

On-scene Investigation / Vehicle to Concrete Light Pole  
Dynamic Science, Inc. / Case Number: DS00-013  
2000 Ford Taurus SES  
Wisconsin  
July, 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 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 crash-worthiness performance of the involved vehicle(s) or their safety systems.*

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16. Abstract <p>This case was initiated because the case vehicle was equipped with an Event Data Recorder and Advanced Occupant Protection System. The collision occurred in Wisconsin in July, 2000 at 0300 hours. This was a single vehicle collision involving an avoidance maneuver to avoid a dog leading to a collision into a concrete light pole.</p> <p>The case vehicle, a rented 2000 Ford Taurus SES 4-door sedan, was driven by an unrestrained 24-year-old male (173 cm-68 in/113 kg-250 lbs). The case vehicle had exited the driveway of a restaurant/bar heading south and then turned left and headed east. As the case vehicle crossed through an intersection, a dog crossed directly in front the case vehicle. The driver of the case vehicle swerved to the right in an effort to avoid hitting the dog. The case vehicle ran up and over the south-east concrete curb and then struck the concrete light pole with its front right corner (12FREE2). On impact, both front air bags in the case vehicle deployed.</p> <p>The case vehicle sustained moderate damage to the front bumper, hood, grille area, front right fender and the windshield. The case vehicle was towed from the scene due to damage and was later declared a total loss. The police report indicates that no injuries were reported by the driver of the case vehicle. The driver indicated that he had sustained a laceration to the right side of his forehead and he complained of pain to both of his knees. The driver was picked up from the scene and driven home. He did not seek any medical treatment.</p> <p>The Delta V for the case vehicle was computed using WinSmbash version 2.12 with the pole option as a total delta v of 29.0 km/h (18.0 mph), a longitudinal delta v of -29.0 km/h (-18.0 mph) and a latitudinal delta v of 0 km/h (0 mph). This is a borderline reconstruction, but the results appear reasonable. The downloaded Electronic Data Recorder (EDR) data indicates a cumulative longitudinal delta v of -28.6 km/h (-17.8 mph) and a cumulative lateral delta v of -7.6 km/h (-4.7 mph) at the 78 ms mark. There is a reasonable match between the WinSmash results and the EDR data. The EDR report is included as an attachment to this report. The case vehicle was assigned a Collision Deformation Classification (CDC) of 12FREE2 and a Principle Direction of Force (PDOF) of 000 degrees. The combined direct and induced damage width was 127.5 cm (50.2 in) [CRASH L = 148 cm (58.3 in)], and the maximum crush depth was 32.7 cm (12.9 in) located at C<sub>g</sub>.</p> <p>The case vehicle was equipped with a driver's steering wheel mounted air bag and a top-mount front right passenger's air bag. Both front seat positions of the case vehicle were equipped with seat belt pretensioners. The depth of the pretensioner barrels were checked and measured. The depth of the driver's barrel measured 10.9 cm (4.3 in.), indicating that it had not deployed. The depth of the front right barrel measured 10.8 cm (4.3 in.), indicating it had not deployed.</p>					
17. Key Words Air bag, deployment, advanced, AOPS			18. Distribution Statement		
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**Dynamic Science, Inc.  
Accident Investigation  
Case Number: DS00-013**

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**BACKGROUND:**

**Description:** This Event Data Recorder and Advanced Occupant Protection System case was reported to the National Highway Traffic Safety Administration (NHTSA) by Dynamic Science, Inc. on August 17, 2000. The NHTSA assigned the case to DSI on August 18, 2000 and an on-scene investigation was conducted.

**Investigation Type:** On-scene

**Crash Location:** Wisconsin

**Crash Date:** July, 2000

**Notification Date:** August 17, 2000

**Field Work Completed:** August 19, 2000

**SUMMARY:**

The collision occurred in Wisconsin in July, 2000 at 0300 hours. This was a single vehicle collision involving an avoidance maneuver to avoid a dog leading to a collision into a concrete light pole. At the area of impact, the roadway is a four leg intersection that was controlled by standard tri-colored signals. The east-west roadway consists of two travel lanes for eastbound traffic and three lanes for westbound traffic. The roadway was dry, straight and level concrete surface with a posted speed limit of 40 km/h (25 mph). The south-east corner of the intersection is bordered by a 15 cm (5.9 in) high concrete curb, and there was a 16 cm (6.3 in) diameter light support.



**Figure 1.** Approach to impact.

The case vehicle, a rented 2000 Ford Taurus SES 4-door sedan, was driven by an unrestrained 24-year-old male (173 cm-68 in/113 kg-250 lbs). The case vehicle had exited the driveway of a restaurant/bar heading south and then turned left and headed east. As the case vehicle crossed through the intersection, a dog crossed directly in front the case vehicle. The driver of the case vehicle swerved to the right in an effort to avoid hitting the dog. The case vehicle ran up and over the south-east concrete curb and then struck the concrete light pole with its front right corner (12FREE2). On impact, both front air bags in the case vehicle deployed.

The case vehicle sustained moderate damage to the front bumper, hood, grille area, front right fender and the windshield. The case vehicle was towed from the scene due to damage and was later declared a total loss.

The police report indicates that no injuries were reported by the driver of the case vehicle. The

driver indicated that he had sustained a laceration to the right side of his forehead and he complained of pain to both of his knees. The driver was picked up from the scene and driven home. He did not seek any medical treatment.

The Delta V for the case vehicle was computed using WinSmash version 2.12 with the pole option as a total delta v of 29.0 km/h (18.0 mph), a longitudinal delta v of -29.0 km/h (-18.0 mph) and a latitudinal delta v of 0 km/h (0 mph). This is a borderline reconstruction, but the results appear reasonable. The downloaded Electronic Data Recorder (EDR) data indicates a cumulative longitudinal delta v of -28.6 km/h (-17.8 mph) and a cumulative lateral delta v of -7.6 km/h (-4.7 mph) at the 78 ms mark. There is a reasonable match between the WinSmash results and the EDR data. The EDR report is included as an attachment to this report. The case vehicle was assigned a Collision Deformation Classification (CDC) of 12FREE2 and a Principle Direction of Force (PDOF) of 000 degrees. The combined direct and induced damage width was 127.5 cm (50.2 in) [CRASH L = 148 cm (58.3 in)], and the maximum crush depth was 32.7 cm (12.9 in) located at C<sub>5</sub>.

The case vehicle is equipped with grey fabric-covered bucket seats<sup>1</sup> in the outboard front seating positions and a gray fabric-covered bench seat in the rear. The front left seat had been removed prior to the vehicle inspection. The front left seat position was equipped with a manual lap and shoulder belt and emergency locking retractor (ELR). At time of inspection the front right seat back was reclined rearward at a 35E angle from vertical and the seat was adjusted to the rear most track position. This seat position was equipped with a manual lap and shoulder belt and a switchable retractor in ELR mode.

#### AOPS discussion

This 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. Data related to the driver and passenger air bag deployment include: 78 milliseconds of crash pulse, deployment strategy of the dual-stage air bag system, seat belt latch use, pretensioner operation, and driver seat track location.

The EDR report further indicates that:

1. This was a first stage deployment.
2. The driver's seat was not in the forward position.
3. The front left and front right seat buckles were not engaged.
4. The front left and front right pretensioner did not deploy-neither of the seat buckles were engaged.
5. The time from algorithm wake-up to first stage - unbelted was 12 milliseconds.

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<sup>1</sup> At the time of the vehicle inspection the driver's seat had been removed and the driver's air bag cut off. The driver's seat was placed back in the case vehicle for photography purposes. Photograph showing the driver's air bag on the steering wheel were obtained from the insurance company.

The case vehicle was equipped with a driver's steering wheel mounted air bag and a top-mount front right passenger's air bag. The driver's air bag was cut off prior to the vehicle inspection. The dual module covers opened in an "H" configuration. The front right passenger's air bag was rectangular and measured 41 cm (16.1 in) high by 54 cm (21.3 in) wide. It was equipped with two vent ports and was not tethered. 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 and was not damaged.

Both front seat positions of the case vehicle were equipped with seat belt pretensioners. The depth of the pretensioner barrels were checked and measured. The depth of the driver's barrel measured 10.9 cm (4.3 in.), indicating that it had not deployed. The depth of the front right barrel measured 10.8 cm (4.3 in.), indicating it had not deployed.

### Scene Diagram

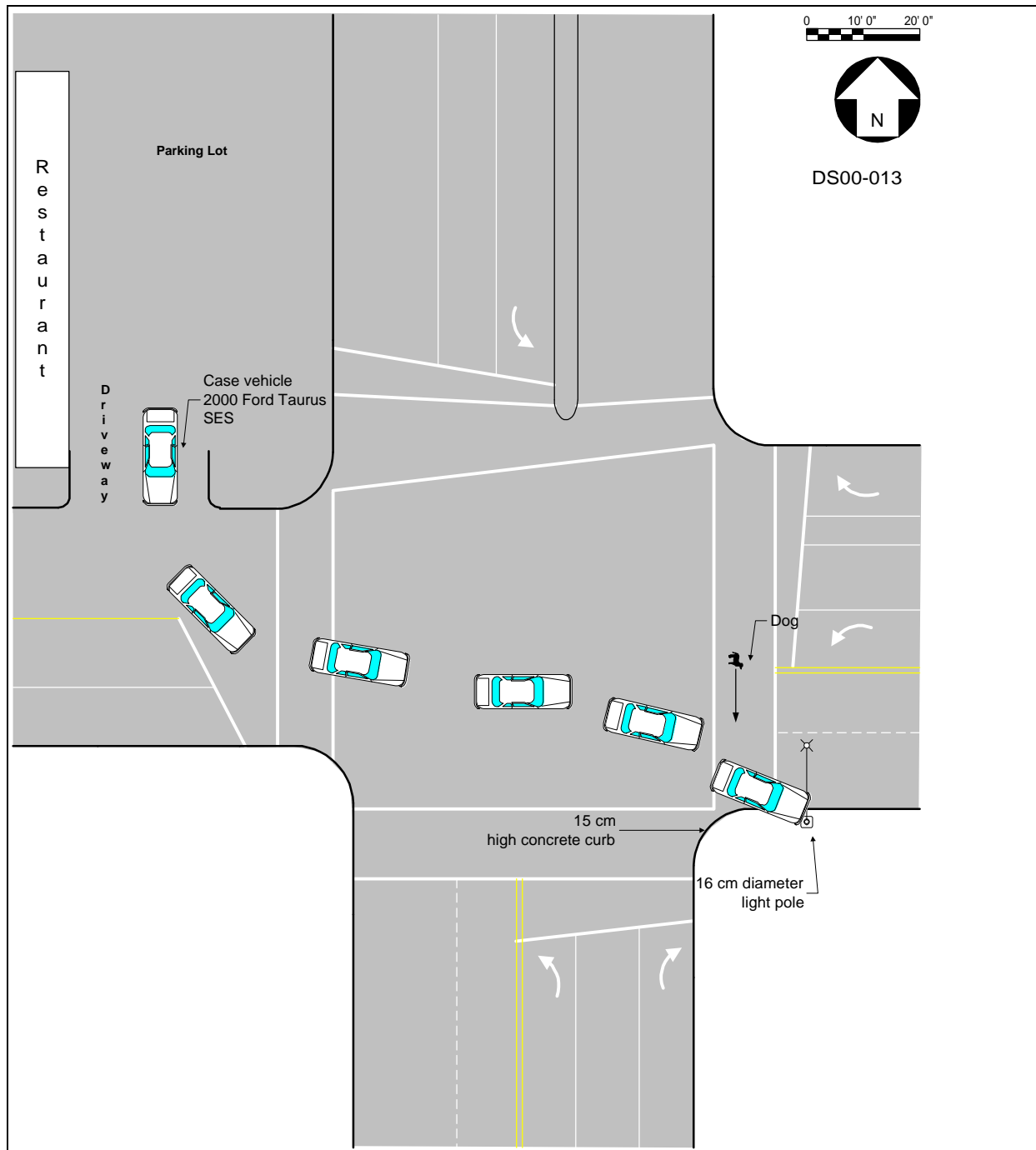


Figure 2. Scene diagram



**DETAILED INFORMATION****Vehicles**Case vehicle

Description:	2000 Ford Taurus SES 4-door
VIN:	1FAFP55U7YGxxxxxx
Odometer:	7,245 km (11,659 miles)
Engine:	3.0L 6 cyl
Reported Defects:	None
Cargo:	None
Damage Description:	Moderate damage to the front bumper, hood, grille area, front right fender and windshield
CDC:	12FREE2
Delta V:	Total                    29.0 km/h (18.0 mph)
	Longitudinal            -29.0 km/h (-18.0 mph)
	Latitudinal             0.0 km/h (0.0 mph)
	Energy                   56,952 joules (42,006 ft-lbs)



**Figure 3.** Exterior damage to case vehicle.

**Occupants**

<u>Case vehicle</u>	Occupant 1
Age/Sex:	24/Male
Seated Position:	Front left
Seat Type:	Gray fabric-covered bucket seat. Seat had been removed prior to inspection. The seat track position at impact is not known.
Height:	173 cm (68 in)
Weight:	113 kg (250 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Presumed to be greater than 6 years
Body Posture:	Assumed normal, upright
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt <u>not</u> used
Air bag:	Steering wheel mounted air bag deployed
Pretensioner:	Front outboard seats equipped with pretensioners at the belt buckles that did not deploy

**Injuries and Injury Mechanisms**

Case vehicle

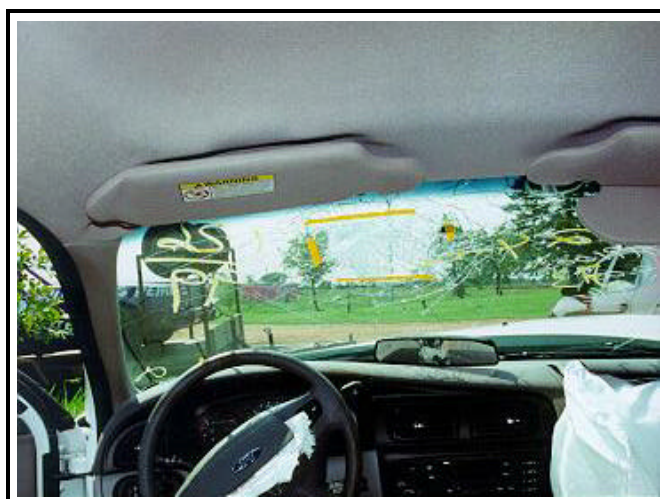
	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Laceration to the right side of forehead	290602.1, 7	873.42	Windshield
	Complained of pain to both his knees—Not codeable			

## Occupant Kinematics

The 24-year-old male driver of the case vehicle is assumed to have been seated in a normal, upright fashion in the fabric-covered bucket seat. He was not wearing the available lap and shoulder belt. The EDR showed that the restraint buckle was not engaged. At impact, the driver responded to the 0 degree direction of force by moving straight forward. The driver engaged the deploying air bag in some fashion with his torso although there was no evidence of contact. As he loaded the bag and the steering wheel, the steering column shear capsules were stroked—1.5 cm (0.6 in) to the right capsule and 2.5 cm (1.0 in) to the left capsule. His head struck the windshield—there was hair embedded in the glass, causing the laceration to his forehead. Both of his knees struck the rigid plastic covers on the left instrument panel area, deforming the knee bolster. He complained of pain to both of his knees. The driver was picked up from the scene and driven home. He did not seek medical treatment.



**Figure 4.** Deformed knee bolster.



**Figure 5.** Driver contact to windshield and mirror.



**Figure 6.** Left side steering column.

## Attachment 1. EDR report

## 2000 Taurus/Sable EDR Report - Summary Page

**Investigation Data**

<b>File Name:</b>	ds00-013.hex	<b>File Save Date:</b>	06-Sep-2000
<b>File Read-out Date:</b>	N/A	<b>Report Date:</b>	06-Sep-2000
<b>Report Version:</b>	1.4		

**EDR Control Module Data**

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

**Algorithm Times**

Actual initiation depends on restraint system status (below).

	ms
<b>Time From Algorithm Wakeup to Pretensioner:</b>	12
<b>Time From Algorithm Wakeup to First Stage - Unbelted:</b>	12
<b>Time From Algorithm Wakeup to First Stage - Belted:</b>	22
<b>Time From Algorithm Wakeup to Second Stage:</b>	0

**Restraint System Status**

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

**Deployment Initiation Attempt Times**

	Driver	Passenger
<b>Time From Algorithm Wakeup to Pretensioner Deployment Attempt:</b>	Unbelted	Unbelted
<b>Time From Algorithm Wakeup to First Stage Deployment Attempt:</b>	12	12
<b>Time From Algorithm Wakeup to Second Stage Deployment Attempt:</b>	Disposal	Disposal

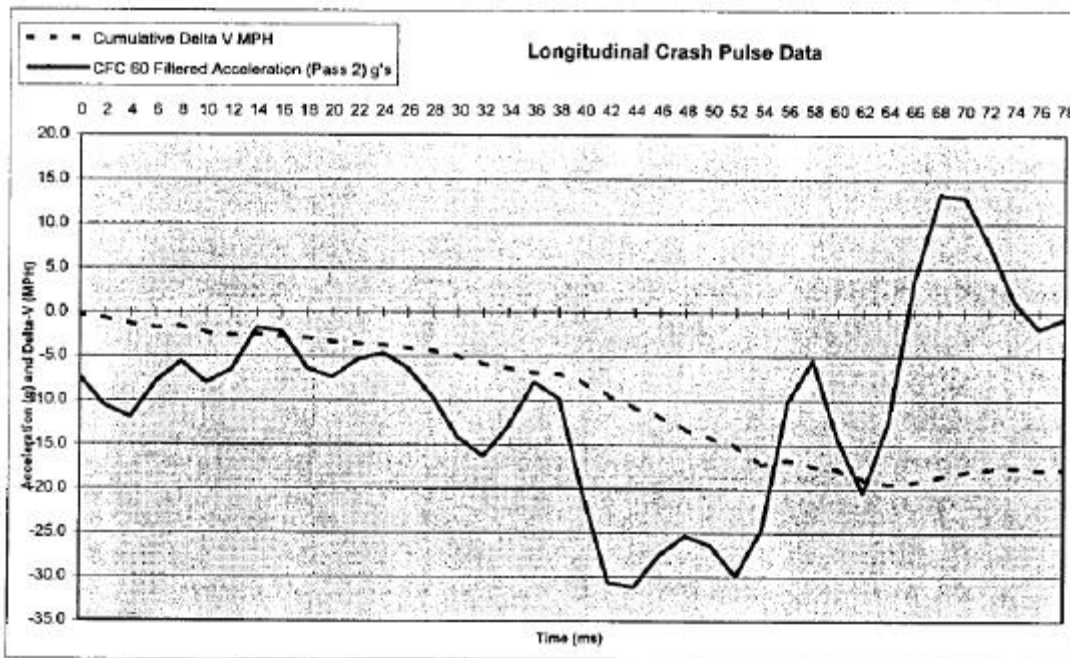
**Notes**

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

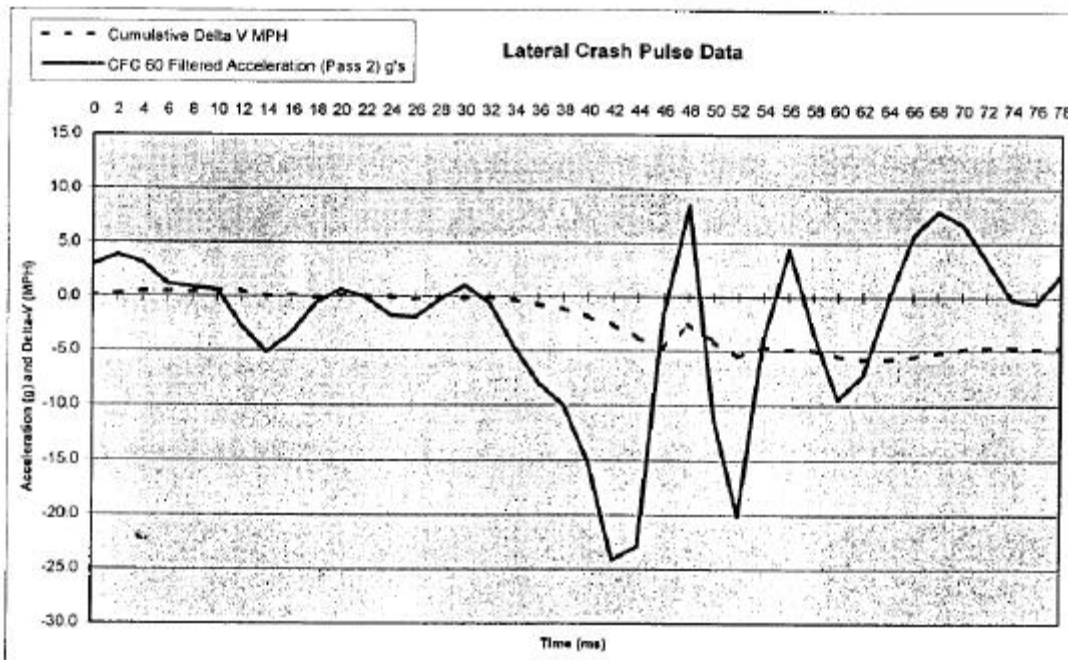
### Longitudinal Cumulative Delta-V

Time (ms)	0	10	20	30	40	50	60	70	78
Delta-V (MPH)	-0.3	-2.3	-3.4	-5.0	-8.0	-14.2	-17.8	-18.1	-17.8



### Lateral Cumulative Delta-V

Time (ms)	0	10	20	30	40	50	60	70	78
Delta-V (MPH)	0.1	0.6	0.1	-0.1	-1.8	-4.1	-5.4	-4.9	-4.7



File Name: ds00-013.hex

## 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	40	76	14	FB	FF	FF	FF	FF	0E	24	0F	2D	3A	4C
0810	C8	FF	00	FF	52	60	52	60	60	52	E3	20	3C	78	D6	A0
0820	08	03	28	37	5F	0F	0F	0A	F5	0A	B7	84	A1	5E	D5	AA
0830	03	0C	1B	1E	00	FF	3C	3C	80	06	28	64	64	00	0C	01
0840	5A	96	50	FF	FF	FF	EF	DF	D5	E7	FF	72	4E	13	25	B1
0850	EC	14	09	0F	01	FF	FF	88	7F	FF	CD	44	08	FF	FF	95
0860	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0870	05	3A	F7	06	EA	00	8F	FE	59	46	31	41	00	02	FF	19
0880	02	FD	80	06	FF	7E	12	FD	80	1C	FF	80	2B	FF	80	FF
0890	33	FF	80	35	FF	80	38	FF	80	FF	FF	00	FF	FF	00	FF
08A0	44	00	04	10	00	08	28	01	00	00	FF	FF	FF	FF	FF	FF
08B0	02	FF	81	38	00	8D	01	FF	FF	FF	FF	FF	11	01	D9	57
08C0	FF	34	01	D9	57	43	01	D9	57	51	03	24	73	45	FF	FE
08D0	01	0E	0C	80	02	58	16	87	1F	BE	01	0A	00	8C	01	04
08E0	00	F0	01	36	00	A0	01	54	00	3F	02	30	02	C7	02	8A
08F0	05	14	07	08	01	2C	03	CA	04	CE	06	40	73	33	00	A0
0900	3F	FF	00	03	00	4B	01	CC	00	03	0F	FF	00	14	00	78
0910	00	A0	00	6E	0A	16	FF	01	00	00	00	7F	0F	0C	0F	02
0920	03	5A	32	46	05	50	02	02	FA	1E	08	0C	0A	1C	02	23
0930	09	06	28	32	16	20	16	1F	5F	FF	FF	02	FF	FF	FF	11
0940	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0950	0C	00	16	00	0C	00	00	05	00	00	04	09	0B	07	21	2B
0960	07	08	0C	15	0C	12	09	00	00	00	09	16	1E	07	0F	13
0970	00	00	D1	10	A1	7F	B2	B2	A8	AB	B1	6C	58	9B	B9	75
0980	78	AE	DC	BA	D1	B8	A1	C8	94	80	9C	AC	AD	B9	AD	B3
0990	AB	A8	AB	A6	AA	B6	A8	A6	B2	A7	A5	AD	AF	AB	B2	93
09A0	90	83	8C	A9	81	93	A8	96	98	8C	9B	99	8F	93	85	7A
09B0	8E	88	9A	74	5E	62	75	60	74	76	41	BC	7E	92	6E	85
09C0	AF	BD	B7	B2	A7	95	A2	84	86	89	7F	7D	86	7C	68	87
09D0	72	89	7A	7F	77	82	7E	82	74	6C	6F	5D	5C	48	53	E6
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File name: ds00-013.hex