

CRASH DATA RESEARCH CENTER

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**CALSPAN ON-SITE ADVANCED OCCUPANT PROTECTION SYSTEM
CRASH INVESTIGATION**

CASE NO: CA02-045

VEHICLE: 2002 FORD TAURUS

LOCATION: SOUTH CAROLINA

CRASH DATE: OCTOBER 2002

Contract No. DTNH22-01-C-17002

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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 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.

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**CALSPAN ON-SITE ADVANCED OCCUPANT PROTECTION
SYSTEM CRASH INVESTIGATION
SCI CASE NO.: CA02-045
VEHICLE: 2002 FORD TAURUS SE
LOCATION: SOUTH CAROLINA
CRASH DATE: OCTOBER 2002**

BACKGROUND

This investigation focused on the crash severity, the performance of the Advanced Occupant Protection System (AOPS), and the driver injuries for a severe head-on crash that involved a 2002 Ford Taurus (**Figure 1**). The Taurus was equipped with an AOPS that included dual stage frontal air bags, front seat buckle pretensioners, variable deployment thresholds based on belt usage, and an Event Data Recorder (EDR). The EDR was removed from the vehicle by the



Figure 1 - Damaged 2002 Ford Taurus SE.

investigating agency and was not available for SCI download. The Taurus was being operated by a 49-year old male that impacted a 1972 Dodge Challenger in a head-on configuration during the early morning hours in October, 2002. The crash occurred on a rural, two-lane roadway as the driver of the Taurus allowed his vehicle to cross the centerline of the roadway after exiting a right curve. The crash resulted in severe damage to both vehicles and fatal injuries to the two restrained adult passengers of the Challenger. The driver of the Taurus was restrained by the manual 3-point lap and shoulder belt and suffered incapacitating injuries. He was extricated from the vehicle by rescue personnel and transported to a local hospital and admitted. Both vehicles were towed from the scene due to severe damage.

The crash was identified by the Calspan Special Crash Investigations (SCI) team during an on-site investigation of an unrelated crash. The investigating officer of the unrelated crash advised the SCI investigator of this crash, who in turn notified the National Highway Traffic Safety Administration (NHTSA). Due to the presence of the AOPS, the NHTSA assigned the case on October 4, 2002 and the investigation commenced. Both vehicles and the scene were inspected and a detailed Police Accident Report (PAR) was provided by the investigating agency.

SUMMARY

Crash Site

This two-vehicle crash occurred in the state of South Carolina in October 2002 on a two-lane rural roadway. The north/south roadway was configured with one travel lane in each direction that was delineated by a single broken yellow painted centerline. The roadway was straight and level at the crash site; however, the southbound traffic lane emanated from a right curve 53 m (174') prior to the point of impact. At the time of the crash, the weather was clear and the asphalt roadway was dry. The crash occurred in the early

morning hours after midnight; the scene was dark with no artificial illumination. The roadside consisted of natural growth and sporadic dwellings and the posted speed limit was 89 km/h (55 mph). The SCI scene schematic is included as **Figure 13** at the end of this narrative report:

Vehicle Data

2002 Ford Taurus SE

The subject vehicle in this crash was a 2002 Ford Taurus SE four-door sedan. The Taurus was identified by the Vehicle Identification Number: 1FAFP53U02A (production number omitted). The vehicle had 48,989 km (30,441 miles) at the time of the SCI inspection. The vehicle was powered by a 3.0-liter, 6 cylinder engine linked to an automatic transmission. The service brakes consisted of front disc and rear drum brakes without antilock (ABS). The Taurus was configured with 41 (16”) steel wheels and varied P215/60R16 tires. The specific tire information at the time of the SCI investigation is outlined in the following table:

Position	Tire Type	Measured Tire Pressure	Measured Tread Depth	Tire/Wheel Damage
Left Front	Firestone Affinity Touring T3	0 kPa	6 mm (8/32”)	Restricted/tears in tread
Left Rear	Firestone Affinity Touring T3	200kPa (29 PSI)	6 mm (8/32”)	None
Right Front	Firestone Affinity Touring T3	207 kPa (30 PSI)	6 mm (8/32”)	None
Right Rear	Continental Touring Contact AS	186 kPa (27 PSI)	6 mm (8/32”)	None

The interior of the Taurus was configured with front bucket seats with adjustable head restraints and a center fixed seat with the folding seatback convertible to an armrest. The second row contained fixed bench seat with no head restraints for the three rear seat positions. The driver’s seat was power adjustable and was in a full-rear seat track position at the time of the inspection. The driver’s adjustable head restraint was removed from the seatback post-crash and found inside the vehicle’s trunk during the inspection. The front right seatback was manually adjustable and was also in the full rear track position. The safety systems included manual lap and shoulder belts for the four outboard positions and the second row center seat, and a fixed length lap belt for the first row center position. The front seat belts were equipped with buckle pretensioners for the driver and front right passenger position.

1972 Dodge Challenger

The 1972 Dodge Challenger was a two-door sedan and was identified by the VIN: JS23H28 (production number omitted). The Challenger was powered by a 5.6-liter, 8 cylinder engine linked to an automatic transmission. The service brakes consisted of front disc and rear drum brakes without ABS. The Challenger was configured with 38 cm (15”) steel wheels and Futura tires. The specific tire information was not recorded.

Crash Sequence

Pre-Crash

The 49-year old male driver of the 2002 Ford Taurus was traveling southbound on the unlit roadway and was initially negotiating a right curve (**Figure 2**). An unrelated vehicle was traveling in front of the Taurus. The driver of this vehicle reported seeing the Taurus's headlights in his rear view mirror for several miles while maintaining the same gap distance at a travel rate of 89 km/h (55 mph). The 1972 Dodge Challenger was traveling in the northbound direction (**Figure 3**) at a witness-reported speed of approximately 89 km/h (55 mph). The witness noticed that the Taurus left its lane of travel and entered the northbound lane after exiting a curve that was located 53 m (178') prior to the impending point of impact. The witness also reported that the Taurus swerved into the northbound lane on at least one other occasion prior to the impact. The witness tracked the vehicle's headlights for a few seconds further until he witnessed the crash. The crash scene revealed no evidence of pre-crash braking to either the on-scene investigative police agency or to the follow-up SCI investigator.



Figure 2 - Northbound approach of the 2002 Ford Taurus SE.



Figure 3 - Southbound approach of the 1972 Dodge Challenger.

Crash

The front of the Taurus impacted the front of the Challenger in an off-set configuration in the northbound lane. The initial point of impact involved the center and left aspects of both vehicles' front bumper beams, which eventually encompassed the entire frontal structures as a result of the vehicles rotating around the other. The direction of force for both vehicles was in the 12 o'clock sector and the impact was sufficient to deploy the frontal air bags and the driver's buckle pretensioner of the Taurus.

The impact resulted in severe damage to both vehicles. The damage algorithm of the WinSMASH program computed a total delta-V of 83 km/h (51.6 mph) for the Taurus and 84 km/h (52.1 mph) for the Challenger. The specific longitudinal and lateral velocity changes were -82 km/h (-60 mph) and 14 km/h (8.7 mph) for the Taurus and -83 km/h (51.6 mph) and -15 (-9.3 mph) for the Challenger. Based on the severe damage to the vehicles and the witness reported pre-crash impact speeds, the delta-V results appear valid; however, the results exceed the computational scope of the WinSMASH program and should be utilized for anecdotal purposes only.

The impact caused the Taurus to rotate clockwise approximately 140 degrees where it came to final rest facing in a northeast direction. The Challenger rotated counterclockwise (CCW) approximately 50 degrees and came to rest facing in northwest direction. Both vehicles came to rest within 3 m (10') of the point of impact.

Post-Crash

The driver of the unrelated vehicle traveling ahead of the Taurus witnessed the crash and reversed his direction to aid the passengers. Upon his arrival, he reported that the driver of the Challenger had ceased breathing and the front right passenger was breathing only intermittently. He stated that he proceeded to the Taurus to check the status of the driver and recalled that he was initially unresponsive. The witness also reported that a strong odor of alcohol emanated from the passenger compartment of both vehicles. After checking on the passengers of the Challenger a second time, he noticed that the driver of the Taurus was now conscious. He, along with another passing motorist, approached the Taurus and inquired as to the driver's status. The driver of the Taurus was incoherent and upon being informed that he was involved in a car crash, he denied it. He stated disjointedly that he wasn't in a crash, but that he had been drinking.

Upon arrival of emergency personnel, the driver of the Taurus was removed from the vehicle using extrication measures. The A- and B-pillars were cut on both sides of the vehicle, the left side doors were removed, and the roof was peeled back. After being removed from the vehicle, the driver of the Taurus was transported by ambulance to a local hospital where he was admitted for an unreported length of time. It should be noted that subsequent blood tests revealed that the driver of the Taurus had a Blood Alcohol Content (BAC) of .231. Both passengers of the Challenger were pronounced deceased at the scene and transported to the local morgue.

Vehicle Damage

Exterior Damage – 2002 Ford Taurus SE

The 2002 Ford Taurus (**Figure 4**) sustained severe frontal damage as a result of the impact with the 1972 Dodge Challenger. The direct contact damage began at the left front corner and extended 135 cm (53.1") along the damage profile. The combined direct and induced damage was measured parallel to the original length of the reference line and was 88 cm (34.6) in width. The maximum crush was located at the left front bumper corner and measured 114 cm (44.9") in depth. The Collision Deformation Classification (CDC) for the impact with the Challenger was 12-FDEW-5. Six equidistant crush measurements were documented across the front bumper and were as follows: C1 = 114 cm (44.9"), C2 = 109 cm (42.9"), C3 = 104 cm (40.9"), C4 = 79 cm (31.1"), C5 = 48 cm (18.9"), C6 = 18 cm (7.9").



Figure 4 - Oblique view of damaged 2002 Ford Taurus SE.

The severe damage to the Taurus resulted in induced damage across the roof and down both side planes of the vehicle. Both left side doors were jammed closed and rescue personnel used extrication measures to mechanically remove the doors from the vehicle. The glazing in the left side windows was also shattered. The left wheelbase was compressed from its original length 64 cm (25.2"). The right side wheelbase expanded 2 cm (0.5") to 278 cm (109.4") between the axles. Due to the injuries sustained by the driver, rescue personnel used further extrication measures to cut the left and right side A- and B-pillars and then deflected the roof rearward.

Interior Damage – 2002 Ford Taurus SE

The 2002 Ford Taurus sustained moderate interior damage as a result of intrusion and occupant contact. **Figure 5** is an overall view of the first row interior of the Taurus. Longitudinal intrusions of the instrument panel, knee bolster, the right toe pan, and the steering assembly reduced occupant space. The maximum intrusion occurred to the left toe pan which intruded longitudinally 49 cm (19.3"). The windshield was cracked and it possibly intruded along with the windshield header and the left A-pillar; however, extrication measures by emergency personnel masked any definitive evidence of this.



Figure 5 - Post-crash view of the interior of the 2002 Ford Taurus.

The driver of the vehicle loaded several components resulting in moderate interior damage and probable injuries. A large contact point was identified on the left instrument panel in the area of the driver's left knee (**Figure 6**). Horizontally, the contact point began 60 cm (23.5") left of the vehicle's centerline and extended to the left for 13 cm (5"). Vertically, it began 32 cm (12.5") below the top aspect of the brow and extended downward 18 cm (7.25"). The driver's left knee penetrated the instrument panel housing to a depth of 1 cm (0.25"). The component revealed hair, tissue, and blood transfers embedded within the cracked panel. The emergency brake pedal located on the left aspect of the floor pan was loaded and rotated clockwise approximately 90 degrees. This probably occurred as a result of the driver's left lower extremity being in close proximity to the component as intrusion directed the toe pan rearward into the occupant space. The emergency brake release lever was also contacted and cracked due to occupant loading.



Figure 6 - Area of knee contact on instrument panel/knee bolster.

The four-spoke steering wheel was contacted and the column was partially collapsed from driver loading. The upper left side of the wheel rim was deformed slightly rearward from the compression of the occupant loading through the expanding air bag in

combination with the intruded components into the front left seating position. In response, the shear capsules were displaced from their pre-crash locations. The left shear compressed 3 cm (1.1”) and the right shear was fractured. Additional contact evidence to the expanding air bag and manual lap and shoulder belt is discussed in later sections of this report.

The passenger compartment intrusions identified during the SCI investigation are listed by their magnitude in the following table:

Position	Component	Magnitude	Direction
Front row left	Toe pan	49 cm (19.3”)	Longitudinal
Front row left	Instrument panel left	28 cm (11”)	Longitudinal
Front row left	Knee bolster	23 cm (9.6”)	Longitudinal
Front row center	Instrument panel center	21 cm (8.3”)	Longitudinal
Front row right	Toe pan	10 cm (3.9”)	Longitudinal
Front row left	Steering assembly	7 cm (2.8”)	Longitudinal

Exterior Damage – 1972 Dodge Challenger

The 1972 Dodge Challenger sustained severe damage as a result of the impact with the 2002 Ford Taurus (**Figures 7 and 8**). The direct contact damage encompassed the entire front end of the vehicle and measured 131 cm (51.6”) in width. The combined direct and induced damage was documented along the compressed bumper beam and measured 51 cm in length. The maximum crush was located at the vehicle’s front left corner and measured 177 cm (69.7”) in depth. Both frontal frame rails shifted to the left and the incremented CDC for the impact with the Taurus was 92-FDEW-6. Due to the compressed bumper beam, only four equidistant measurements were documented and were as follows: C1 = 177 cm (69.7”), C2 = 158 cm (62.2”), C3 = 130 (51.1”), C4 = 54 cm (21.3”).



Figure 7 - Frontal view of the damaged 1972 Dodge Challenger.



Figure 8 - Left side view of the damaged 1972 Dodge Challenger.

Manual Safety Belt Systems – 2002 Ford Taurus SE

The Taurus was equipped with manual 3-point lap and shoulder belts for both frontal seating positions. The driver’s belt was configured with a sliding latch, an Emergency

Locking Retractor (ELR), and an adjustable D-ring, which was in the full up position. The front right belt was configured with a sliding latch plate, a switchable ELR/Automatic Locking Retractor (ALR), and an adjustable D-ring. The driver's shoulder belt webbing was cut by emergency personnel to facilitate the removal of the driver post-crash.

Loading evidence in the form of an abrasion was present on the driver's lap belt webbing with a correlative transfers present on the plastic trim at the left outboard aspect of the seat cushion trim. The full width belt abrasion was documented on the inside aspect of the lap belt and was located 4 – 6 cm (2 – 2.5") above the vinyl anchorage sleeve. The correlative abrasion on the seat cushion trim was 5 cm in length and 1 cm (0.4") in width. A separate 5 cm (2") abrasion consistent with latch plate loading was present on the shoulder belt



Figure 9 - Safety belt system in the 2002 Ford Taurus.

webbing. It began 65 cm (25.5") above the top of belt anchor. Additionally, vertical striations were present on the webbing just below the cut position of the shoulder belt. The cut position on the belt and striations were located 98 cm (38.5") above the seat belt anchor sleeve. **Figure 9** is an overall view of the damaged restraint system.

The second row seats consisted of 3-point lap and shoulder belts for all three seating positions. The belts were configured with sliding latch plates, ELR/ALR retractors, and fixed D-rings.

Advanced Occupant Protection System – 2002 Ford Taurus SE

The Taurus was equipped with an AOPS that included dual stage frontal air bags, front seat buckle pretensioners, variable deployment thresholds based on belt usage, and an Event Data Recorder (EDR). The EDR was removed from the vehicle by the investigating agency and was not available for download. The driver's air bag deployed as a result of the impact with the Dodge Challenger. An air bag sensor was located at the center aspect of the vehicle's upper radiator support area. The following nomenclature was affixed to the air bag sensor:

(PBT+PC) – GF 30
C3
2130108

The variable deployment threshold aspect of the AOPS included a driver's seat track position sensor, and a driver's and front right passenger's safety belt buckle switch. Both front restraints were also equipped with buckle pretensioners, which were designed to fire upon impact and reduce the webbing's slack, thereby limiting passenger motion within the vehicle.

The driver's air bag (**Figure 10**) deployed from the center of the steering wheel hub through H-configuration trapezoidal cover flaps. The top flap measured 17 cm (6.7") horizontally and 8 cm (3.1") vertically. The upper aspect of the lower flap measured 17 cm (6.7") horizontally and the bottom aspect tapered in to a horizontal width of 11 cm (4.3"). The lower flap was 5 cm (2") in height. The air bag measured 56 cm (22") in diameter in its deflated state. The air bag contained two 11 cm (4.5") wide tether straps at the 12 and 6 o'clock positions of the air bag. The bag was vented by two 3 cm (1.125") diameter ports located at the 11:30 and 12:30 positions on the back of the bag. A blood transfer was concentrated on the lower left aspect of the deployed air bag at the 8 o'clock position. No additional occupant loading evidence was identified. The following nomenclature was stamped on the back of the air bag:



Figure 10 - Deployed driver's air bag.

P5206008 800 EE00

TMM2428DADRN

The front right passenger's air bag (**Figure 11**) deployed from a top-mount module located on the right instrument panel with a single cover flap design. The rectangular cover flap measured 27 cm (10.9") horizontally and 14 cm (5.5") vertically. The front right air bag measured 48 cm (18.9") horizontally and 56 cm (22") vertically in its deflated state. The air bag was not tethered and had no vent ports. There was no occupant contact evidence on the front right air bag.

The front safety belts were equipped with buckle pretensioners designed to fire in conjunction with the frontal air bag system in frontal impacts. The driver's buckle pretensioner fired with the deployment of the air bag system (**Figure 12**). The stalk from the buckle's anchor point to the top aspect of the buckle compressed approximately 5 cm (2"). The driver's pretensioner rotated into the floor pan and prevented access to measure the barrel length. The front right seating position was not occupied during the crash; therefore, the front right buckle pretensioner did not fire.



Figure 11 - Deployed front right air bag.



Figure 12 - Driver's pretensioner post-crash.

Occupant Demographics

Age/Sex: 49-year-old/Male
Height: 185 cm (73")
Weight: 95 kg (210 lb)
Seat Track Position: Full-rear
Manual Restraint Use: 3-point manual lap and shoulder belt
Usage Source: Vehicle inspection
Eyewear: Not reported
Type of Medical Treatment: Transported by ambulance to a local hospital and admitted for an undetermined amount of days

Driver Kinematics

The 49-year old male was seated in an assumed upright posture with the seat in full-rear track position and with a slightly reclined seatback. He was restrained by the 3-point lap and shoulder belt. At impact with the Dodge Challenger, the buckle pretensioner fired, the air bag deployed, and the driver initiated a forward and slightly left trajectory in response to the 12 o'clock direction of force. The driver loaded the 3-point lap and shoulder belts as evidenced by the various loading marks on the belts. The driver also contacted and loaded the expanding air bag compressing the same into the steering assembly. The steering column was compressed displacing the left shear capsule 3 cm (1.1") and fracturing the right shear capsule. The driver's left knee contacted and fractured the lower aspect of the left instrument panel and the upper aspect of knee bolster. Associative body fluid transfers were embedded within these components. The driver's left foot contacted and deformed the emergency brake pedal rotating the component 90 degrees clockwise.

The driver was unconscious upon the arrival of passerby's to the crash scene. Multiple witnesses stated that the driver eventually became semi-alert; however, his speech was largely incoherent. After being advised that he was involved in a crash he denied it but admitted to drinking alcohol earlier shortly before. A blood test was later administered which registered a BAC of .231. Upon arrival of emergency personnel, the driver was extricated from his vehicle due to his injuries and transported by ambulance to a local hospital. He was admitted for an unreported length of time.

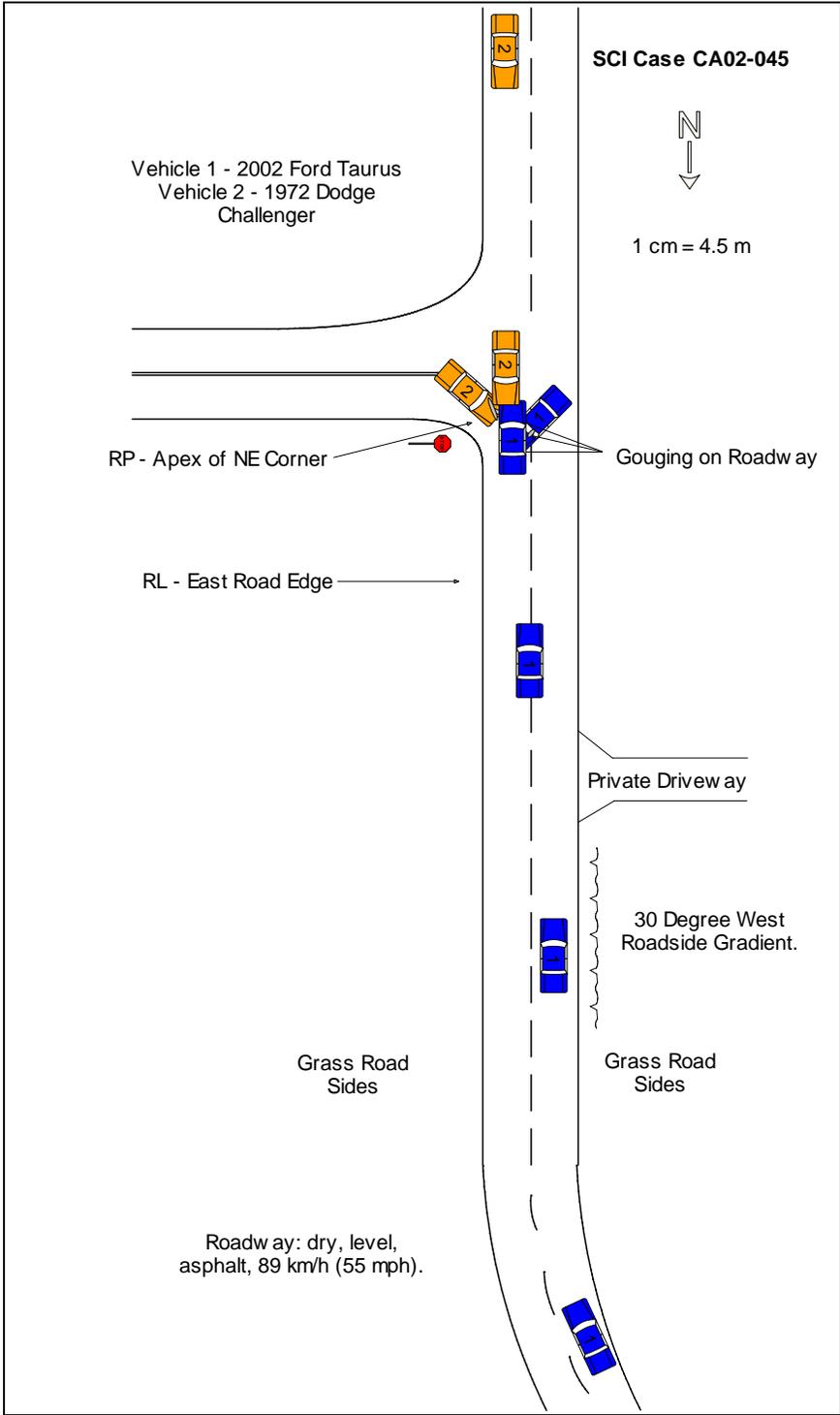


Figure 13 – SCI Scene Schematic