

On-scene Investigation / Vehicle to Vehicle  
Dynamic Science, Inc. / Case Number: DS00014  
2000 Ford Taurus  
Missouri  
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 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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**Technical Report Documentation Page**

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16. Abstract  <p>This case was initiated because the case vehicle was equipped with an advanced occupant protection system. The crash occurred in Missouri in May, 2000 at 1637 hours. The case vehicle, a 2000 Ford Taurus SE driven by a restrained 48-year-old female, was traveling southbound directly behind the other vehicle. The other vehicle, a 1990 Jeep Wrangler SUV driven by a restrained 16-year-old female, was stopped directly in front of the case vehicle and intending to turn left and head east. There were three additional occupants in the other vehicle. The front right seat was occupied by a restrained 16-year-old female. The rear left and right seats were also occupied by restrained 16-year-old females.</p> <p>The other vehicle had stopped at the intersection to yield the right of way to a northbound vehicle that was attempting to turn right and head east. The driver of the case vehicle at the last moment braked and the vehicle deposited 11.7 m (38.4 ft) of locked wheel skidmarks on the roadway. The case vehicle was unable to stop and its front (12FYEW1) struck the back of the other vehicle. At impact, the case vehicle sustained a total delta v of 25.2 km/h (15.7 mph), a longitudinal delta v of -25.2 km/h (-15.7 mph) and a latitudinal delta v of 0 km/h (0 mph).</p> <p>The driver of the case vehicle complained of pain to her neck to the police. She was transported by ground ambulance to a local hospital for treatment. The driver and all occupants of the other vehicle stated to police that they would seek medical treatment on their own after the collision. The police classified their injuries as "probable but not evident." The case vehicle was towed from the scene, and the other vehicle was driven from the scene.</p>					
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**Dynamic Science, Inc.**  
**Accident Investigation**  
**Case Number: DS00014**

**TABLE OF CONTENTS**

Background ..... 1  
    Description ..... 1  
    Investigation Type ..... 1  
    Crash Location ..... 1  
    Crash Date ..... 1  
    Notification Date ..... 1  
    Field Work Completed ..... 1  
  
Summary ..... 1  
  
Scene Diagram ..... 3  
  
Detailed Information ..... 4  
    Vehicles ..... 4  
    AOPS Discussion ..... 5  
    Occupants ..... 8  
    Injuries and Injury Mechanisms ..... 11  
    Occupant Kinematics ..... 12  
  
Attachment 1. EDR Report ..... 13

**BACKGROUND:**

Description: This Advanced Occupant Protection Systems case was generated by DSI through existing insurance contacts. NHTSA was notified of the case on August 21, 2000. DSI was assigned the case on August 22, 2000 and an on-site investigation was conducted. All field work was completed on August 25, 2000.

Investigation Type: On-scene

Crash Location: Missouri

Crash Date: May, 2000

Notification Date: August 22, 2000

Field Work Completed: August 25, 2000

**SUMMARY:**

The roadway is a north and south two way, two lane, undivided rural state route. The roadway forms a T-intersection with a east-west street at the area of impact. The asphalt roadway was dry, straight with a positive 1.7% grade. The weather was clear and the posted speed limit is 64 km/h (40 mph).

The crash occurred in Missouri in May, 2000 at 1637 hours. The case vehicle, a 2000 Ford Taurus SE driven by a restrained<sup>1</sup> 48-year-old female, was

traveling southbound directly behind the other vehicle. The other vehicle, a 1990 Jeep Wrangler SUV driven by a restrained 16-year-old female, was stopped directly in front of the case vehicle and intending to turn left and head east. There were three additional occupants in the other vehicle. The front right seat was occupied by a restrained 16-year-old female. The rear left and right seats were also occupied by restrained 16-year-old females.

The other vehicle had stopped at the intersection to yield the right of way to a northbound vehicle that was attempting to turn right and head east.



**Figure 1.** Area of impact

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<sup>1</sup> The EDR report indicates that the driver seat belt buckle was “engaged”.

The driver of the case vehicle at the last moment braked and the vehicle deposited 11.7 m (38.4 ft) of locked wheel skidmarks on the roadway. The case vehicle was unable to stop and its front (12FYEW1) struck the back of the other vehicle. At impact, the case vehicle sustained a total delta v of 25.2 km/h (15.7 mph), a longitudinal delta v of -25.2 km/h (-15.7 mph) and a latitudinal delta v of 0 km/h (0 mph) as computed by WinSmash<sup>2</sup>. Both front air bags in the case vehicle deployed on impact with the other vehicle. The results fit the collision model and appear reasonable.



**Figure 2.** Exterior frontal damage to case vehicle.

The driver of the case vehicle complained of pain to her neck to the police. She was transported by ground ambulance to a local hospital for treatment.

The driver and all occupants of the other vehicle stated to police that they would seek medical treatment on their own after the collision. The police classified their injuries as “probable but not evident.”

The case vehicle was towed from the scene, and the other vehicle was driven from the scene.



**Figure 3.** Case vehicle driver's air bag.



**Figure 4.** Case vehicle driver's area.

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<sup>2</sup> Calculated with Winsmash 1.2.1, Missing Vehicle with averaged NCAP stiffness values.

Scene Diagram

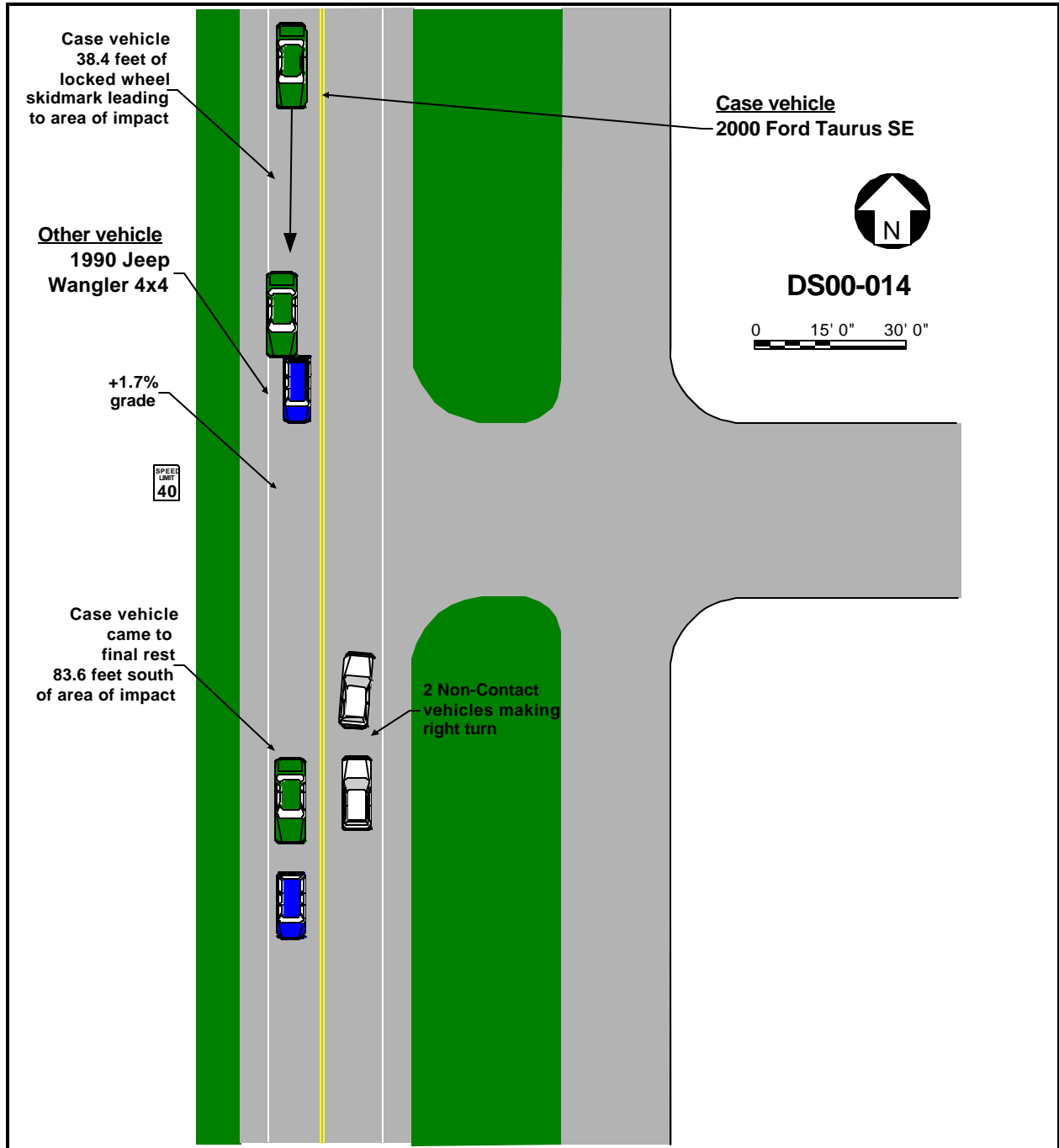


Figure 5. Scene diagram

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

Description:	2000 Ford Taurus SE	
VIN:	1FAFP53U1YAxxxxxx	
Odometer:	19,615 km (12,189 miles)	
Engine:	6 cyl 182 ci	
Reported Defects:	None	
Cargo:	None	
Damage Description:	Moderate frontal damage. Vehicle towed from the scene. Later declared a total loss.	
CDC:	12FYEW1	
Delta V:	Total	25.2 km/h (15.7 mph)
	Longitudinal	-25.2 km/h -15.7 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	25,363 joules (18,719 foot-lbs)

**Figure 6.** Front left, case vehicle



### 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.

At impact, the case vehicle sustained a total  $\Delta v$  of 25.2 km/h (15.7 mph), a longitudinal  $\Delta v$  of -25.2 km/h (-15.7 mph) and a latitudinal  $\Delta v$  of 0 km/h (0 mph) as computed by WinSmash. Both front air bags in the case vehicle deployed on impact with the other vehicle. The results fit the collision model and appear reasonable.



**Figure 7.** Damaged fuse block

The downloaded Electronic Data Recorder (EDR) data indicates a cumulative longitudinal  $\Delta v$  of -22.9 km/h (-14.2) at the 20 ms mark. This data is very suspect. The cumulative lateral  $\Delta v$  appears to be reasonable up until the 10 ms mark. The EDR stopped recording after 30 ms. After that point the crash pulses for both the longitudinal and lateral directions are virtually identical which is clearly impossible for this crash. The left side fuse block was damaged during the crash and may have caused the unusual data. The EDR report is included as an attachment to this report.

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 left front seat buckle was engaged, the right was not.
4. The time from algorithm wake-up to pretensioner deployment attempt was 21 milliseconds.
5. The time from algorithm wake-up to first stage - belted was 30 milliseconds.

The case vehicle steering wheel mounted driver's air bag was equipped with two tethers and two vent

ports. The air bag is circular and measures 43 cm (16.9 in) in diameter. There was a contact evidence on the center right area of the air bag that was probably lipstick. There was no damage to the driver's air bag.

The front right passenger air bag was rectangular in shape and measured 43 cm (16.9 in) tall by 59 cm (23.2 in) wide. It was equipped with two vent ports and did not have any tethers. There was no occupant contact evidence found on the air bag and it was not damaged.

Both front seat positions were equipped with seat belt pretensioners. The driver's pretensioner barrel was checked and measured 3.2 cm (1.3 in), indicating that it had deployed. The case vehicle was also equipped with adjustable foot controls. The longitudinal distance from the toe pan to the top of the brake pedal was 20.5 cm (8 in). There was no deformation to the pedal. The steering column breakaway coupling was found to be intact. There was no movement of the steering column shear capsules.

Other vehicle

Description: 1990 Jeep Wrangler  
VIN: 2J4FY29TXLJxxxxxx  
Odometer: Unknown  
Engine: 6 cyl - 258 ci  
Reported Defects: None  
Cargo: Unknown  
Damage Description: Moderate damage to right rear. Driven from the scene.  
CDC: Unknown  
Delta V:  
Total 25.5 km/h (15.9 mph)  
Longitudinal 25.5 km/h (15.9 mph)  
Latitudinal 0 km/h (0 mph)  
Energy 56,680 joules  
(41,830 ft lbs)



**Figure 8.** Exemplar vehicle

**Occupants**

<u>Case vehicle</u>	Occupant 1
Age/Sex:	48/Female
Seated Position:	Front left
Seat Type:	Fabric covered bucket seat—adjusted to between middle and rear most track position
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Presumed to be greater than 20 years
Body Posture:	Normal, upright
Hand Position:	Unknown. Steering column was found in full up position.
Foot Position:	Right foot presumed to be on brake. The longitudinal distance from the toe pan to the top of the brake pedal was 20.5 cm (8 in). There was no deformation to the pedal.
Restraint Usage:	Lap and shoulder belt used
Air bag:	Driver's air bag deployed

Other vehicle

Age/Sex:	16/Female	16/Female
Seated Position:	Front left	Front right
Seat Type:	Bucket with folding back	Bucket with folding back
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	Unknown	Unknown
Alcohol/Drug Involvement:	None	None
Driving Experience:	Approx. 1 year	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt used	Lap and shoulder belt used

Age/Sex:	16/Female	16/Female
Seated Position:	Rear left	Rear right
Seat Type:	Unknown	Unknown
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	NA	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt used	Lap and shoulder belt used

**Injuries and Injury Mechanisms**

## Case vehicle

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Complained of pain to neck			

## Other vehicle

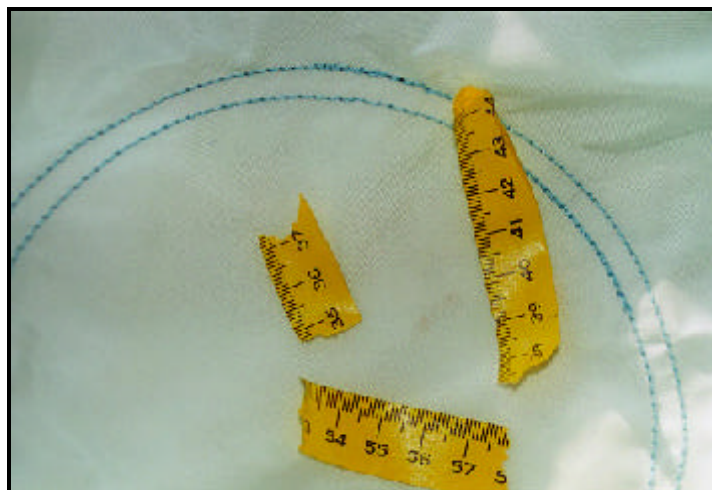
	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Not injured			
Front right occupant:	Not injured			
Rear left occupant:	Not injured			
Rear right occupant:	Not injured			

## Occupant Kinematics

The 48-year-old female driver of the case vehicle was seated in the fabric covered bucket seat in a normal, upright fashion. The seat had been adjusted to the between middle and rear track position. She was wearing the available lap and shoulder belts. The shoulder belt anchorage was adjusted to the full up position. Prior to the impact, the driver saw the other vehicle and began braking. The driver likely braced prior to impact. At impact, the driver pitched forward in response to the 0 degree direction of force. She loaded the lap and shoulder belt. Her face engaged the center of the driver's air bag, depositing a lip stick imprint. There was no steering wheel rim deformation. The driver complained of pain to her neck, but did not sustain any injuries.




**Figure 9.** Load marks to driver's seat belt

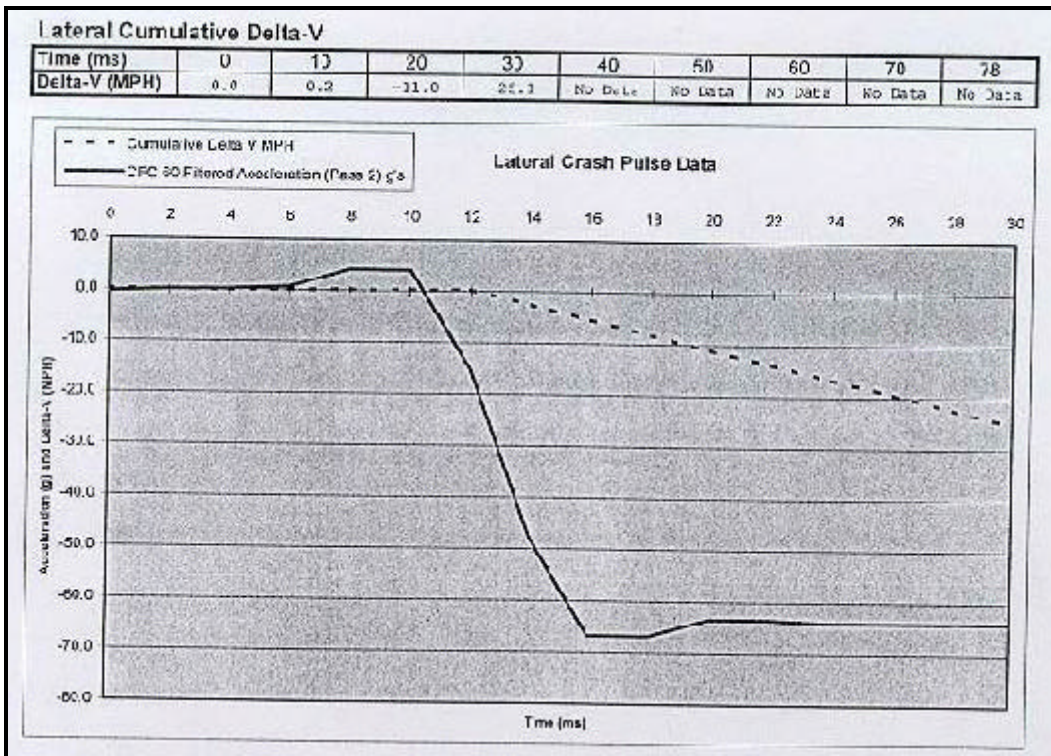
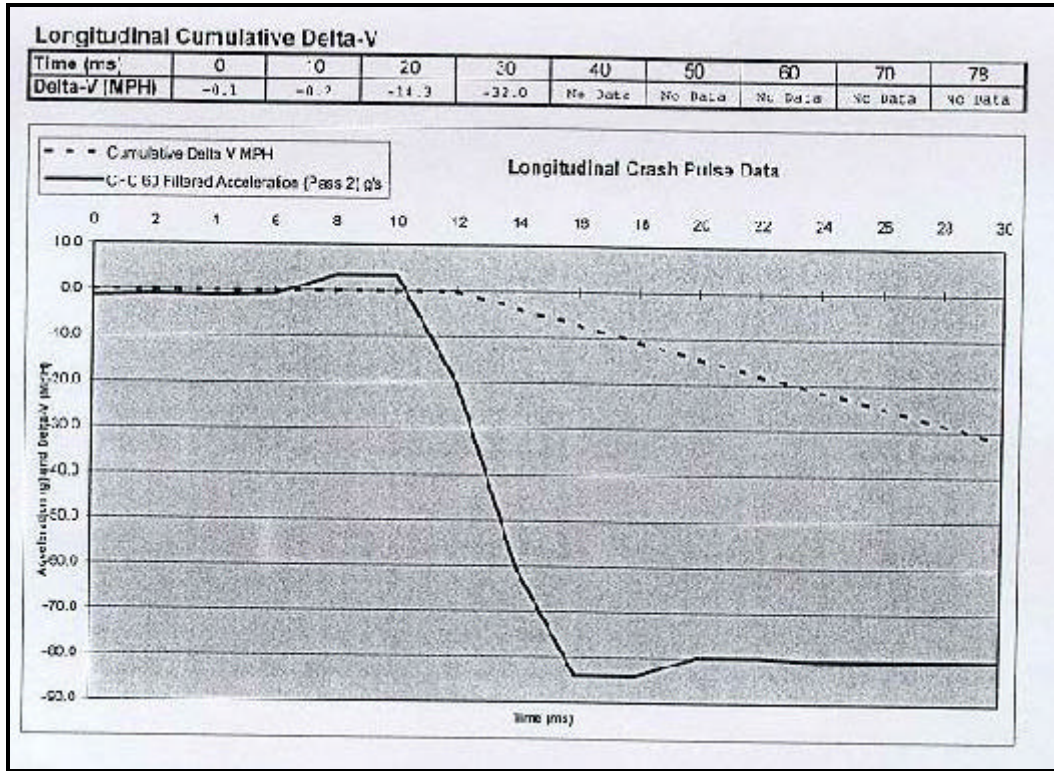


**Figure 10.** Lip stick imprint to air bag



EDR Report

2000 Taurus/Sable EDR Report - Summary Page			
<b>Investigation Data</b>			
File Name:	Ds00014.hex	File Save Date:	07-Sep-2000
File Read-out Date:	N/A	Report Date:	06-Sep-2000
Report Version:	1.1		
<b>EDR Control Module Data</b>			
Data Validity Check:	Valid	EDR Model Version:	141
Time From Side Saling Decision to Left (Driver) Side Bag Deployment:	Not Deployed		
Time From Side Saling Decision to Right (Passenger) Side Bag Deployment:	Not Deployed		
Passenger Airbag Switch Position During Event:	N/A		
Diagnostic Codes Active When Event Occurred:	0		
<b>Algorithm Times</b> <small>Actual initiation depends on test air system status (below)</small>			
Time From Algorithm Wakeup to Pretensioner:			ms
Time From Algorithm Wakeup to First Stage - Unbelted:			21
Time From Algorithm Wakeup to First Stage - Belted:			29
Time From Algorithm Wakeup to Second Stage:			30
			0
<b>Restraint System Status</b>			
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		
<b>Deployment Initiation Attempt Times</b>			
Time From Algorithm Wakeup to Pretensioner Deployment Attempt:	Driver	Passenger	
Time From Algorithm Wakeup to First Stage Deployment Attempt:	21	Unbelted	
Time From Algorithm Wakeup to Second Stage Deployment Attempt:	30	30	
	Disposal	Disposal	



## 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	EB	FF	FF	FF	FF	0E	24	0F	20	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	FF	FF	3C	3C	80	06	20	C4	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	87	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	00	00	00	00	00	00	8F	FE	59	46	31	41	00	02	FF	10
0880	06	FF	7E	17	FF	7E	30	FF	7E	35	FF	7E	38	FF	7E	FF
0890	FF	FF	00	FF	FF	00	FF	FF	00	FF	FF	00	FF	FF	00	FF
08A0	40	00	80	00	00	00	21	01	00	00	FF	FF	FF	FF	FF	FF
08B0	02	FE	81	38	00	8D	01	FF	FF	FF	FF	FF	11	01	C5	66
08C0	FF	14	14	C5	67	33	01	C5	67	51	00	16	63	73	FF	FE
08DC	01	0E	0C	80	02	58	16	87	1F	BE	01	0A	00	8C	01	04
08eC	00	F0	01	36	00	A0	01	54	00	3F	02	30	02	C7	02	8A
08FC	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	1D	00	1E	00	15	00	00	0F	00	00	1B	17	14	2A	29	00
0960	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0970	00	00	20	90	A1	80	B2	B2	B1	B1	AF	AF	B0	B1	00	00
0980	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0990	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	9E
09A0	9F	A0	A1	A0	A1	A1	00	00	00	00	00	00	00	00	00	00
09B0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
09C0	00	00	00	00	00	00	00	7F	80	81	83	82	83	82	00	0C
09D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	0C
09E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	0C
09F0	00	00	00	00	00	00	00	FF	FF	00	FF	FF	FF	FF	FF	0E