wheelbase was shortened by 58 centimeters [23 inches] on the left and 46 centimeters [18 inches] on the right. The engine hood was folded double and pushed against the windshield, causing extensive fracturing across the entire windshield. The front doors were distorted and bent outward, but the latches and hinges did not fail and the doors did not come open (the NASS case indicates that it is unknown whether the doors came open because of damage incurred during extrication efforts). The roof was buckled in the area of the B-pillars. The CDC is **12-FDEW-4** (direction of principal force 0 degrees). The WinSMASH reconstruction program indicated total, longitudinal and lateral Delta V, respectively: 94 km.p.h. [58 m.p.h.], -94 km.p.h. [-58 m.p.h.] and 0. The coded NASS case does not include these Delta V estimates because the crash was judged as being beyond the scope of the WinSMASH program due to the very great amount of crush.

Figure 4: On-scene, right side of case vehicle at final rest, prior to extrication of victim

Figure 5: Front left view of damage measurement

Extrication activities resulted in the case vehicle being extensively altered from its post-crash condition and the available photographs do not enable an assessment of the interior prior to extrication activities, but it is apparent that the entire front seat row sustained heavy intrusion by the instrument panel and floor (**Figure 6**). The NASS researcher documented intrusion of 55 centimeters [22 inches] by the left toe pan and 25 centimeters [10 inches] by the mid instrument panel. The steering column was forced into a nearly vertical configuration and the left instrument panel was separated from its mountings and lifted upward. The steering wheel rim appears to be intact, with no evidence of rim/spoke damage except a possible contact point at the bottom of the rim (**Figure 7**). (The NASS case indicates complete steering wheel collapse, but this reflects the NASS researcher's assessment of the steering assembly as a whole.)

Figure 6: Case vehicle's instrument panel viewed from right door opening, after extrication

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with redesigned front air bags for the driver and front right passenger seat positions. The driver air bag was located in the steering wheel hub. The module cover flaps opened along the seams with no evidence of damage to the flaps or the air bag. The driver air bag was round with diameter 50 centimeters [20 inches], with two tethers and two vent ports at the 11 and 1 o'clock positions. There was a small blood splatter in the front lower left quadrant and no other evidence of contact. The front right passenger air bag was located in the top of the instrument panel. The module's single cover flap opened along the seams and there was no evidence of damage to the flap or the air bag. The front right passenger air bag was rectangular, 40 centimeters [16 inches] wide and 50 centimeters [20 inches] high. It had no tether and two vent ports, at the 9 and 3 o'clock positions. There was no evidence of contact.

Figure 7: Case vehicle's steering assembly with contact points marked, after extrication

The case vehicle driver (36-year-old male, white, unknown if Hispanic, 175 centimeters, 87 kilograms [69 inches, 192 pounds]) was not restrained by his available manual three-point lap-and-shoulder safety belt system. His pre-crash seated posture and seat adjustments are not known. The case vehicle was not equipped with a tilt steering wheel. He was declared dead at the scene. Toxicological analysis of his urine revealed cocaine, marijuana, barbiturates, benzoylecgonine and salicylates. The following discussion of his injuries is based on the coroner's report of a complete autopsy and the principles of occupant kinematics.

The case vehicle's high-speed impact into the concrete bridge pillar caused the driver and front right passenger air bags to deploy and caused the entire instrument panel, steering assembly, toe pan and foot controls to collapse rearward into the passenger compartment. The steering column was forced into a nearly vertical configuration. This was a crash of overwhelming violence and the autopsy report enumerates twenty-one (21) specific injuries of AIS:2 or greater. Witness statements suggest that the driver may have been reaching into the back seat, that is, he may not have been in a normal driving posture. He sustained abrasions and contusions on his nose, chin and anterior neck, which are consistent with face-forward air bag contact. The steering column and wheel pivoted upward to a nearly vertical configuration and the driver's chest was crushed against the underside of the instrument panel and steering column by the combination of his own forward momentum and the opposite force of the intruding components. He sustained a laceration of the midbrain, atlanto-occipital dislocation, complete transection of the aorta, a laceration of the left ventricle, multiple bilateral rib fractures, multiple lacerations of the liver, and comminuted fractures on both sides of his pelvis. The toe pan and foot controls also intruded and he sustained multiple comminuted fractures of the lower extremities, including bilateral tibia/fibula and both feet. He also sustain contusions and abrasions on his lower chest and abdomen.

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.	Contusion, tip of nose	290402.1 minor	Driver's air bag	Probable	Autopsy
2.	Abrasion, chin	290202.1 minor	Driver's air bag	Probable	Autopsy
3.	Abrasion, anterior neck	390202.1 minor	Driver's air bag	Probable	Autopsy
4.	Contusion, anterior neck	390402.1 minor	Driver's air bag	Probable	Autopsy
5.	Complex basilar skull fracture, from left to right sphenoid across pituitary sella and posteriorly into occipital bone	150206.4 severe	Left B-pillar	Possible	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
6.	Diffuse subarachnoid hemorrhage over cerebrum	140684.3 serious	Left B-pillar	Possible	Autopsy
7.	Transverse laceration of the midbrain just below the pons	140212.6 untreatable	Steering wheel rim	Possible	Autopsy
8.	Complete dislocation of atlanto-occipital joint	650208.2 moderate	Steering wheel rim	Possible	Autopsy
9.	The pituitary gland is avulsed from the pituitary sella	140799.3 moderate	Steering wheel rim	Possible	Autopsy
10.	Abrasions, right lower chest	490202.1 minor	Driver's air bag	Probable	Autopsy
11.	Abrasions, left lower chest	490202.1 minor	Steering column	Probable	Autopsy
12.	Abrasions, right upper abdomen	590202.1 minor	Driver's air bag	Probable	Autopsy
13.	Contusions, left lower back	690402.1 minor	Seat back	Probable	Autopsy
14.	Abrasions, left lower back	690202.1 minor	Seat back	Probable	Autopsy
15.	Multiple abrasions, left knee and lower leg	890202.1 minor	Knee bolster	Probable	Autopsy
16.	Transverse fracture of sternum	450804.2 moderate	Steering column	Probable	Autopsy
17.	Rib fractures: left 2-7 anterior; right 1-7 anterior; left and right 3rd posterior[1]	450240.4 severe	Steering column	Probable	Autopsy
18.	Laceration of anterior pericardial sac	441602.2 moderate	Steering column	Probable	Autopsy
19.	Laceration of the anterior wall of the left ventricle	441008.3 serious	Steering column	Probable	Autopsy
20.	Complete transverse transection of the aorta just below the aortic arch, with 400 cc right and 600 cc left hemothorax[2]	420218.6 untreatable	Steering column	Probable	Autopsy

[1]The autopsy information indicates greater than three ribs fractured on each of the two sides, as indicated by the SCI injury code. AIS-90 code 450232.4 was used for this injury in the NASS case coding, which indicates three or fewer rib fractures on one side.

[2]The autopsy indicates that the hemorrhage was not confined to the mediastinum. AIS-90 code 420216.5 was used for this injury in the NASS case coding, which indicates hemorrhage confined to the mediastinum.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
21.	Contusion, left upper and lower lobes of lung	441406.3 serious	Steering column	Probable	Autopsy
22.	Multiple lacerations of the liver, NFS	541820.2 moderate	Steering column	Probable	Autopsy
23.	Multiple fractures of right pelvic ramus	852600.2 moderate	Left instrument panel	Probable	Autopsy
24.	Multiple abrasions, fingers of right hand	790202.1 minor	Center instrument panel	Probable	Autopsy
25.	Contusion, dorsum of right hand[3]	790402.1 minor	Center instrument panel	Probable	Autopsy
26.	Contusion, right fingers[3]	790402.1 minor	Center instrument panel	Probable	Autopsy
27.	Contusion, left upper arm	790402.1 minor	Driver's air bag	Probable	Autopsy
28.	Abrasions over knuckles of left hand	790202.1 minor	Left instrument panel	Probable	Autopsy
29.	Abrasion over left medial malleolus	890202.1 minor	Floor	Probable	Autopsy
30.	Multiple comminuted fractures, left tibia	851606.2 moderate	Knee bolster	Probable	Autopsy
31.	Multiple comminuted fractures of left tibia	853422.3 serious	Knee bolster	Probable	Autopsy
32.	Contusion over left medial malleolus	890402.1 minor	Floor	Probable	Autopsy
33.	Abrasion, left buttock	890202.1 minor	Floor	Probable	Autopsy
34.	Multiple contusions, medial left foot	890402.1 minor	Floor	Probable	Autopsy
35.	Laceration, medial left foot, 5 x 2 cm with exposed bone	890602.1 minor	Foot controls	Probable	Autopsy
36.	Laceration, bottom of right foot, 9 x 10 cm, gaping with exposed bone	890602.1 minor	Foot controls	Probable	Autopsy

[3]The NASS coding includes a second abrasion to the right hand attributed to the center instrument panel. Injury Coding Rule 10.b indicates that when several similar soft tissue injuries in the same body region are attributed a single injury mechanism, the several similar injuries are to be represented as one code.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
37.	Multiple comminuted fractures, right tibia	851606.2 moderate	Knee bolster	Probable	Autopsy
38.	Multiple comminuted fractures of right tibia[4]	853422.3 serious	Knee bolster	Probable	Autopsy
39.	Dislocation, right knee, NFS	850806.2 moderate	Knee bolster	Probable	Autopsy
40.	Multiple comminuted fractures, bones of right foot, NFS	852000.2 moderate	Floor	Probable	Autopsy
41.	Multiple comminuted fractures, bones of left foot, NFS	852000.2 moderate	Floor	Probable	Autopsy
42.	Transverse anterior fracture of vertebra T-5[5]	650430.2 moderate	Seat back	Possible	Autopsy
43.	Multiple fractures of left pelvic ramus[6]	852600.2 moderate	Left instrument panel	Probable	Autopsy

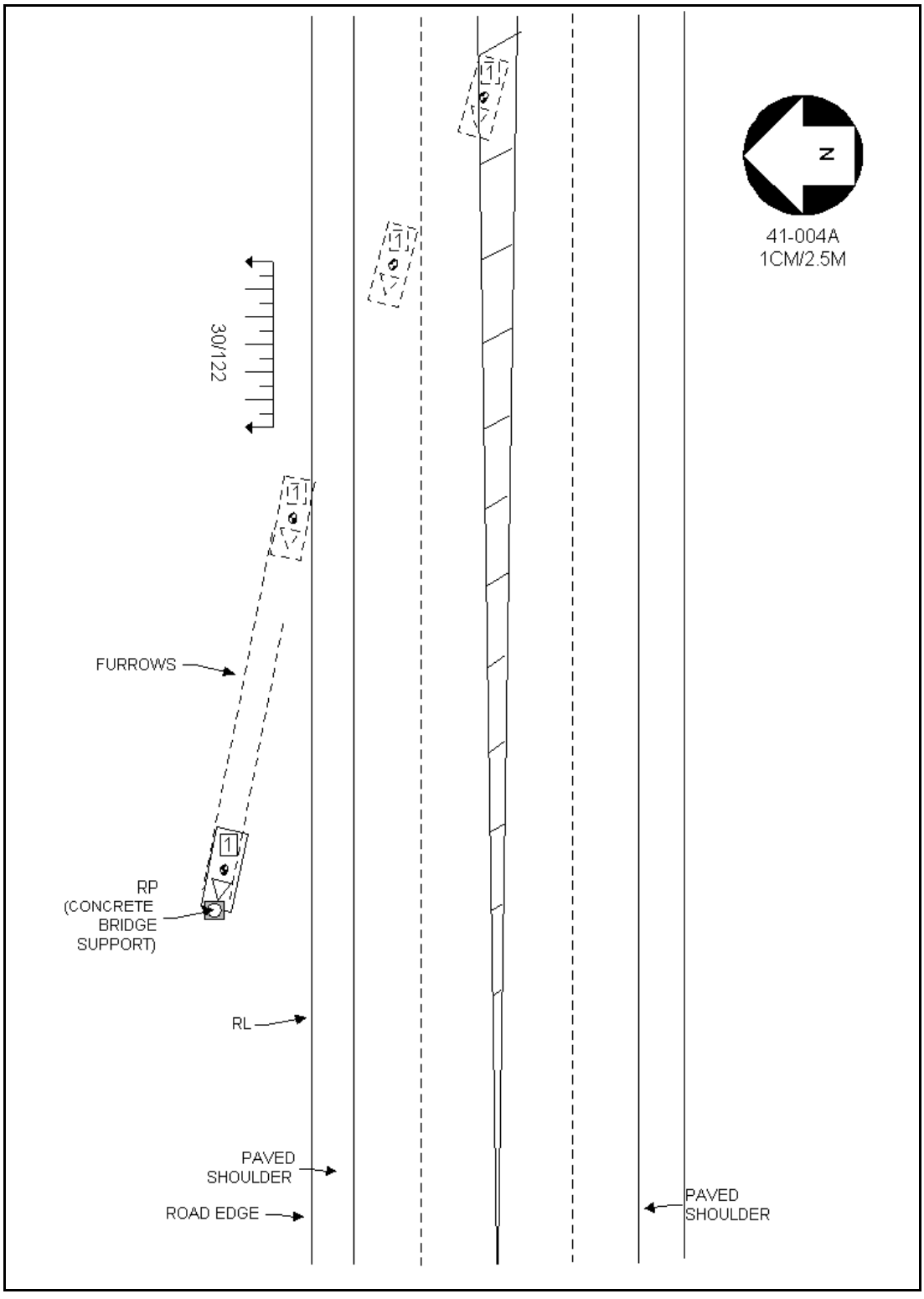
OBJECT CONTACTED

The case vehicle impacted a round concrete bridge pillar with diameter approximately 1.5 meters [5 feet]. The column was part of a large system of piers supporting a deck for a multi-lane roadway overhead (**Figure 2**, above). The column was not damaged except for some light gouging and paint transfers. (Note, the on-scene photos show a large black scrub on the pillar that was impacted and another scrub on the next pillar in line -- these are not related to this crash.)

[4]The autopsy report indicates, "multiple comminuted fractures of the right tibia." AIS-90 code 853404.2 was used for this injury in the NASS case coding, which indicates a simple fracture.

[5]The autopsy information is as stated, which indicates the vertebral body. AIS-90 code 650416.2 was used for this injury in the NASS case, which indicates fracture NFS.

[6]The autopsy report indicates, "multiple fractures of the left and right pelvic rami." The NASS case coding includes right ramus fracture only.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