TRANSPORTATION SCIENCES
Crash Data Research Center

Veridian Engineering
Buffalo, New York 14225

VERIDIAN ON-SITE ADVANCED OCCUPANT PROTECTION SYSTEM INVESTIGATION
VERIDIAN CASE NO. CA00-021
VEHICLE: 2000 FORD TAURUS SE
LOCATION: TENNESSEE
CRASH DATE: MAY 2000

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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.

TECHNICAL REPORT STANDARD TITLE PAGE

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16. *Abstract* This on-site investigation focused on the performance of the Advanced Occupant Protection System (AOPS) in a 2000 Ford Taurus SE. The vehicle was rented from a local rental car company and involved in an early morning crash with a utility pole. The renter reported the vehicle as stolen to the rental car company, however, the police crash report identified a relative of the renter as the driver of the vehicle. This person denied involvement in the crash to the SCI program. The Taurus sustained minor center frontal damage that did not warrant deployment of the frontal air bag system or firing of the seat belt buckle pre-tensioner. There was no occupant contact evidence within the vehicle and the driver was police reported as not injured. The Taurus sustained police reported disabling damage and was towed from the scene of the crash.			
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BACKGROUND

This on-site investigation focused on the performance of the Advanced Occupant Protection System (AOPS) in a 2000 Ford Taurus SE. The vehicle was rented from a local rental car company and involved in an early morning crash with a utility pole. The renter reported the vehicle as stolen to the rental car company, however, the police crash report identified a relative of the renter as the driver of the vehicle. This person denied involvement in the crash to the SCI program. The Taurus sustained minor center frontal damage **(Figure 1)** that did not warrant deployment of the frontal air bag system or firing of the seat belt buckle pre-tensioner. There was no occupant contact evidence within the vehicle and the driver was police reported as not injured. The Taurus sustained police reported disabling damage and was towed from the scene of the crash.

Figure 1. Front left three-quarter view of the 2000Ford Taurus.

This crash was identified by a consultant who provided notification of another 2000 Ford Taurus crash to the NHTSA Special Crash Investigations Headquarters in June 2000. This vehicle was stored at the same rental car depot as the other 2000 Ford Taurus. An on-site investigation was assigned for the other Taurus crash and this vehicle was included in the AOPS study due to its availability. A single trip was scheduled to inspect both vehicles and download the Event Data Recorders (EDR) on July 11, 2000. The delay in this investigation was to accommodate legal representatives of the other Taurus case and representatives of Ford.

SUMMARY

Crash Site

The crash site for this minor severity crash was not inspected during this on-site investigation. The police crash report identified the crash as occurring at a 3-leg T-intersection in a city environment during nighttime hours. The conditions were reported as dark, but lighted with rain and wet asphalt road surfaces. The Taurus was traveling on a four-lane state route that was intersected by another four-lane road which formed the T-intersection. Traffic flow through the intersection was controlled by an overhead signal system.

Crash Sequence

Pre-Crash

The 2000 Ford Taurus was traveling in a northerly direction on the curb lane of the four lane state route on an approach to the 3-leg T-intersection. The driver apparently had a green signal phase and was

traveling straight through the intersection. As the driver entered the intersection, a non-contact vehicle that was traveling ahead of the Taurus stopped in the curb lane at the north leg of the intersection. The driver of the Taurus steered right and braked to avoid impact with the non-contact vehicle. The Taurus departed the northeast corner of the intersection and struck a utility pole that was located adjacent at the roadedge.

Crash

The center frontal area of the Ford Taurus impacted the wooden utility pole. The 12 o'clock direction of force impact crushed the front bumper system, the hood face, and the radiator support panel **(Figure 2)**. Maximum crush was 19.3 cm (7.6") located on the bumper beam 9.5 cm (3.75") right of the vehicle's centerline. The damage algorithm of the WinSMASH program computed a total velocity change of 18.5 km/h (11.5 mph) with a matching longitudinal component. The velocity change was below the threshold required for the frontal air bag first stage deployment. Additionally, the driver's seat belt buckle pretensioner did not fire. The EDR output data identified the restraint system as engaged.

Figure 2. Center frontal damage to the Taurus.

Post-Crash

The Ford Taurus came to rest engaged against the struck utility pole. Although unconfirmed by interview data, the driver probably unbuckled the manual belt system and exited the vehicle unassisted. He was not listed as injured on the police crash report and refused medical treatment. The investigating police agency received notification 20 minutes following the crash and dispatched an officer to the scene. He arrived within four minutes and initiated his on-scene investigation. There were no charges filed against the driver of the Taurus. The Taurus sustained disabling damage and was towed from the scene. The vehicle was subsequently towed to the rental facility regional depot where it was removed from service.

Vehicle Data

The 2000 Ford Taurus SE was manufactured in January 2000 and identified by vehicle identification number (VIN) 1FAFP5520YA (production number deleted). At the time of the SCI inspection, the vehicle's odometer reading was (11,760 miles). The Taurus was equipped with cloth covered front bucket seats and a flip-and-fold center armrest configuration that doubled as a center armrest/comsole and a center seated position.

The Taurus was equipped with the Advanced Occupant Protection System (AOPS) that included a center front mounted crash sensor, dual stage inflators for the frontal air bags **(Figure 3)**, a driver's seat positioning sensor, front seat belt buckle pre-tensioners **(Figure 4)**, load force limiters in the front seat belt retractors, and a center tunnel mounted Restraints Control Module that had sensing and Event Data Recording capabilities. Although the Taurus sustained a center frontal impact, the external crash sensor was not damaged. The Taurus was not equipped with the adjustable pedal option or side impact air bags.

Figure 3. Interior view of the non-deployed frontal air bag modules.

Figure 4. Non-fired front seat belt buckle pre-tensioners.

The front outboard seated positions were equipped with continuous loop lap and shoulder belt systems with sliding latchplates, dual mode locking retractors with load force limiters. The center front position was equipped with a manual lap belt. All three rear seat positions were equipped with 3-point lap and shoulder belt systems. Although the driver was restrained by the manual belt system, there was no loading evidence on the system's components. The load force limiter was not inspected.

Vehicle Damage

Exterior:

The 2000 Ford Taurus sustained minor center frontal damage from the run-off-road impact with the utility pole. Maximum crush was 19.3 cm (7.6") located on the bumper beam 9.5 cm (3.75") right of center **(Figure 5)**. The impact deformed the bumper fascia and bumper beam, fractured the plastic grille, and crushed the hood face and fiberglass upper radiator support panel. The direct contact damage began 6.6 cm (2.6") left of center and extended 17.8 cm (7.0") laterally to the right. The combined induced and direct contact damage length was 125.7 cm (49.5") that extended the full width of the bumper beam. The crush profile at the bumper beam **(Figure 6)** was as follows: C1 = 0 cm , C2 = 6.6 cm (2.6"), C3 = 13.2 cm (5.2"), C4 = 17.8 cm (7.0"), C5 = 8.9 cm (3.5"), C6 = 0 cm. The Collision Deformation Classification (CDC) for this impact event was 12-FCEN-1.

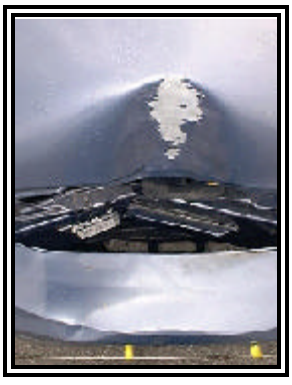


Figure 5. Displacement of the bumper beam from the fascia.

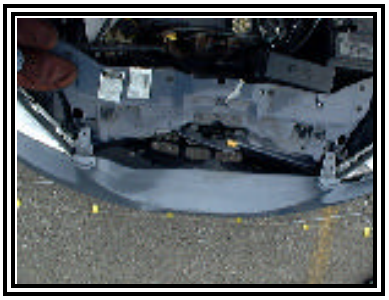


Figure 6. Overhead view of the frontal crush profile.

Interior:

There was no damage to the interior surfaces of the Ford Taurus.

Event Data Recorder Output

The Event Data Recorder (EDR) in the 2000 Ford Taurus was downloaded by the SCI team during the on-site investigation. The hexidecimal data retrieved in the field was electronically forwarded to Ford for interpretation. The results were received and are attached as an Appendix to this summary report. The following is a discussion of the data:

The EDR recorded the status of the driver belt system as buckled and the status of the front right passenger belt system as unbuckled. This was consistent with the police report identifying the driver as the sole occupant of the vehicle at the time of the crash. The EDR recorded a longitudinal delta V of -12.1 km/h (-7.5 mph) that occurred at 78 ms (end of recording time) with a lateral delta V of -1.9 km/h (-1.2mph). The longitudinal crush pulse was increasing at the 78 ms termination point of the EDR, therefore, the WinSMASH generated delta V of -18.5 km/h (-11.5 mph) may be a more realistic estimate of the total pulse experienced by the Taurus.

This longitudinal component did not meet the threshold to fire the driver's seat belt buckle pre-tensioner or the frontal air bag system. Therefore, the algorithm times recorded from wake-up to pretensioner and air bag deployment are 0 ms.

Driver Demographics

Age/Sex:	20 year old male
Height:	Unknown
Weight:	Unknown
Eyeware:	Unknown
Manual Restraint System Usage:	3-point lap and shoulder belt system
Usage Source:	EDR output data
Type of Medical Treatment:	None, not injured

Driver Injuries

Driver Injuries	Injury Severity (AIS/Update 98)	Injury Mechanisms
Not injured	N/A	N/A

Driver Kinematics

The 20 year old male driver of the 2000 Ford Taurus was presumed to be in an upright driving posture and properly restrained by the manual belt system. At impact, he responded to the 12 o'clock direction of force by initiating a forward trajectory and loading the manual belt system. The belt system provided adequate crash protection and prevented the driver from contact with interior components **(Figure 7)**. He was not injured and refused medical treatment at the scene.

Figure 7. Steering wheel rim and knee bolster lacking contact evidence.

Attachment A:
EDR Report

2000 Taurus/Sable EDR Report - Summary Page

[redacted]

Investigation Data

File Name:	CA00-021.hex	File Save Date:	19-Jul-2000
File Read-out Date:	N/A	Report Date:	19-Jul-2000
Report Version:	1.2		

EDR Control Module Data

Data Validity Check:	Valid	EDR Model Version:	141
Left (Driver) Side Bag Deployment Time (ms):			Not Deployed
Right (Passenger) Side Bag Deployment Time (ms):			Not Deployed
Passenger Airbag Switch Position During Event:			N/A
Diagnostic Codes Active When Event Occurred:			0

Algorithm Times (Actual initiation depends on restraint system status (below))	ms
Time From Algorithm Wakeup to Pretensioner:	0
Time From Algorithm Wakeup to First Stage - Unbelted:	0
Time From Algorithm Wakeup to First Stage - Belted:	0
Time From Algorithm Wakeup to Second Stage:	0

Restraint System Status

Driver Seat Belt Buckle:	Engaged
Passenger Seat Belt Buckle:	Not Engaged
Driver Seat Track In Forward Position:	No
Passenger Seat Weight Switch Position:	N/A

Deployment Initiation Attempt Times	Driver	Passenger
Time From Algorithm Wakeup to Pretensioner Deployment Attempt:	Not Deployed	Not Deployed
Time From Algorithm Wakeup to First Stage Deployment Attempt:	Not Deployed	Not Deployed
Time From Algorithm Wakeup to Second Stage Deployment Attempt:	Not Deployed	Not Deployed

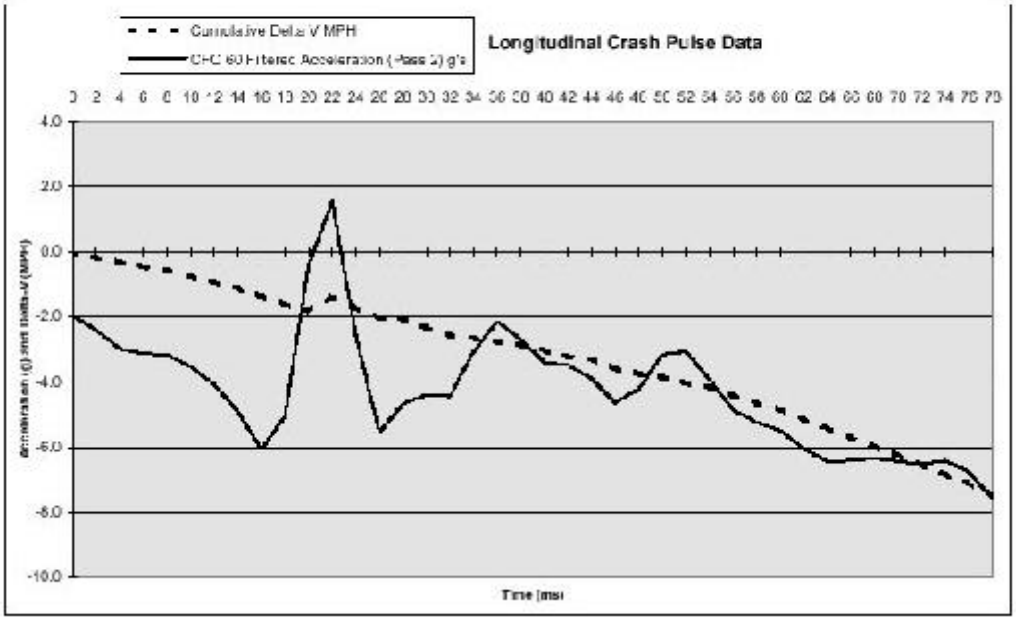
Notes

1. Read-out date is set by the PC interface tool.
2. Features and data parameters which are not available on the module are marked "N/A".
3. CFC 60 is a Butterworth 4-pole phaseless digital filter. (See SAE J211 Part 1 Appendix C dated March 1995.)
4. Total and maximum Delta-V results are not available from truncated/incomplete crash pulses.
5. Algorithm wakeup (0 ms) is not the first moment of vehicle contact or impact.
6. The Excel "Analysis ToolPak" Add-in must be enabled for this spreadsheet to operate properly.

2000 Taurus/Sable EDR Report - Charts

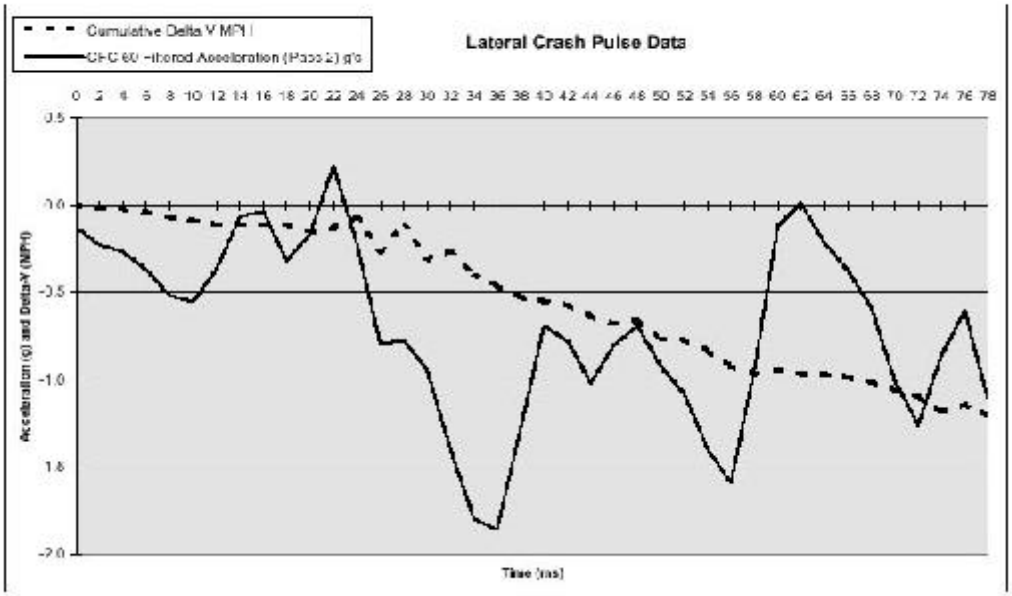
Longitudinal Cumulative Delta-V

Time (ms)	0	10	20	30	40	50	60	70	78
Delta-V (MPH)	-0.1	-0.7	-1.8	-3.3	-5.0	-6.9	-8.9	-10.3	-11.5



Lateral Cumulative Delta-V

Time (ms)	0	10	20	30	40	50	60	70	78
Delta-V (MPH)	0.0	-0.3	-0.8	-1.5	-2.5	-3.9	-5.9	-8.1	-10.2



2000 Taurus/Sable EDR Report - Memory Dump

Hexidecimal Module Memory Dump

Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
0800	0F	4A	4C	76	14	FB	FF	FF	F7	FF	0E	31	0F	2D	3A	4C
0810	C0	FF	0C	FF	52	C0	52	6C	60	52	D3	20	3C	73	D6	A0
0820	08	03	28	37	5F	CF	0F	0A	F5	DA	B7	84	A1	53	D5	AA
0830	03	0C	1B	8	30	FF	3C	3C	80	06	28	64	64	00	DC	01
0840	5A	95	5C	FF	FF	FF	EF	DF	D5	E7	FF	72	4E	13	25	B1
0850	EC	14	05	0F	D1	FF	FF	0C	77	FF	CD	44	00	F7	FF	95
0860	FF	FF	FF	FF	FF	FF	FF	FF	F7	FF	FF	FF	FF	F7	FF	FF
0870	05	38	FA	24	48	C0	8F	FF	59	46	31	41	00	02	FF	00
0880	FF	FF	0C	FF	FF	C0	FF	FF	00	FE	FF	00	FF	F7	00	FF
0890	FF	FF	0C	FF	FF	C0	FF	FF	00	FE	FF	00	FF	F7	00	FF
08A0	00	0D	0C	00	30	C0	0D	0C	00	30	FF	FF	FF	F7	FF	FF
08B0	02	FF	81	38	30	8D	01	FF	F7	FF	FF	FF	22	01	CF	00
08C0	FF	33	01	CF	30	22	01	CF	00	51	02	12	67	71	FF	FE
08D0	01	0E	0C	80	02	58	15	87	1F	BE	01	0A	00	8C	01	04
08E0	00	FD	01	36	30	A0	01	54	00	3F	02	30	02	C7	D2	8A
08F0	05	14	07	08	01	2C	03	CA	04	CE	06	4D	73	33	DC	A0
0900	3F	FF	0C	03	30	4B	01	CC	00	03	0F	FF	00	11	0C	78
0910	00	AD	0C	6E	DA	16	FF	01	00	30	00	7F	0F	0C	0F	02
0920	03	5A	32	46	05	50	02	02	FA	1E	08	0C	0A	1C	D2	23
0930	09	05	28	32	16	20	15	1F	57	FF	FF	02	FF	F7	FF	11
0940	FF	FF	FF	FF	FF	FF	FF	FF	F7	FF	FF	FF	FF	F7	FF	FF
0950	00	0D	0C	00	30	C0	0D	11	00	30	26	17	12	0D	1C	00
0960	17	0D	0C	30	30	1D	03	0C	00	30	00	23	3E	03	27	00
0970	00	0D	92	90	A3	82	B2	AA	9B	B1	B7	BB	B6	B2	71	5A
0980	E1	B3	CF	BB	9E	E9	C5	A6	91	A8	AA	BB	A5	A3	9A	BB
0990	C3	8C	93	B8	C0	B5	AD	B1	A7	AE	B2	B1	A6	AA	B2	9F
09A0	9F	9C	9D	9D	9C	9A	9A	98	98	9A	B7	93	95	A2	96	99
09B0	9F	97	9B	9C	9A	A0	95	9C	9B	9F	9D	9B	98	9A	95	97
09C0	96	95	97	95	96	97	93	82	81	82	81	81	81	81	82	82
09D0	02	0D	0D	85	79	09	79	04	7C	7F	7F	01	01	77	00	03
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09F0	00	0D	0C	00	30	C0	0D	FF	F7	FE	FF	FF	FF	F7	FF	05