

On-scene Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS00-008
2000 Mercury Sable LS
California
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.

Technical Report Documentation Page

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16. Abstract <p>This two vehicle crash occurred in California in May, 2000 at 0835 hours. The crash took place on the approach to a four-leg intersection. The case vehicle, a 2000 Mercury Sable LS four-door sedan driven by a restrained 59-year-old male (183 cm/72 in., 79 kg/179 lbs), was traveling southbound at a witness reported speed of (35-40 mph) and approaching a heavily congested intersection. A 1996 Chevrolet Suburban was driven by a 47-year-old male was traveling southbound and stopped for the traffic signal directly in front of the case vehicle. The front right seat of the Suburban was occupied by a 39-year-old female. The driver indicated that he had been stopped for approximately 10 seconds before the impact.</p> <p>The driver of the case vehicle stated that he momentarily looked down at his watch and when he looked up, traffic in front of him had come to a stop. There was no pre-impact braking according to both the driver and witnesses. The police did not find any skidmarks. On impact, both frontal air bags in the case vehicle deployed. The case vehicle sustained a longitudinal delta v of -18.9 km/h (-11.7 mph). The downloaded Electronic Data Recorder (EDR) data indicates a cumulative longitudinal delta v of -24.6 km/h (-15.3 mph) at the 78 ms mark. The data indicates that the driver' seat belt was engaged and that the pretensioner on the driver's side fired.</p> <p>The driver of Vehicle 1 sustained a small laceration to his forehead caused by the eyeglass frame as the glasses were knocked off by the deploying air bag. He also sustained "seatbelt bruises" to his left torso, left shoulder, and abdomen. He was able to exit the vehicle on his own. He was transported to a local hospital via ground hospital for medical treatment. There were no injuries reported to the occupants of the Suburban. The case vehicle was towed from the scene due to damage. The Suburban sustained minor damage to its rear end, and it was driven from the scene.</p>					
17. Key Words Air bag, deployment, advanced air bag			18. Distribution Statement		
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Dynamic Science, Inc.
Accident Investigation
Case Number: DS00-008

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BACKGROUND:

Description: This Advanced Occupant Protection Systems case was generated by DSI through existing insurance contacts. NHTSA was notified of the case on July 28, 2000. DSI was assigned the case on July 28, 2000 and an on-site investigation was conducted.

Investigation Type: On-scene

Crash Location: California

Crash Date: May, 2000

Notification Date: July 28, 2000

Field Work Completed: July 28, 2000

SUMMARY:

This two vehicle crash occurred in California in May, 2000 at 0835 hours. The crash took place on the approach to a four-leg intersection. The crash occurred on a five-lane, two-way, undivided roadway. The roadway is comprised of two northbound lanes, two southbound lanes, and a reversible center lane that becomes a left hand turn lane as it approaches the intersection.

The case vehicle, a 2000 Mercury Sable LS four-door sedan driven by a restrained 59-year-old male (183 cm/72 in., 79 kg/179 lbs), was traveling southbound at a witness reported speed of (35-40 mph) and approaching a heavily congested intersection.

A 1996 Chevrolet Suburban was driven by a 47-year-old male was traveling southbound and stopped for the traffic signal directly in front of the case vehicle. The front right seat of the Suburban was occupied by a 39-year-old female. The driver indicated that he had been stopped for approximately 10 seconds before the impact.

The driver of the case vehicle stated that he momentarily looked down at his watch and when he looked up, traffic in front of him had come to a stop. There was no pre-impact braking according to both the driver and witnesses. The police did not find any skidmarks.



Figure 1. Approach to area of impact

On impact, both frontal air bags in the case vehicle deployed. The case vehicle sustained a longitudinal delta v of -18.9 km/h (-11.7 mph)¹. The downloaded Electronic Data Recorder (EDR) data indicates a cumulative longitudinal delta v of -24.6 km/h (-15.3 mph) and a lateral cumulative delta v of 0.8 km/h (0.5 mph) at the 78 ms mark. The EDR report is included as an attachment to this report.

The driver of Vehicle 1 sustained a small laceration to his forehead caused by the eyeglass frame as the glasses were knocked off by the deploying air bag. He also sustained “seatbelt bruises” to his left torso, left shoulder, and abdomen. He was able to exit the vehicle on his own. He was transported to a local hospital via ground hospital for medical treatment.

There were no injuries reported to the occupants of the Suburban.

The case vehicle was towed from the scene due to damage. The Suburban sustained minor damage to its rear end, and it was driven from the scene.



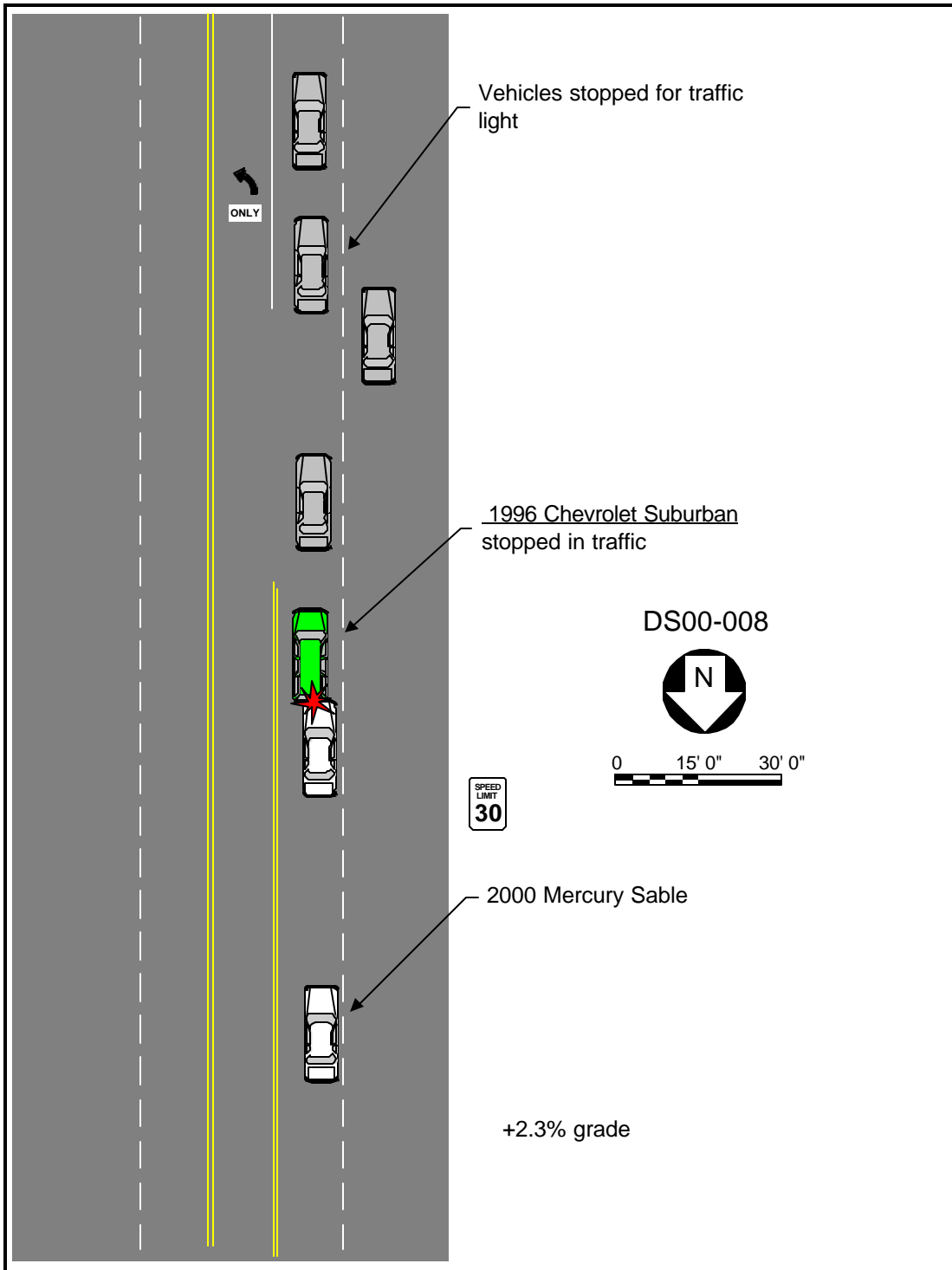
Figure 2. Front view, case vehicle



Figure 3. Front right quarter view, case vehicle

¹Calculated using stiffness values provided by Ford, borderline reconstruction

Scene Diagram



DETAILED INFORMATION**Vehicles**Case vehicle

Description:	2000 Mercury Sable LS four-door	
VIN:	1MEFM55SXYAxxxxxx	
Odometer:	7,111 km (4,419 miles)	
Engine:	V6	
Reported Defects:	None	
Cargo:	None	
Damage Description:	Minor front to rear crush to front bumper and grille.	
CDC:	12FDEW1	
Delta V:	Total	18.9 km/h (11.7 mph)
	Longitudinal	-18.9 km/h (-11.7 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	13,733 joules (10,124 ft-lbs)

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 18.9 km/h (11.7 mph), a longitudinal delta v of -18.9 km/h (-11.7 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 are borderline but appear reasonable.



Figure 5. Driver's air bag.

The downloaded Electronic Data Recorder (EDR) data indicates a cumulative longitudinal delta v of -24.6 km/h (-15.3) and a lateral cumulative delta v of 0.8 km/h (0.5 mph) at the 78 ms mark.

The data indicates that the driver's seat belt was engaged and that the pretensioner on the driver's side fired.

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 25 milliseconds.
5. The time from algorithm wake-up to first stage - belted was 27 milliseconds.

The driver's air bag was circular and measured 43 cm (16.9 in.) in diameter. It was equipped with two tethers and two vent holes. There appeared to be 6 horizontal folds and possibly 11 vertical folds. There were no indications of occupant contact. The module cover opened in an "H" configuration. There were no indications of any damage to the cover.

The front right occupant's frontal air bag was rectangular and measured 59 cm (22.8) laterally. It was equipped with two vent ports and did not have any tethers. On the face of the air bag there was cover-related scuffing. The single flap module did not sustain any damage.

The case vehicle was equipped with adjustable foot controls. According to the driver, these were adjusted to the most forward position.

Both front seat positions were equipped with seat belt pretensioners. The pretensioner barrels were checked. The driver's pretensioner measured 5.6 cm (2.2 in)—indicating that it had fired. The passenger's pretensioner measured 10.8 cm (4.3 in.)—indicating that it had not fired.

There was no steering column stroke and the steering column breakaway coupling was intact.



Figure 6. Front right passenger's air bag



Figure 7. Driver's seat belt pretensioner—in fired position

Other vehicle

Description:	1996 Chevrolet Suburban	
VIN:	Unknown	
Odometer:	Unknown	
Engine:	Unknown	
Reported Defects:	None noted	
Cargo:	Unknown	
Damage Description:	Minor rear damage according to police report. Vehicle was driven from the scene.	
CDC:	Unknown	
Delta V:	Total	13.0 km/h (8.1 mph)
	Longitudinal	13.0 km/h (8.1 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	23,358 joules (17,204 ft-lbs.)

Occupants

<u>Case vehicle</u>	Occupant 1
Age/Sex:	59/Male
Seated Position:	Front left
Seat Type:	Leather covered bucket seat—seat adjusted to between the middle and rear most track positions
Height:	183 cm (72 in.)
Weight:	79 kg (179 lbs.)
Occupation:	Sales
Pre-existing Medical Condition:	None
Alcohol/Drug Involvement:	None
Driving Experience:	> 20 years
Body Posture:	Normal, upright
Hand Position:	Both hands on steering wheel
Foot Position:	Right foot on accelerator, left on floor board
Restraint Usage:	Lap and shoulder belt used properly
Air bag:	Driver's air bag deployed

<u>Other vehicle</u>	Driver	Front right occupant
Age/Sex:	47/Male	39/Female
Seated Position:	Front left	Front right
Seat Type:	Unknown	Unknown
Height:	173 cm (68 in)	Unknown
Weight:	68 kg (150 lbs.)	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	Unknown	Unknown
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Unknown	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 MechanismsCase vehicle

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Small laceration, forehead	290602.1,7	873.42	Driver's frontal air bag / glasses
	Contusion, left shoulder	790401.1,2	923.0	Seat belt
	Contusion, left torso	490402.1,2	922.1	Seat belt
	Contusion, abdomen	590402.1,4	922.2	Seat belt

Other vehicle

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

Occupant Kinematics


The driver of the case vehicle was seated in a normal, upright fashion. He was wearing the available lap and shoulder belt. The upper anchorage adjustment was in the full up position. The leather-covered bucket seat was adjusted to between the middle and rear most track positions. The seat back angle was 30E. He was wearing prescription glasses with metal frames and plastic lenses.

At impact, the driver responded to the 0 degree direction of force by moving straight forward. The lap and shoulder belts restricted this forward motion—causing the torso, shoulder, and abdomen contusions. His face came into contact with the deploying air bag. His glasses were pushed upward and off his head. The frame came into contact with his forehead—causing a minor laceration. The driver complained of being light-headed and was transported by ground ambulance to a local hospital where he was seen and released.



Figure 8. Driver's seated position

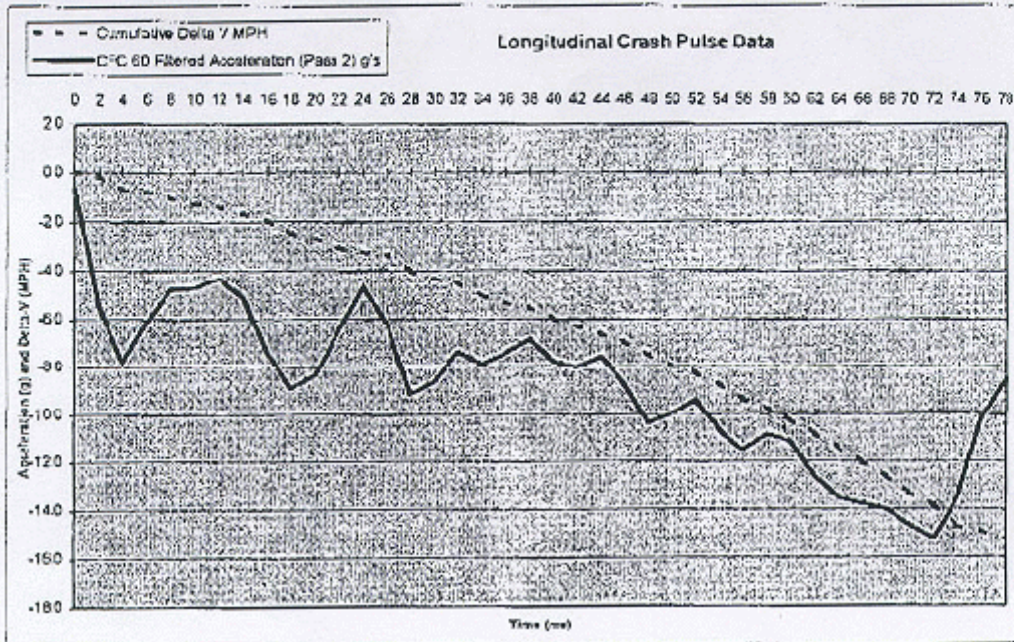
Attachment 1. EDR Report

2000 Taurus/Sable EDR Report - Summary Page			
Investigation Data			
File Name:	DS00-008.hex	File Save Date:	18-Aug-2000
File Read-out Date:	N/A	Report Date:	28-Aug-2000
Report Version:	1.4		
EDR Control Module Data			
Data Validity Check:	Valid	EDR Model Version:	141
Time From Side Safing Decision to Left (Driver) Side Bag Deployment:	Not Deployed		
Time From Side Safing Decision to Right (Passenger) Side Bag Deployment:	Not Deployed		
Passenger Airbag Switch Position During Event:	N/A		
Diagnostic Codes Active When Event Occurred:	0		
Algorithm Times <small>Actual times may depend on seat and system status (below).</small>			
			ms
Time From Algorithm Wakeup to Pretensioner:			25
Time From Algorithm Wakeup to First Stage - Unbelted:			26
Time From Algorithm Wakeup to First Stage - Belted:			27
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:	25	Unbelted	
Time From Algorithm Wakeup to First Stage Deployment Attempt:	27	27	
Time From Algorithm Wakeup to Second Stage Deployment Attempt:	Disposal	Disposal	

2000 Taurus/Sable EDR Report - Charts

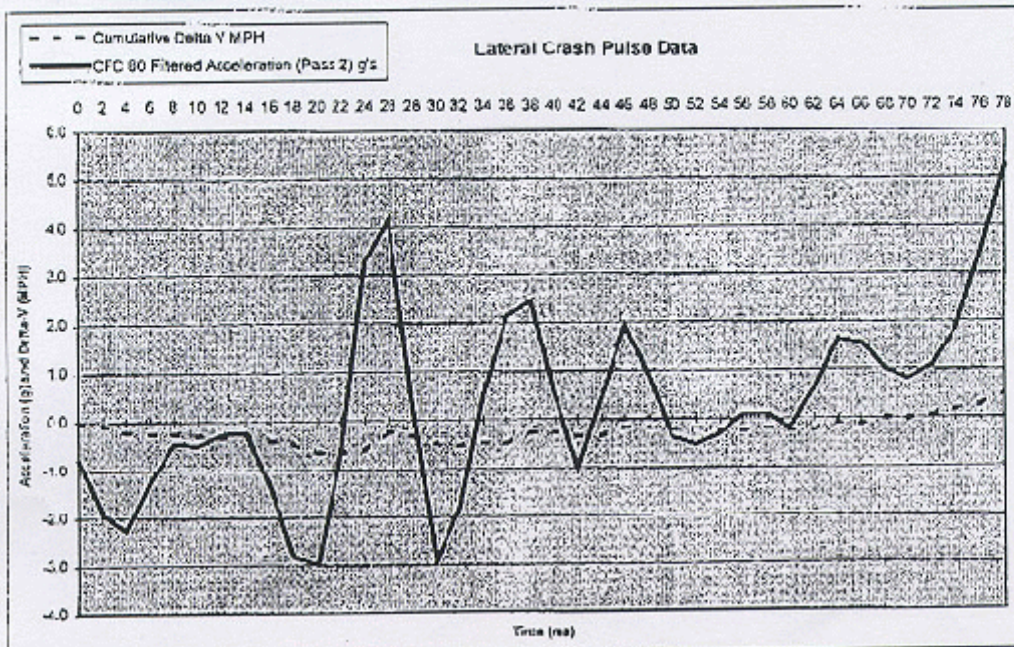
Longitudinal Cumulative Delta-V

Time (ms)	0	10	20	30	40	50	60	70	78
Delta-V (MPH)	0.0	-1.3	-2.7	-4.3	-6.0	-7.9	-10.3	-13.3	-15.3



Lateral Cumulative Delta-V

Time (ms)	0	10	20	30	40	50	60	70	78
Delta-V (MPH)	0.0	-0.3	-0.7	-0.5	-0.3	-0.2	-0.3	0.0	0.5



File Name: DS00-C03.hex