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ON-SITE REDESIGNED AIR BAG REPORT

CASE NUMBER - IN98-007
LOCATION - TEXAS
VEHICLE - 1998 FORD TAURUS SE
CRASH DATE - December, 1997

Submitted:

December 3, 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.* IN98-007	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* On-Site Redesigned Air Bag Report Vehicle - 1998 Ford Taurus SE Location - Texas		5. *Report Date:* December 3, 2002 6. *Performing Organization Code*	
7. *Author(s)* Special Crash Investigations Team #2		8. *Performing Organization Report No.* Task #s 0155 and 0276	
9. *Performing Organization Name and Address* Transportation Research Center Indiana University 222 West Second Street Bloomington, Indiana 47403-1501		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: December, 1997 14. *Sponsoring Agency Code*	

15. *Supplementary Notes*
On-site air bag deployment investigation involving a 1998 Ford Taurus SE, four-door sedan, with manual safety belts and dual front redesigned air bags, and a 1994 Oldsmobile Achieva S, four-door sedan

16. *Abstract*

This report covers an on-site investigation of an air bag deployment crash that involved a 1998 Ford Taurus SE (case vehicle) and a 1994 Oldsmobile Achieva S (other vehicle). This crash is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of the crash events, and the driver (23-year-old female) and front right passenger (26-year-old male) sustained only minor, integumentary injuries from the crash. The case vehicle was traveling east in the eastbound lane of a two-lane, undivided, service road to an interstate highway. The Oldsmobile was traveling north in the northbound lane of a two-lane, undivided, city street that intersected (i.e., a "Tee") the service road and was making a left turn to travel west on the service road. The crash occurred in the intersection of the two roadways. The front right of the case vehicle impacted the left front of the Oldsmobile, causing the case vehicle's driver and front right passenger redesigned, supplemental restraints (air bags) to deploy. The case vehicle's driver was seated with her seat track located between its middle and forward-most positions, and the steering wheel was located in its middle position. She was restrained by her available, active, three-point, lap-and-shoulder, safety belt system and sustained, according to her interview, a middle back strain. The case vehicle's front center passenger (3-year-old female) and front right passenger were seated with their seat track located between its middle and forward-most positions, and the front center passenger was restrained by her available, active, two-point, lap belt while the front right passenger was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The front right passenger sustained, according to the interview with the case vehicle's driver, a knee abrasion from the dash. The three back passengers in the case vehicle (30-year-old male–back left, 6-year-old male–back center, and 23-year-old female–back right) were seated in a non-adjustable bench seat. The outboard passengers were restrained by their available, active, three-point, lap-and-shoulder, safety belt systems, while the back center passenger was using his available, active, two-point, lap belt. According to the case vehicle's driver, none of the three back-seated passengers were injured.

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* $6,900

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

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BACKGROUND

IN98-007

This on-site investigation was brought to NHTSA's attention on January 5, 1998, by GES sampling activities. This crash involved a 1998 Ford Taurus (case vehicle) and a 1994 Oldsmobile Achieva S (other vehicle). The crash occurred in December, 1997, at 6:38 a.m., in Texas, and was investigated by the applicable municipal police department. This crash is of special interest because the case vehicle was equipped with redesigned air bags, and the driver (23-year-old female) and front right passenger (26-year-old male) sustained only minor integumentary injuries from this crash. This contractor's investigative consultant inspected the scene and the Oldsmobile on January 26, 1998, and the case vehicle on February 6, 1998. The case vehicle's driver was interviewed on July 8, 1998. This report is based on the Police Crash Report, an interview with the case vehicle's driver, scene and vehicle inspections, occupant kinematic principles, self-reported injury information, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

Figure 1: Case vehicle's travel path in eastbound lane approaching "Tee" intersection; Note: eastbound lanes of Interstate are visible on left of photo (case photo #02)

The case vehicle was traveling east in the eastbound lane of a two-lane, undivided, service road to an interstate highway (**Figure 1** and **Figure 11** below), and intended to continue its easterly travel path. Service road dimensions were 7.4 meters (24.3 feet) wide with 0.3 meter (1.0 foot) paved shoulders. The asphalt pavement was traveled and worn, with an estimated dry coefficient of friction of 0.60. Pavement markings for the service roadway included single solid white edge lines on each side of the roadway and a single broken yellow centerline. A single solid yellow line (i.e., no passing for eastbound traffic) was added to the centerline approximately 15.2 meters (50.0 feet) west of the "Tee" intersection. Ambient weather conditions at the time of the crash were: night time, dark and not lighted, clear, no precipitation, and a dry pavement. The roadway was undivided, straight, and level. There were no reported view obstructions, traffic controls, or roadway defects. The case vehicle's driver estimated her pre-impact travel speed at 66-80 km.p.h. (41-50 m.p.h.). The statutory speed limit for this roadway was 89 km.p.h. (55 m.p.h.).

Figure 2: Case vehicle's frontal damage with contour gauge present; Note: extensive damage to front right corner (case photo #16)

The Oldsmobile was traveling north in the northbound lane of a two-lane, undivided, city street that intersected the service road in a Tee configuration (**Figure 12** below) and intended to make a left turn and travel westward on that service road. The case vehicle's driver steered to the left and braked, attempting to avoid the crash. The crash occurred in the Tee intersection of the two roadways.

The front right of the case vehicle (**Figure 2** above and **Figure 3**) impacted the left front of the Oldsmobile (**Figure 4**), causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. As a result, the case vehicle rotated counterclockwise and came to rest mostly off the north roadside, facing northeast. The Oldsmobile rotated clockwise and came to rest on the roadway, facing east. Crash severity for the case vehicle's deployment impact was low [14-23 km.p.h. (9-14 m.p.h.)].

Figure 3: Close-up of damage to case vehicle's front right corner (case photo #28)

Figure 4: Oldsmobile's left front corner impact with case vehicle, viewed from left of front, showing impact to left front corner and case vehicle's continuation across Oldsmobile's front; Note: disregard placement of contour gauge on front (case photo #66)

CASE VEHICLE

The 1998 Ford Taurus was a front wheel drive, four-door sedan (VIN: 1FAFP52U9WG------). Four-wheel, anti-lock brakes are an option for the case vehicle, but there was no indication that the case vehicle was so equipped. The case vehicle was towed due to disabling damage. The engine was a 3.0 liter, OHV, SMPEFI, 12 valve, V-6, coupled to a four-speed, automatic transmission with its shift lever on the steering column. Steering was power-assisted, as was the front disc/rear drum braking system. An odometer reading of 2,013 kilometers (1,251 miles) was recorded. The case vehicle had six occupant seating positions.

Inspection of the case vehicle's interior revealed: electronic windows and door locks; the front seating area had a split bench with separate back cushions; the back seating area had a non-adjustable bench seat; three-point, lap-and-shoulder, safety belt systems were provided for the front and back outboard seating positions (**Figure 13** below); and two-point, lap belts were found at the front center and back center seating positions. The front seat belt systems were equipped with manually operated, upper anchorage adjusters for the "D"-rings. The back outboard seats did not have adjustable upper anchorages. The front anchorage adjustments were found to be in the full down location for the driver and the mid-position for the front right

Figure 5: Case vehicle's frontal damage viewed from right side; Note: front-to-rear crush to right fender (case photo #26)

passenger. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a driver air bag and a front right passenger air bag. Both front seat air bags in the case vehicle deployed as a result of this crash.

Direct damage began 6 centimeters (2.4 inches) to the right of the case vehicle's centerline and extended to the front right corner. Damaged components included the front bumper, grille, splash guard, front body apron, hood, radiator, cooling fan, air conditioner, windshield, right headlamp/turn signal assembly, right fender, right front door panel, left fender, and left front door panel (**Figures 3** and **5** above). Indirect damage extended to the rear of the right front fender and the forward seam of the right front door. In addition, there was indirect damage to the rear of the left front fender and the forward seam of the left front door.

The CDC for the case vehicle's single impact was determined to be: **12-FZEW-1** [maximum crush was 16 centimeters (6.3 inches)]. The WinSMASH reconstruction program, missing vehicle algorithm[1], was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 10.7 km.p.h. (6.6 m.p.h.), -10.5 km.p.h. (-6.5 m.p.h.), and -1.9 km.p.h. (-1.2 m.p.h.). This contractor believes that the determined results for the deployment impact are low.

The 1998 Ford Taurus was equipped with a Supplemental Restraint System (SRS) that contained frontal air bags at the driver and front right passenger seat positions. Both air bags deployed as a result of the impact between the case vehicle and the Oldsmobile. The case vehicle's driver air bag was located in the steering wheel hub, with module seams in an asymmetrical, "H" configuration (**Figure 6**). Measurements for the larger, top cover flap were 10 centimeters (3.9 inches) along the top horizontal seam, 14 centimeters (5.5 inches) along the lower horizontal seam, 3 centimeters (1.2 inches) along the angled side seam, and 5 centimeters (2.0 inches) along the vertical side seam. Measurements for the smaller, bottom cover flap were 14 centimeters (5.5 inches) along the upper horizontal seam, 10 centimeters (3.9 inches) along the lower horizontal seam, and 5.6 centimeters (2.2 inches) at its maximum height (**Figure 7**). Both cover flaps opened along their designated tear seams. There was a possible driver contact to the top left of the upper cover flap, centered approximately 5 centimeters (2.0

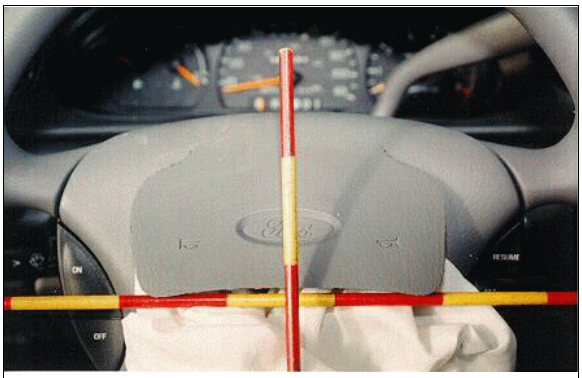

Figure 6: Case vehicle driver air bag module's upper cover flap; Note: possible occupant contact to end of left upper seam (case photo #35)

Figure 7: Case vehicle driver air bag module's lower cover flap (case photo #36)

[1] The crush measurements for the Oldsmobile were taken on the wrong plane; therefore, the missing vehicle algorithm was used.

inches) left of the flap's midpoint and 6 centimeters (2.4 inches) up from the lower horizontal seam. The deployed driver's air bag was round, with a diameter of 61 centimeters (24 inches). It was designed with two cloth tethers 4 centimeters (1.6 inches) wide and was vented by two exhaust ports, approximately 2 centimeters (0.8 inches) in diameter. The exhaust ports were located at the 11 and 1 clock positions.

The front side of the driver's air bag (**Figure 8**) revealed a faint scuff to the top part of the upper right quadrant, some 20 centimeters (7.9 inches) up from the bag's horizontal axis and 5 centimeters (2.0 inches) right of the vertical axis. In addition, there was a large area of cloth transfers to the bottom right portion of the lower left quadrant and to most of the lower right quadrant, centered approximately 7 centimeters (2.8 inches) right of the vertical axis and 13 centimeters (5.1 inches) down from the horizontal axis. The reverse side of the driver's air bag fabric revealed a small scuff near the middle of the upper left quadrant (unmeasured), black scuffs near the circumferential seam of the lower left quadrant (unmeasured), and a small fluid spot near the middle of the lower right quadrant (unmeasured).

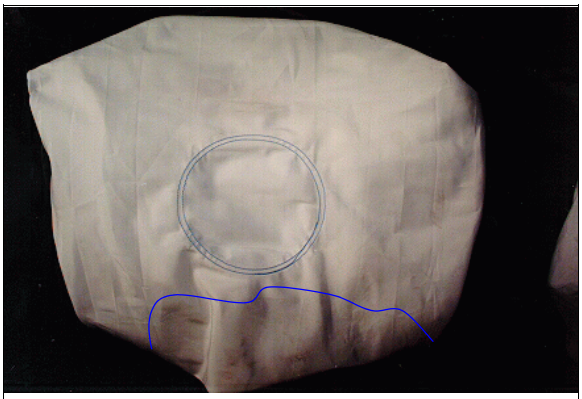

Figure 8: Case vehicle's driver air bag; Note: large area of cloth transfers at lower right (case photo #41)

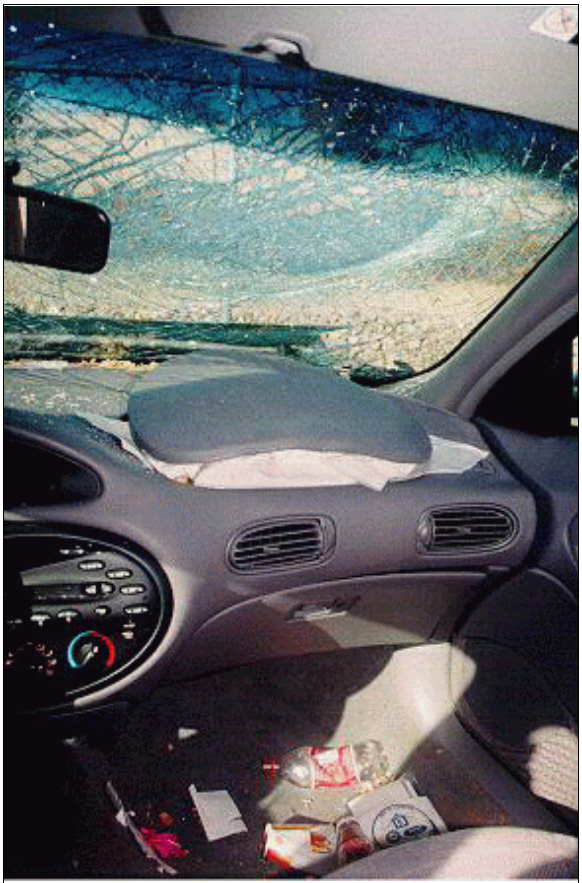

Figure 9: Case vehicle front right air bag module's single cover flap; Note: asymmetrical shape (case photo #34)

Inspection of the front right passenger's air bag, which was located in the top of the instrument panel, revealed that the single cover flap opened at its designated tear points. The shape of the cover flap was irregular and measured a maximum height of 30 centimeters (11.8 inches), a maximum length of 43 centimeters (16.9 inches) along its bottom seam, and contained three rounded corners (**Figure 9**). Deployment caused the cover flap to bend slightly in the middle and contact the windshield, with the flap's front seam abraded by the splintered glass. However, there did not appear to be any evidence of occupant contact to the cover flap. The deployed front right passenger air bag was rectangular, with a height of approximately 54 centimeters (21.3 inches) and a width of approximately 64 centimeters (25.2 inches). The front side of the passenger air bag fabric (**Figure 10** below) revealed a small scuff at the mid-top of

the upper left quadrant, a black scuff at the mid-top of the upper right quadrant, a small soda stain to the bottom left of the lower left quadrant, and a large coffee stain over the right two-thirds of the lower right quadrant, extending up into the bottom right corner of the upper right quadrant. The front right passenger's air bag was designed with one large tether, 52 centimeters (20.5 inches) wide, but had no visible vent ports.

Figure 10: Case vehicle's front right passenger air bag; Note: soda stain at lower left and large coffee stain at lower right (case photo #51)

The interior inspection of the case vehicle also detected scuffs on the interior surface of the case vehicle's right front door panel.

CASE VEHICLE OCCUPANTS

The case vehicle had six occupants (i.e., driver, front center passenger, front right passenger, and back left, center, and right passengers). The driver [23-year-old female; 165 centimeters and 52 kilograms (65 inches, 115 pounds)] was restrained by her available, active, three-point, lap-and-shoulder, safety belt systems. There was no evidence of belt pattern bruising and/or abrasions to her body. Inspection of the her seat belt webbing, "D"-ring, and latch plate provided no evidence of loading. The front center passenger [3-year-old female; 76 centimeters and 18 kilograms (30 inches, 40 pounds)] was wearing her available, active, two-point, lap belt, and her body exhibited no evidence of belt pattern bruising and/or abrasions. Inspection of her seat belt webbing and latch plate provided no evidence of loading. The front right passenger [26-year-old male; 170 centimeters and 91 kilograms (67 inches, 200 pounds)] was restrained by his available, active, three-point, lap-and-shoulder, safety belt systems. There was no evidence of belt pattern bruising and/or abrasions to his body. Inspection of his seat belt webbing, "D"-ring, and latch plate provided no evidence of loading.

The case vehicle also contained three passengers in the back seat. For some unknown reason, the back center passenger was not listed on the Police Crash Report. The back left passenger [30-year-old male; 170 centimeters and 73 kilograms (67 inches, 160 pounds)] was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The back center passenger [6-year-old male; 122 centimeters and 23 kilograms (48 inches, 50 pounds)] was restrained by his available, active, two-point, lap belt. The back right passenger [23-year-old female; 165 centimeters and 61 kilograms (65 inches, 135 pounds)] was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. Inspections of their seat belt webbings, "D"-rings (for the outboard passengers), and latch plates provided no evidence of loading.

Immediately prior to the crash, the case vehicle's driver was seated upright, with her back against the seat back, her left foot on the floor, her right foot on the brake pedal, and both hands on the steering wheel. Her seat track was located between its middle and forward-most positions, and the tilt steering wheel was located in its middle position. The front center and front right

passengers were reportedly sitting upright, with their backs against the seat back, but the positioning of their hands, arms, and feet were unknown. Their seat track was located between its middle and forward-most positions. All three back seat occupants were reportedly sitting upright, with their backs against the seat back; however, the positioning of their hands, arms, and feet were unknown. The back seat was not adjustable.

The case vehicle's driver steered to the left and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the use of her available safety belts, she most likely moved slightly forward and to her right just prior to impact. The front right and center passengers also moved slightly forward and to their right in response to the attempted avoidance maneuvers. All three of the case vehicle's back seated occupants most likely moved slightly forward and to their right just prior to impact.

The case vehicle's impact with the Oldsmobile, not only deployed the driver and front right passenger air bags, but thrust the driver forward and slightly upward, allowing her body to come into contact with the her air bag and depositing a large area of cloth transfers to the bottom right portion of the fabric's lower left quadrant and to most of the lower right quadrant. The impact also deployed the front right passenger air bag, and the front right passenger's movements would have mirrored those of the driver. Additionally, the front right passenger's right knee came into contact with the interior right front door panel, sustaining an abrasion. The front center and back center passengers were also thrust forward and slightly upward, but their forward reach would have been greater than that of the outboard passengers because they were not protected by a shoulder belt. The back outboard passengers were also thrust forward and slightly upward.

As a result of the impact, the vehicle rotated approximately 30 degrees counterclockwise, causing all six of the case vehicle's occupants to move rearwards and slightly to their left as their vehicle rotated towards its final rest position.

CASE VEHICLE DRIVER INJURIES

The case vehicle's driver refused medical treatment at the scene and, thus, was not transported to a medical facility. She did, however, seek treatment later from a private physician. Her self-reported, minor integumentary injuries included: a middle back strain, a "very sore" neck, and a "sore" center of her forehead.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Strain middle back (i.e., thoracic)	640478.1 minor	Other noncontact injury: impact force	Possible	Interviewee (same person)

The front center passenger was not injured and, thus, was not transported to a medical facility.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger refused medical treatment at the scene and, thus, was not transported to a medical facility. The case vehicle's driver reported her front right passenger sustained an abrasion to his right knee. No follow-up medical attention was sought.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion right knee	890202.1 minor	Right side interior surface, excluding hardware and/or armrest	Possible	Interviewee (driver)

None of the back seat occupants were injured or transported to a medical facility.

OTHER VEHICLE

The 1994 Oldsmobile Achieva S was a front wheel drive, four-door sedan (VIN: 1G3NL5532RM------). The Oldsmobile was towed due to disabling damage. Based on the vehicle inspection, the CDC was determined to be: **10-LFEE-4** for the Oldsmobile [unknown maximum crush]. The Oldsmobile's driver (21-year-old male; unknown height and weight) was reportedly unrestrained and sustained "possible" injuries. He refused medical treatment at the scene. Although the Oldsmobile was equipped with a driver air bag, it did not deploy in the crash.

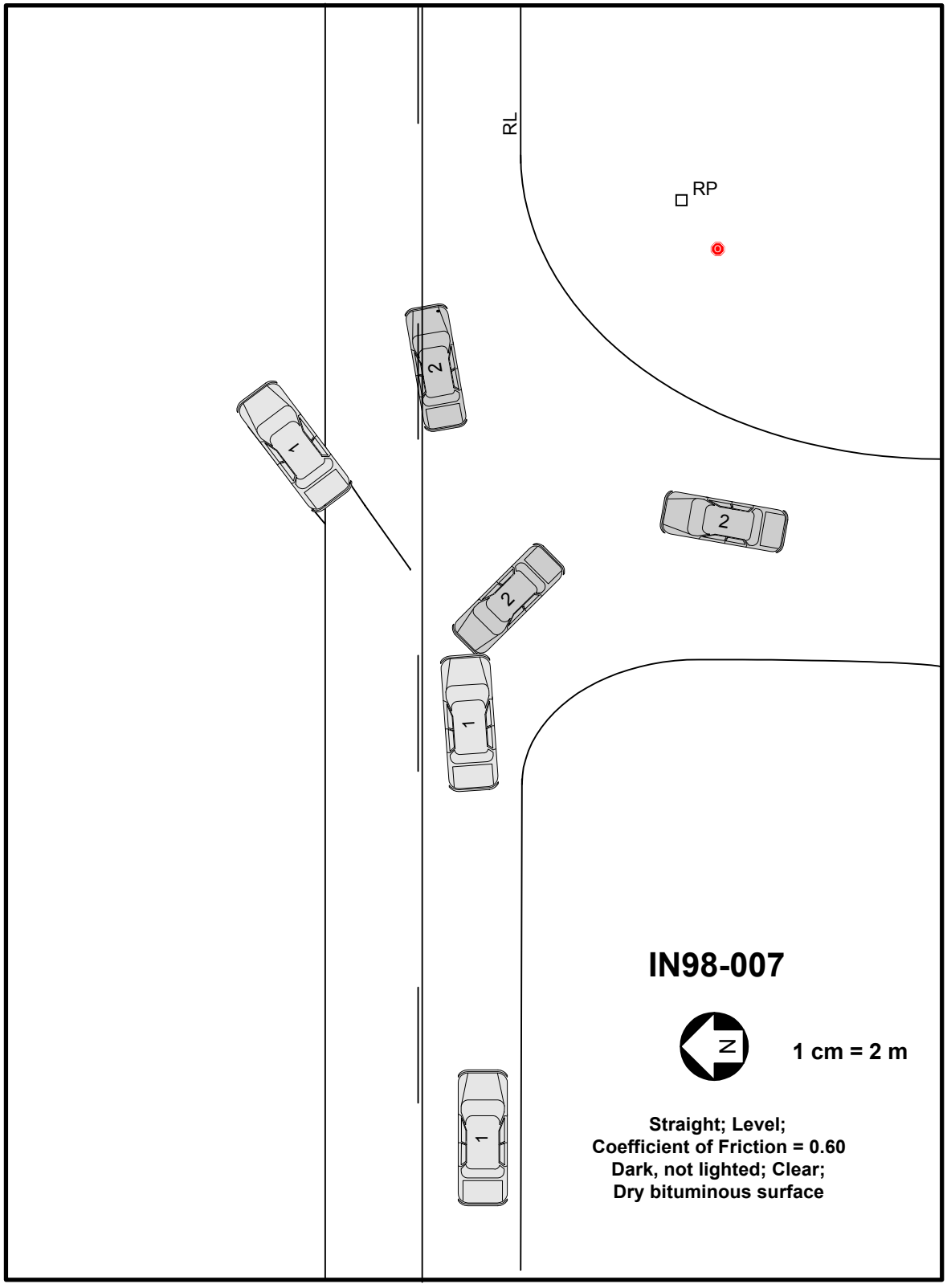
RL
RP
2
1
2
2
1
1
IN98-007
N
1 cm = 2 m
Straight; Level;
Coefficient of Friction = 0.60
Dark, not lighted; Clear;
Dry bituminous surface

Figure 11: Westward view of case vehicle's eastbound approach path (case photo #09)

Figure 12: Southward view of Oldsmobile's northerly approach path, taken from north of case vehicle's final rest position (case photo #15)

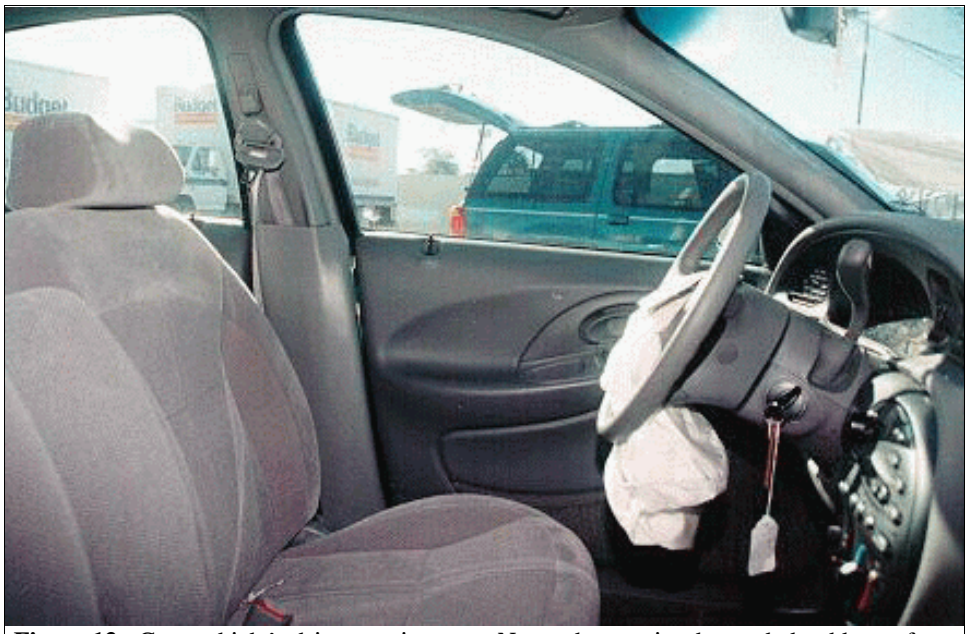

Figure 13: Case vehicle's driver seating area; Note: three-point, lap-and-shoulder, safety belt system (case photo #37)