Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (1998-49-809E)

1998 Ford Taurus

Texas

October/1998

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16. Abstract

This remote investigation focused on the redesigned air bag system deployment of a 1998 Ford Taurus four-door sedan. This two vehicle crash took place during the afternoon hours in October of 1998. The weather was clear and the concrete roadway surface was dry with a positive 2.5% grade. This crash occurred at a busy, urban four-leg intersection. There are four, one-way, northbound travel lanes while the adjoining roadway is comprised of three, one-way, westbound travel lanes. Each leg of the intersection is bordered by curbing. The posted speed limit is 48 km/h (30 mph). Vehicle 1, a 1998 Ford Taurus four-door sedan was driven by a 24-year-old male (165 cm/65 in., 70 kg/154 lbs.), who was properly restrained by the available three-point manual lap and shoulder belt. The front, right seated position was occupied by a 22-year-old male (180 cm/71 in., 84 kg/185 lbs.), who was wearing the available three-point manual lap and shoulder belt. Vehicle 1 was traveling northbound in lane three at an undetermined rate of speed. Driver 1 entered the intersection while the overhead traffic signal was in the red signal phase. Vehicle 2, 1990 Plymouth Voyager minivan was driven by a 44-year-old female who police reported to be fully restrained by the three-point lap and shoulder belt. Driver 2 entered the intersection with the intention of continuing westbound. The full frontal plane of Vehicle 2 (70FDEW2) impacted the right side plane of Vehicle 1 (01RYEW3) in a “T”-type impact configuration. The total delta V for Vehicle 1 was calculated at 22.1 km/h (13.7 mph) and the longitudinal delta V was -19.1 km/h (-11.9 mph) which proved to be of sufficient force to deploy the frontal air bag systems. The delta V for Vehicle 2 was calculated at 25.1 km/h (15.6 mph) and sustained a lateral delta V of 21.7 km/h (13.5 mph). Vehicle 1 was deflected to the left and departed the northwest intersection quadrant coming to rest facing northwest. The driver of Vehicle 1 (case vehicle) sustained a left knee contusion (AIS-1) due to contacting the knee bolster. He also reported a lumbar strain (AIS-1) due to rebounding into the seatback support. The front, right seated occupant sustained a laceration to his right elbow (AIS-1) due to loading the right arm rest area and received a scalp laceration (AIS-1) due to flying glass fragments. The investigating police officer reported that driver 2 sustained a possible injury (no further information available). The driver and front, right passenger of Vehicle 1 were transported to a local hospital where they were treated for their injuries. The driver of Vehicle 2 was transported to a different hospital than the occupants of Vehicle 1.

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Summary

This remote investigation focused on the redesigned air bag system deployment of a 1998 Ford Taurus four-door sedan. This two vehicle crash took place during the afternoon hours in October of 1998. The weather was clear and the concrete roadway surface was dry with a positive 2.5% grade. This crash occurred at a busy, urban four-leg intersection. There are four, one-way, northbound travel lanes while the adjoining roadway is comprised of three, one-way, westbound travel lanes. Each leg of the intersection is bordered by curbing. The posted speed limit is 48 km/h (30 mph).

Figure 1. Vehicle 1's trajectory and Point of Impact

Vehicle 1, a 1998 Ford Taurus four-door sedan was driven by a 24-year-old male (165 cm/65 in., 70 kg/154 lbs.), who was properly restrained by the available three-point manual lap and shoulder belt. The front, right seated position was occupied by a 22-year-old male (180 cm/71 in., 84 kg/185 lbs.), who was wearing the available three-point manual lap and shoulder belt. Vehicle 1 was traveling northbound in lane three at an undetermined rate of speed. Driver 1 entered the intersection while the overhead traffic signal was in the red signal phase. Vehicle 2, 1990 Plymouth Voyager minivan was driven by a 44-year-old female who police reported to be fully restrained by the three-point lap and shoulder belt.

Figure 2. Vehicle 2's Pre-Impact Trajectory and Point of Impact Area

Driver 2 entered the intersection with the intention of continuing westbound. The full frontal plane of Vehicle 2 (70FDEW2) impacted the right side plane of vehicle 1 (01RYEW3) in a "T"-type impact configuration.

Figure 3. Right Side Damage to Vehicle 1

Figure 4. Frontal Damage to Vehicle 2

The total delta V for Vehicle 1 was calculated at 22.1 km/h (13.7 mph) and the longitudinal delta V was -19.1 km/h (-11.9 mph) which proved to be of sufficient force to deploy the frontal air bag systems. The delta V for Vehicle 2 was calculated at 25.1 km/h (15.6 mph) and sustained a lateral delta V of 21.7 km/h (13.5 mph)[1].

Figure 5. Post-Impact Trajectory and Final Rest of Vehicle 1

Vehicle 1 was deflected to the left and departed the northwest intersection quadrant coming to rest facing northwest. The driver of Vehicle 1 (case vehicle) sustained a left knee contusion (AIS-1) due to contacting the knee bolster. He also reported a lumbar strain (AIS-1) due to rebounding into the seatback support. The front, right seated occupant sustained a laceration to his right elbow (AIS-1) due to loading the right arm rest area and received a scalp laceration (AIS-1) due to flying glass fragments.

The investigating police officer reported that driver 2 sustained a possible injury (no further information available). The driver and front, right passenger of Vehicle 1 were transported to a local hospital where they were treated for their injuries. The driver of Vehicle 2 was transported to a different hospital than the occupants of Vehicle 1.

Table 1. Delta V

	Case Vehicle		Other Vehicle	
	km/h	mph	km/h	mph
Total	22.1	13.7	25.1	15.6
Longitudinal	-19.1	-11.9	-12.5	-7.8
Lateral	-11.0	-6.8	21.7	13.5

[1] Calculated using WinSmash Damage Only Routine

Exterior of Case Vehicle

Table 2. Vehicle Information

Model year, make and model	1998 Ford Taurus
VIN	1FAFP52U1WA
CDC	01RYEW3

Figure 6. Exterior, Vehicle 1 (Ford Taurus)

Figure 7. Close-up Showing Right Side Impact to Vehicle 1

Table 3. Crush Measurements

Plane of Impact	Field L cm/in.	C1 cm/in.	C2 cm/in.	C3 cm/in.	C4 cm/in.	C5 cm/in.	C6 cm/in.
Right Side-Mid Door Level	280	0	7	30	19	7	0
	110.2	0	2.8	11.8	7.5	2.8	0

Interior of Case Vehicle

The interior of the Ford Taurus sustained moderate damage mostly due lateral intrusion from right side components. The right B-pillar, both right side door panels, lower sill area and the right roof side rail were all displaced laterally due to the right side impact. The intruded values are reported in Table 4.Occupant contact scuff marks were documented to the knee bolster, right A-pillar and front, right door arm rest area.

Table 4. Intrusions

Intruded Component	Location of Intrusion	Intruded Value cm/in.		Dominant Crush Direction
B-Pillar	Front, Left	22	8.7	Lateral
Door Panel (Side)	Front, Right	19	7.5	Lateral
Door Panel (Side)	Second Seat, Right Side	18	7.1	Lateral
Sill	Front, Right	13	5.1	Lateral
Sill	Second Seat, Right Side	11	4.3	Lateral
Second Seat back	Front, Right	10	3.9	Lateral
Seat Cushion	Front, Right	6	2.4	Lateral
Roof Side Rail	Front, Right	5	2.0	Lateral

This vehicle was equipped with front bucket seats that had adjustable seat backs. Both front seats can be adjusted longitudinally on seat track mechanisms. The front, left bucket seat was adjusted between the middle and rear-most position while the front, left bucket seat was adjusted at the rear most seat track position. It was equipped with adjustable head restraints-which were not damaged.

Case Vehicle Occupant Protection Systems

Figure 8. Interior of case vehicle showing drivers and passenger frontal air bags.

The Ford Taurus four-door sedan was equipped with a redesigned air bag system which consisted of two frontal primary crash sensors located over the front left and front right wheel wells. The air bag diagnostic monitor is located in the center console, just below the instrument panel and left of the vehicle centerline. The diagnostic monitor consists of both a sending and return feed monitor for both frontal air bag units. An air bag diagnostic lamp is located in the front left mid-instrument panel area and PIN #7 within the air bag diagnostic monitor is designated to the lamp circuit function (refer to attached Air Bag Component Mapping Location Views). There is an air bag module located in the front left (steering wheel hub) and front right (top mount) which house the air bags and inflator units. The front seats are equipped with active three-point lap and shoulder restraints with adjustable height anchorage adjustments.

The front, left air bag was housed in the steering wheel hub and was concealed by symmetrical double hoizontal module cover flaps. The circular air bag had two tether straps and two exhaust vent port holes. The lower instrument panel is equipped with a rigid plastic knee bolster**.** A small scuff mark was noted to the lower right area of the knee bolster**.**

The front, right air bag was located on the instrument panel, top surface plane. The module cover flap is symmetrical and oblong with rounded flap corners**.** The module cover and air bag broke the laminated windshield glazing upon impact**.** There were small tears located on the right side of the air bag due to flying side window glazing fragments**.** There were blood fluid deposits noted to the bottom surface of the air bag and were likely due to the injured passenger coming into contact with the fabric post-impact. The passenger had a scalp laceration and a right elbow laceration.

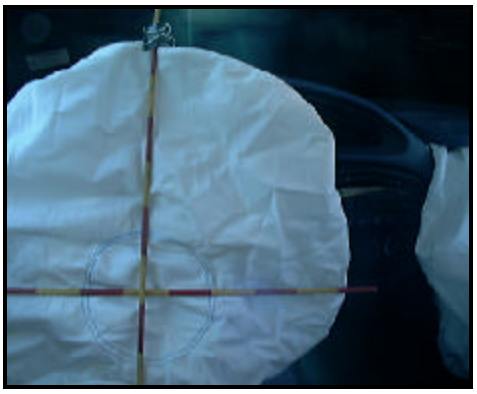


Figure 9. View showing deployed drivers air bag

Figure 10. Right lateral views of passenger air bag showing small tears

Figure 11. View of blood deposits to bottom of passenger air bag

Case Vehicle Occupant Demographics

	Occupant 1	Occupant 2
Age/Sex:	24/Male	22/Male
Seated Position:	Front Left	Front Right
Seat Type:	Bucket-cloth covered	Bucket-cloth covered
Height (cm/in:):	165 64.96	180 70.87
Weight (kg/lbs).:	70 154.3	84 185.2
Pre-existing Medical Condition:	None Reported	None Reported
Body Posture:	Normal/ Upright	Normal/Upright
Hand Position:	Unknown	Unknown
Foot Position:	Right foot on accelerator pedal. Left foot on floor panel	Both feet on floor panel
Restraint Usage:	Active, three-point lap and shoulder belt	Active, three-point lap and shoulder belt
Air bag:	Driver air bag deployed as a result of the right side impact	Passenger air bag deployed as a result of the right side impact.

Occupant Injuries

Table 5. Injuries

Injury	Injury Severity (AIS)	Injury Mechanism
Driver/Occupant #1- Left Knee Contusion	1	Knee bolster
Driver/Occupant #1- Lumbar strain	1	Seat back support
Occupant #2 - Scalp laceration	1	Flying glass
Occupant #2 - Right Elbow Laceration	1	Right side hardware or armrest

Occupant Kinematics

The 24 year old male driver of the Ford Taurus was fully restrained by the available three-point manual lap and shoulder belt. He was reportedly in a normal, upright driver posture, pre-crash.

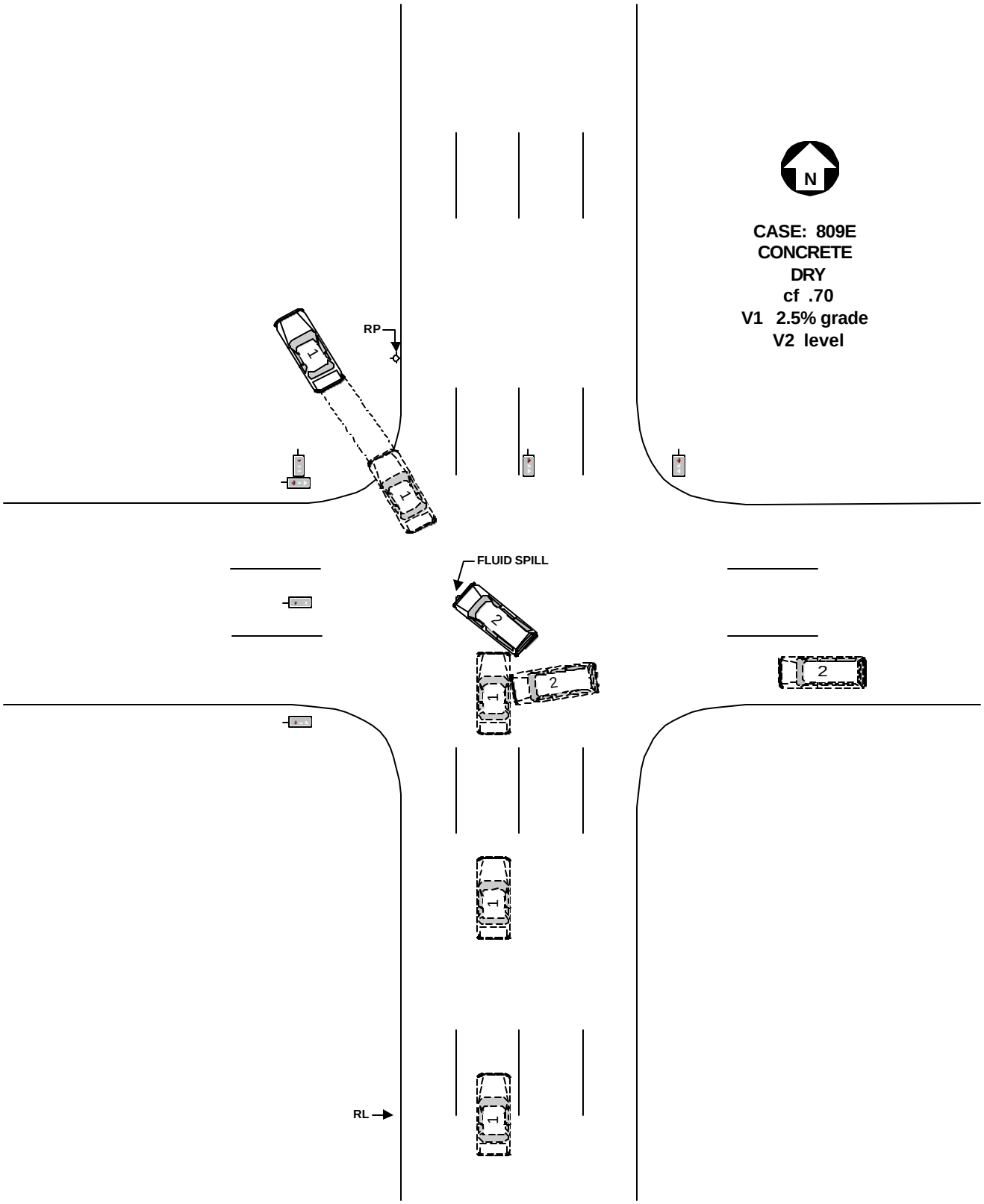
The driver responded to the 30 degree impact force by moving forward and to the right. He loaded the lap portion of the lap belt which prohibited continued movement of his lower torso. His knees contacted the knee bolster which resulted in a left knee contusion (AIS-1). His upper torso pitched forward loading the shoulder belt webbing and simultaneously contacting the deploying drivers air bag. He rebounded into the seat back support which resulted in a lumbar strain (AIS-1).

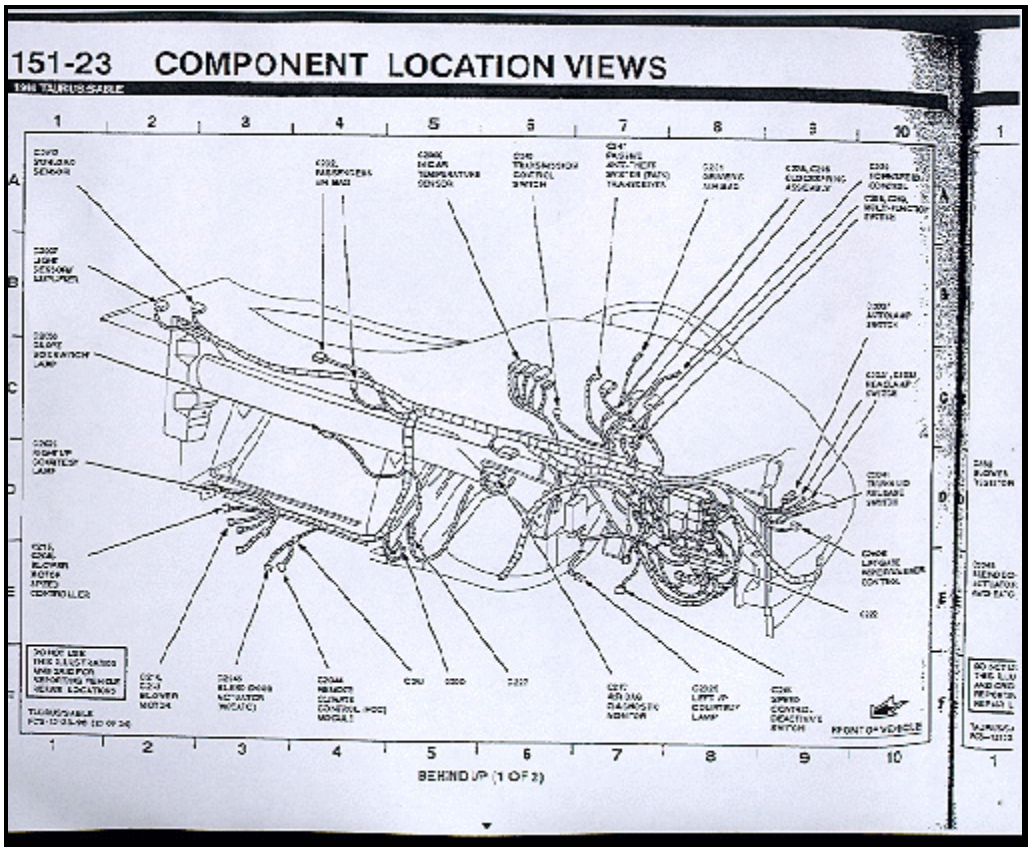
The 22 year old male who occupied the front, right seated position was also wearing the available three-point manual lap and shoulder belt. He responded to the 1 o'clock direction of force by moving forward and slightly to the right. He loaded the lap belt webbing which secured his lower torso from continued forward motion. His right elbow was lacerated (AIS-1) when it came into contact with the intruding right front door panel/ armrest and hardware. He also sustained a laceration (AIS-1) to the right side of his scalp due to flying glass fragments. At some point (post-crash), his bleeding right elbow came into contact with the bottom surface of the passenger air bag fabric. Residual blood stains were noted to the air bag fabric.

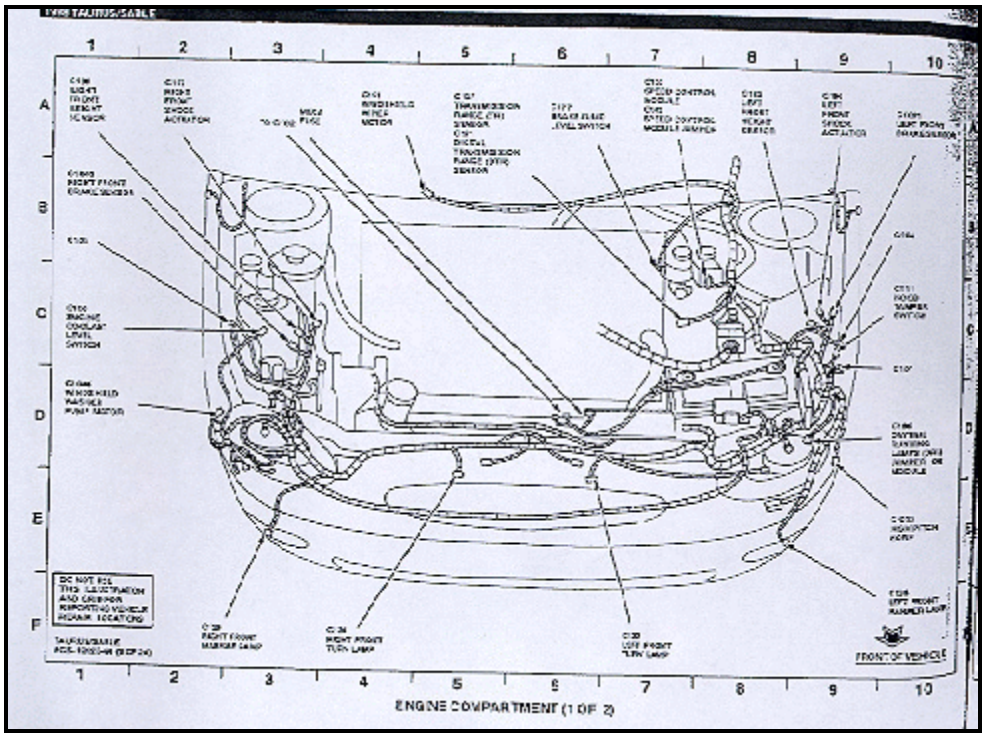
Figure 12. View showing drivers seated position

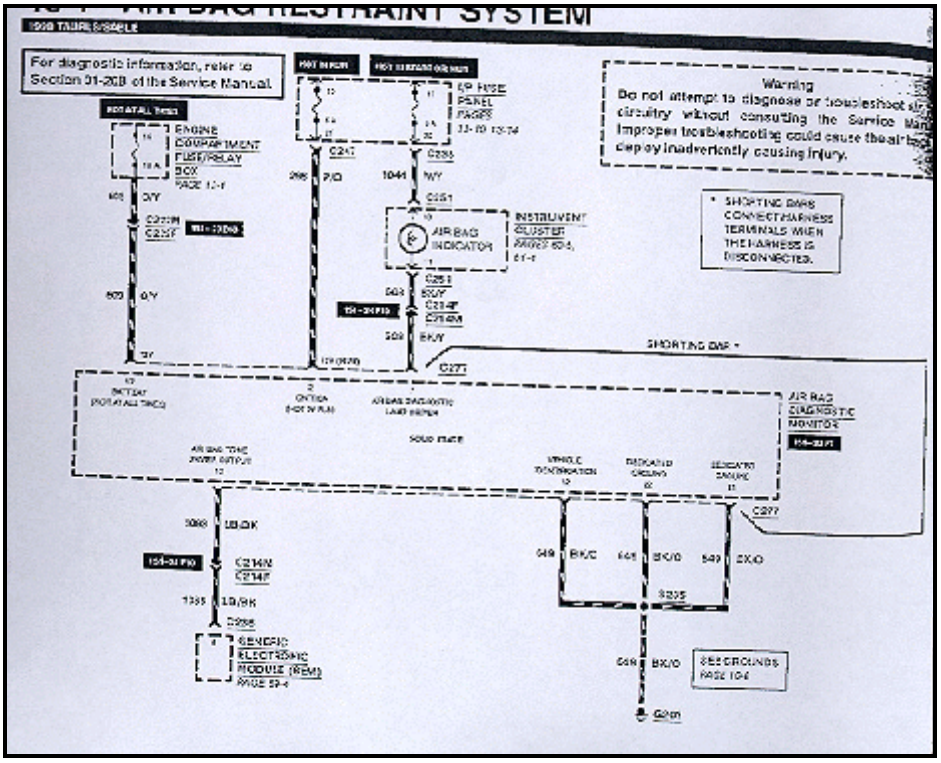
Figure 13. View showing passenger seated position

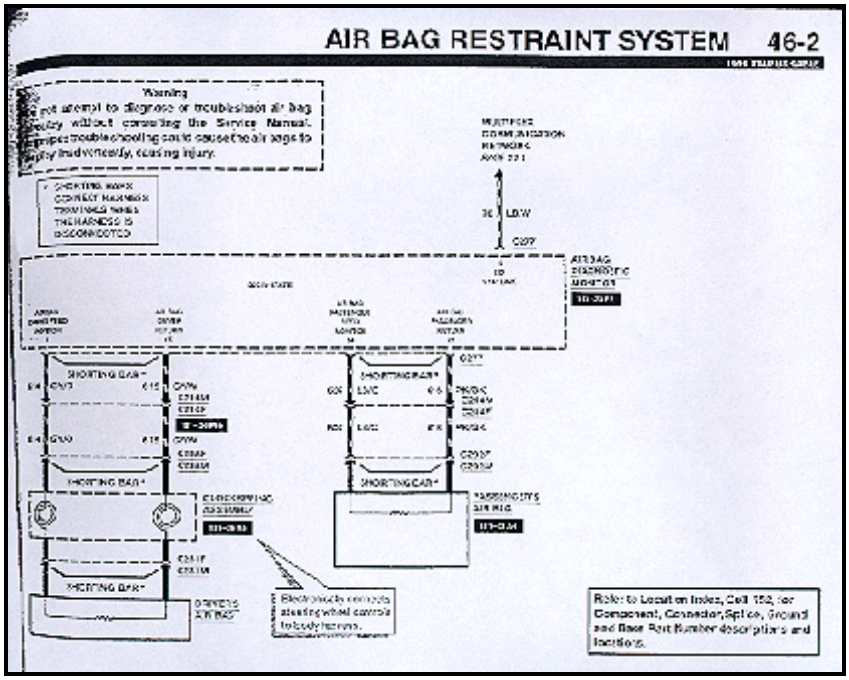
Scene Diagram




151-23 COMPONENT LOCATION VIEWS
1996 TAURUS/SABLE
BEHIND I/P (1 OF 2)


1996 TAURUS/SABLE
ENGINE COMPARTMENT (1 OF 2)


AIR BAG RESTRAINT SYSTEM
For diagnostic information, refer to Section 01-20B of the Service Manual.
Warning
Do not attempt to diagnose or troubleshoot air bag circuitry without consulting the Service Manual. Improper troubleshooting could cause the air bags to deploy inadvertently causing injury.
* SHORTING BARS CONNECT HARNESS TERMINALS WHEN THE HARNESS IS DISCONNECTED.
ENGINE COMPARTMENT FUSE/RELAY BOX
INSTRUMENT CLUSTER
AIR BAG INDICATOR
SHORTING BAR *
AIR BAG DIAGNOSTIC MONITOR
SOLID STATE
GENERIC ELECTRONIC MODULE (GEM)
RECEPTACLE
SHORTING BAR *


AIR BAG RESTRAINT SYSTEM 46-2
Warning
SHORTING BAR *
SHORTING BAR *
SHORTING BAR *
SHORTING BAR *
Refer to Location Index, Cell 152, for Component, Connector, Splice, Ground and Base Part Number descriptions and locations.