Advanced Occupant Protection Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS02009
2002 Ford Taurus SE Four-door Sedan
California
May, 2002

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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.

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16. Abstract

This crashed occurred in California in May, 2002 at 2120 hours. This on-scene investigation was conducted because the case vehicle was equipped with Advanced Occupant Protection System (AOPS) features. The crash occurred at a four-leg intersection. The north/south roadway is straight and level. There are no traffic controls present for the north\south roadway and the speed limit is 56 km/h (35 mph). The asphalt surface was dry, level and free of defects. The weather was clear. It was dark but the roadways were lit by overhead street lamps.

The case vehicle, a 2002 Ford Taurus SE four-door sedan, was a rental fleet vehicle driven by an unrestrained 60-year-old male. The case vehicle was initially traveling northbound in the left lane approaching the intersection. For an unknown reason, the case vehicle went into the center left turn lane directly into the path of the other vehicle. The other vehicle was a 2000 Mitsubishi Montero Sport that was being driven by a 33 year-old male. The other vehicle was traveling southbound and stopped in the left turn lane of the intersection intending to turn left. The driver of the other vehicle noticed that the case vehicle was coming straight at him in the center left turn lane. The driver of the other vehicle honked his horn and turned his steering wheel to the right in an effort to avoid the collision. The front left bumper (12FLEE3) of the case vehicle struck the front left of the other vehicle. At impact, both the driver's and the front right passenger's air bag deployed in the case vehicle. After impact, the case vehicle rotated slightly clockwise and came to final rest facing north. The other vehicle rotated counterclockwise a quarter of a turn and came to final rest facing eastbound. Both vehicles were towed from the scene due to damage.

Fire rescue personnel were dispatched to the scene of the crash. The driver was extricated from his vehicle by rescue personnel and treated at the scene. He was transported from the scene of the crash to a trauma center. The driver of the case vehicle sustained injuries consisting of a comminuted fracture to right mid-clavicle, an abrasion to his left cheek and left temple, a left knee abrasion. He was admitted to the hospital and released the next day at 1330 hours.

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Dynamic Science, Inc.
Crash Investigation
Case Number: DS02009

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BACKGROUND:

Description:	This Advanced Occupant Protection Systems (AOPS) case was initially identified by a NHTSA review of GES police reports. DSI was assigned the case on June 4, 2002. All field work was completed on June 27, 2002. Present at the vehicle inspection was an investigator from Indiana University SCI2, who was present for training purposes.
Investigation Type:	On-scene Advanced Occupant Protection Investigation
Crash Location:	California
Crash Date:	May, 2002
Notification Date:	June 4, 2002
Field Work Completed:	June 27, 2002

SUMMARY

Crash Site

The crash occurred in southern California in May, 2002 at 2120 hours. The crash occurred at a four leg intersection with the east-west roadway being off-set. The north/south straight and level roadway is comprised of three northbound lanes, and three southbound lanes. There is a center left turn lane which separates north and southbound traffic lanes. There are no traffic controls present for the north\south roadway and the speed limit is 56 km/h (35 mph). The east\west roadway on the southwest leg of the intersection is comprised of two undelineated lanes. There is a standard stop sign for eastbound traffic. The east\west roadway on the northeast leg of the intersection is comprised of two undelineated lanes. There is a standard stop sign for westbound traffic. The asphalt surfaces were dry, level and free of defects. The weather was clear. It was dark but the roadways were lit by overhead street lamps.

Figure 1. Case vehicle direction of travel towards impact (north)

Pre-Crash

The case vehicle, a 2002 Ford Taurus SE four door-sedan, was a rental fleet vehicle driven by an unrestrained 60-year-old male (175 cm-69 in./115 kg-253 lbs.). The case vehicle was initially traveling northbound in the left lane approaching the intersection. For an unknown reason, the case vehicle went into the center left turn lane directly into the path of the other vehicle. The

other vehicle was a 2000 Mitsubishi Montero Sport that was being driven by a 33 year-old male. The other vehicle was traveling southbound and stopped in the left turn lane of the intersection intending to turn left.

Crash

The driver of the other vehicle noticed that the case vehicle was approximately 46-61 meters away (150-200 ft) and was coming straight at him in the center left turn lane. The driver of the other vehicle honked his horn and turned his steering wheel to the right in an effort to avoid the collision. The front left bumper (12FLEE3) of the case vehicle struck the front left of the other vehicle. The case vehicle sustained a total delta v of 25.0 km/h (15.5 mph), a longitudinal delta v of –25.0 km/h (-15.0 mph) and a lateral delta v of 4.0 km/h (1.6 mph) as computed by the Missing Vehicle algorithm of the WinSmash[1] crash program. The other vehicle sustained a total delta v of 21.0 km/h (13.0 mph), a longitudinal delta v of -21.0 km/h (-13.0 mph) and a lateral delta v of 0.0 km/h (0.0 mph). The results fit the collision model, and appear reasonable. At impact, both the driver's and the front right passenger's air bag deployed in the case vehicle.

After impact, the case vehicle rotated slightly clockwise and came to final rest facing north approximately 25 m (83 ft) north of the area of impact. The other vehicle rotated counterclockwise a quarter of a turn and came to final rest facing eastbound. The driver of the other vehicle moved his vehicle in order to avoid further collisions.

Post-Crash

Fire rescue personnel were dispatched to the scene of the crash at 2124 hours and arrived at the scene at 2126 hours. The driver was extricated from his vehicle by rescue personnel and treated at the scene. He was unresponsive with a Glasgow Coma Scale score of 5. He was transported from the scene of the crash at 2139 hours and arrived at the emergency room of a trauma center at 2152 hours and medical records indicate that he arrived unconscious and reported to be in altered consciousness with a Glasgow Coma Scale score of 9. X-rays, CT scans were performed of the head, cervical spine, abdomen and pelvis to rule out any injuries. A CT angiogram of the chest was performed to evaluate for traumatic aortic injury (the results were negative for aortic injury but did indicate atelectasis/collapse of the right and left lower lobes). The driver of the case vehicle sustained injuries consisting of a comminuted fracture to right mid-clavicle as a result of striking the steering wheel rim, an abrasion to his left cheek and left temple as a result of contacting the driver's air bag, a left knee abrasion as a result of striking the lower left instrument panel, and considerable atelectasis/collapse of the right and left lower lung lobes possibly due to aspiration. He was admitted to the hospital and released the next day at 1330 hours.

There are no indications on the police report that the driver of the other vehicle that he was injured or received any treatment at the scene.

Both vehicles were towed from the scene due to damage. The case vehicle was later declared a

[1] Calculated with WinSmash version 2.42 missing vehicle algorithm and using NHTSA NCAP test to calculate size and stiffness values for the case vehicle.

total loss by the insurance company.

VEHICLE DATA -2002 Ford Taurus SE four-door sedan

The case vehicle was a low mileage 2002 Ford Taurus SE four-door sedan that was a rental vehicle. The vehicle was equipped with a 3.0 liter, V-6 cylinder engine, front wheel-drive, electronic four-speed automatic transmission, front and rear disc brakes with anti-lock brakes and alloy wheels.

VIN:	1FAFP55UX2Gxxxxxx
Odometer:	4054 km (7519 miles)
Reported Defects:	None
Cargo:	None at the time of inspection

The 2002 Ford Taurus 4-door was equipped with four Continental Touring Contact AS P215/60R16 tires. The specific tire data is as follows:

Tire	Tread Depth	Measured Pressure	Manufacturer Recommended Pressure
LF	7 mm (9/32 in)	Tire Flat	300 kPa (44 psi)
LR	9 mm (11/32 in)	Tire Flat	300 kPa (44 psi)
RR	9 mm (11/32 in)	262 kPa (38 psi)	300 kPa (44 psi)
RF	8 mm (10/32 in)	262 kPa (38 psi)	300 kPa (44 psi)

The 2002 Ford Taurus was equipped with six seating positions. The front seating positions were configured with cloth covered bucket seats with adjustable head restraints for both outboard seat positions. The front middle seat was a cloth covered fold away type seat. It could be used as a seat or when the seat back was folded down, the seat back served as arm rest and cup holder. The driver's seat track was adjusted to between the middle and rear most track position, and the seat back was positioned to 71 degrees from horizontal. The rear seating positions were configured with a three-person cloth covered 60/40 split bench with folding back.

VEHICLE DAMAGE

Exterior Damage - 2002 Ford Taurus

Damage Description:	Moderate frontal damage with a maximum crush of 19.0 cm (7.5 in) at C1. There was direct and induced damage across the entire front bumper, grille, and radiator. There was 41.0 cm (16.1 in) of direct damage that began at the front left bumper corner and extended laterally to the right across the bumper fascia. There was also damage to the left front fender that extended rearward from the front left bumper corner.	
CDC:	12FLEE3	
Delta V:	Total	25.0 km/h (15.5 mph)
	Longitudinal	-25.0 km/h (-15.5 mph)
	Lateral	4.0 km/h (1.6 mph)
	Energy	21429 joules (15805 ft-lbs)

The case vehicle sustained 133.0 cm (52.4 in) of direct and induced contact damage that began at the front left bumper corner and extended across the entire frontal end width of the vehicle. The impact energy was managed by the forward structures of the vehicle. The damaged components included the bumper fascia and reinforcement bar, upper and lower radiator supports, the grille area, the hood, the left front fender, and the windshield was cracked by the deployment of the front right passenger's air bag and hood. Six crush measurements were documented at the bumper back bar level: Cl= 19.0 cm (7.5 in), C2= 15.0 cm (5.9 in), C3= 11.0 cm (4.3 in), C4= 8.0 cm (3.1 in), C5= 0.0 cm (0.0 in), C6= 0.0 cm (0.0 in). A Collision Deformation Classification of 12FLEE3 was assigned to the damage. The principal direction of force was within the 12 o'clock sector and was an estimated 350 degrees. There was a 9.0 cm (3.5 in) reduction of the left side wheelbase, and an elongation of 6.0 cm (2.4 in) of the right side wheelbase. All doors remained closed and operational. The case vehicle was towed from the scene due to damage.

Figure 2. Exterior damage to case vehicle.

Interior Damage - 2002 Ford Taurus

Interior damage to the 2002 Ford Taurus was moderate and attributed to occupant contact, passenger compartment intrusion and the deployment of both frontal air bags. The left instrument panel was cracked and displaced by the left knee of the driver. Both the brake and gas pedals had been displaced laterally to the right by contact with the driver's feet. The toe pan had intruded longitudinally 4.0 cm (1.6 in). The shear capsules had been displaced 1.5 cm (0.6 in) on the left side and 1.0 cm (0.4 in) on the right side by the driver loading the steering column.

Figure 3. Damage to instrument panel.

MANUAL RESTRAINT SYSTEMS - 2002 Ford Taurus

The front outboard seat positions in the 2002 Ford Taurus were equipped with manual 3-point, continuous loop, lap and shoulder safety belts with sliding latch plates and inertial lock/belt sensitive retractors. The front right lap and shoulder safety seat belt was also equipped with a switchable/automatic locking retractor (ALR). Both front manual restraints were configured with buckle pretensioners located on the inboard aspects of the front seat tracks which did not activate in this crash. The driver's D-ring was in the full up position at the time of the inspection. The front middle seat position was equipped with a manual lap belt with a locking latch plate.

The driver's lap and shoulder safety belt was not in use at the time of the crash. There were indications of historical usage in the form of scratching to the metal latch, but there was no evidence of loading to the webbing and the pre-tensioner did not activate.

The rear seat positions were equipped with manual 3-point, continuous loop, lap and shoulder safety belts with sliding latch plates and switchable inertial lock/belt sensitive retractors to ALR.

FRONTAL AIR BAG SYSTEM (Advanced Occupant Protection System) - 2002 Ford Taurus 4-door

The case vehicle was equipped with an advanced occupant protection system. The system consists of a Restraint Control Module (RCM), dual stage front air bags, seat belt pretensioners, seat track sensors, and seat belt latch usage detectors. The system is controlled by the RCM. The primary function of the RCM is to control the deployment of the occupant protection systems. The system records longitudinal and lateral acceleration. An effort was made to download the data from the RCM using the Vetronix's Crash Data Retrieval (CDR) tool, but the case vehicle was not supported by the CDR. The insurance company did not grant permission to remove the RCM.

The 2002 Ford Taurus was equipped with dual-stage frontal air bags for the driver and front right

positions. The driver's air bag was housed in the center of the steering wheel and the front right passenger's air bas was housed in the right upper instrument panel. Both air bags deployed in this crash.

Figure 4. Driver's air bag.

The driver's air bag was circular and measured 50.0 cm (19.7 in) in diameter in its deflated state. It was equipped with two tethers and two vent ports at the 1 and 11 o'clock positions. On the top right and left quadrants of the face of the air bag were black transfer marks that appeared to be from the module cover. There was a spot on the lower left quadrant that appeared to be blood. There was also grease on the lower aspect of the air bag. The dual module covers opened in an "H" tear configuration. There were no indications of any damage to driver's air bag or the module covers. The driver's air bag had a maximum excursion of 30.0 cm (11.8 in) in its post deflated state.

The front right passenger's air bag was rectangular and measured 46.0 cm (18.1 in) high by 58.0 cm (22.8 in) wide in its deflated state. It was equipped with two vent ports at the 2 and 10 o'clock positions and did not have any tethers. On the face of the air bag there were black smudges that were caused by the module cover. The single flap module cover opened properly. There were no indications of any damage to front passenger's air bag or the module cover.

VEHICLE DATA - 2000 Mitsubishi Montero Sport

Description:	2000 Mitsubishi Montero Sport	
VIN:	Unknown	
Odometer:	Unknown	
Engine:	Unknown	
Reported Defects:	None	
Cargo:	Unknown	
Damage Description:	Unknown. The police report indicated that the vehicle sustained “major” frontal plane damage, and was towed from the scene.	
CDC:	Unknown	
Delta V:	Total	21.0 km/h (13.0 mph)
	Longitudinal	-21.0 km/h (-13.0 mph)
	Lateral	0.0 km/h (0.0 mph)
	Energy	56937 joules (41994 ft-lbs)

OCCUPANT DEMOGRAPHICS - 2002 Ford Taurus

	Occupant 1
Age/Sex:	60/Male
Seated Position:	Front left
Seat Type:	Cloth covered bucket seat adjusted between middle and rear most track position. Seat back adjusted to 71 degrees from horizontal.
Height:	175 cm (69 in) per police report
Weight:	115 kg (253 lb) per police report
Occupation:	Bread baker
Pre-existing Medical Condition:	Degenerative changes to spine, left buttock lipoma, multiple uncomplicated gall stones, and vascular calcifications.
Alcohol/Drug Involvement:	Blood test was positive for alcohol
Driving Experience:	Unknown
Body Posture:	Unknown, assumed seated upright
Hand Position:	Unknown
Foot Position:	Right foot on accelerator pedal and left on floorboard
Restraint Usage:	Lap and shoulder belt available, not used
Air bag:	Steering wheel mounted air bag, deployed

OCCUPANT DEMOGRAPHICS - 2000 Mitsubishi Montero Sport

Age/Sex:	33/Male
Seated Position:	Front left
Seat Type:	Unknown
Height:	173 cm (68 in) per police report
Weight:	68 kg (150 lb) per police report
Occupation:	Unknown
Pre-existing Medical Condition:	Unknown
Alcohol/Drug Involvement:	None per police report
Driving Experience:	Unknown
Body Posture:	Unknown, assumed seated upright
Hand Position:	At least one hand on steering wheel, steering to the right
Foot Position:	Right on brake pedal, left on floor
Restraint Usage:	Lap and shoulder belt available and used per Police report
Air bag:	Unknown, police report did not indicate availability nor deployment status

OCCUPANT INJURIES -2002 Ford Taurus

Driver: Injury data were obtained from emergency room records, X-Ray report, CT Scan report, and Emergency Medical Report. CT scan was done of the head, cervical spine, abdomen and pelvis to rule out any injuries. A CT angiogram of the chest was performed to evaluate for traumatic aortic injury. The results were negative for aortic injury but did indicate atelectasis/collapse of the right and left lower lobes.

	Injury	OIC Code	Injury Mechanism	Confidence Level
Driver:	Arrived unconscious at hospital and reported to be in altered consciousness.	160606.2, 0	Driver's air bag	Possible
	Abrasion to left cheek and left temple	290202.1, 2 290202.1, 7	Driver's air bag Driver's air bag	Certain Certain
	Comminuted fracture to right midclavicle	752200.2, 1	Steering wheel rim	Probable
	Left knee abrasion	890202.1, 2	Lower left instrument panel	Certain

OCCUPANT INJURIES - 2000 Mitsubishi Montero Sport

The police report indicates that the driver of the other vehicle did not report any injuries. There is no indication that he was treated at the scene nor was he transported from the scene to a medical facility.

	Injury	OIC Code	Injury Mechanism	Confidence Level
Driver:	No reported injuries			

OCCUPANT KINEMATICS - 2002 Ford Taurus

Figure 5. Driver's area

The 60 year-old male driver (175 cm/69 in-115 kg /253 lbs) of the case vehicle was seated behind the wheel, but his posture is unknown. From the occupant contacts, however, it appears that he may have been sitting upright. An inspection of the vehicle interior revealed that he was not wearing the available 3-point manual lap and shoulder safety belt. The upper anchorage adjustment was found in its full up setting. The fabric-covered bucket seat was adjusted between the middle and the furthest rearward position. The seat back angle was adjusted at 71^{o} from the horizontal. At impact, the driver responded to the 350^{o} direction of force by moving forward and slightly to the left. He struck the left instrument panel with his left knee . It was also noted during the vehicle inspection that both the gas and the brake pedals were displaced laterally to the right, but no apparent injuries were sustained as a result of this contact. The driver came into contact with the air bag during its initial deployment, there was also a small blood stain located on the left lower quadrant of the air bag fabric and he sustained an abrasion to his left cheek and left temple as a result of contacting the driver's air bag. The driver loaded the steering wheel and sustained a comminuted fracture to right mid-clavicle as a result of striking the steering wheel rim. He was initially treated at the scene by fire emergency rescue personnel and was unresponsive. He was extricated from the vehicle and transported to a trauma center. The driver was treated in the emergency room and later was admitted to the hospital. He was released the next day at 1330 hours.

ATTACHMENT 1. Scene Diagram