Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (1998-74-804E)

1998 Mercury Sable

Nebraska

October / 1998

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16. Abstract

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Mercury Sable four-door sedan. This two vehicle, offset, head-on impact configuration occurred during the late morning hours of a weekday in early October, 1998. There was a negative grade for Vehicle1 (>2%) and a positive grade for Vehicle 2 (>2%). The concrete roadway surface was dry and the crash occurred within a four-leg intersection in business oriented vicinity. The north and southbound legs are comprised of a divided five lane roadway. The east and westbound adjoining roadway is a two lane undivided roadway. There is an overhead traffic signal that regulates the traffic flow and the posted speed limit is 72 km/h (45 mph). Vehicle 1, a 1998 Mercury four-door sedan, was driven by a 61 year-old-female (170 cm/ 67 in., 76 kg/168 lbs.) who was wearing the available three-point, manual lap and shoulder belt. Driver 1 was traveling southbound in lane 3 which is a left turn lane. The overhead traffic signal was in the green phase as Driver 1 initiated a left turn. Vehicle 2, a 1991 Honda Accord four-door sedan, was driven by a 48 year-old-female, who was reported to have been wearing the three-point lap and shoulder restraint. Driver 2 was in lane 3 of the southbound travel lanes, approaching the intersection at an undetermined rate of speed. Driver 2 entered the intersection while the overhead traffic signal was in the green phase. As Vehicle 1 (Mercury Sable) turned left at the intersection, the front, left corner of Vehicle 2 (11FYEW1) impacted the front of Vehicle 1(81FDEW2) in an obtuse, front to front impact configuration. The calculated delta V was 13.6 km/h (8.4 mph) for Vehicle 1 with a longitudinal delta V of -11.8 km/h (7.3 mph) which was at the borderline threshold necessary for air bag deployment. Vehicle 2 underwent a calculated delta V of 16.6 km/h (10.3 mph). Vehicle 1 rotated approximately 115 degrees in a counterclockwise rotation and was deflected in a northerly direction. Vehicle 1 came to rest facing northeast and was straddling the northbound travel lane. Vehicle 2 was deflected to the right and subsequently departed the roadway at the northeast intersection quadrant where it came to rest facing northeast. The driver of Vehicle 1 sustained a comminuted fracture of the distal fibula bimalleolar (AIS-2) and a oblique fracture of the left distal tibia medial malleolous (AIS-2). She also sustained contusions of the chest (shoulder belt webbing) , hip (lap belt webbing), thigh(steering wheel rim) and left knee (knee bolster). In addition, Driver 1 sustained a right wrist abrasion (air bag) an abrasion of the left knee (knee bolster) and a cervical neck strain attributed to the deploying air bag unit. The driver of Vehicle 2 was apparently injured, however, the severity of her injuries is unknown.

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Summary

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Mercury Sable four-door sedan. This two vehicle, offset, head-on impact configuration occurred during the late morning hours of a weekday in early October, 1998. There was a negative grade for Vehicle1 (>2%) and a positive grade for Vehicle 2 (>2%). The concrete roadway surface was dry and the crash occurred within a four-leg intersection in business oriented vicinity. The north and southbound legs are comprised of a divided five lane roadway. The east and westbound adjoining roadway is a two lane undivided roadway. There is an overhead traffic signal that regulates the traffic flow and the posted speed limit is 72 km/h (45 mph).

Vehicle 1, a 1998 Mercury four-door sedan, was driven by a 61 year-old-female (170 cm/ 67 in., 76 kg/168 lbs.) who was wearing the available three-point, manual lap and shoulder belt. Driver 1 was traveling southbound in lane 3 which is a left turn lane. The overhead traffic signal was in the green phase as Driver 1 initiated a left turn. Vehicle 2, a 1991 Honda Accord four-door sedan, was driven by a 48 year-old-female, who was reported to have been wearing the three-point lap and shoulder restraint.

Driver 2 was in lane 3 of the southbound travel lanes, approaching the intersection at an undetermined rate of speed. Driver 2 entered the intersection while the overhead traffic signal was in the green phase. As Vehicle 1 (Mercury Sable) turned left at the intersection, the front, left corner of Vehicle 2 (11FYEW1) impacted the front of Vehicle 1(81FDEW2) in an obtuse, front to front impact configuration.

The calculated delta V was 13.6 km/h (8.4 mph) for Vehicle 1 with a longitudinal delta V of -11.8 km/h (7.3 mph) which was at the borderline threshold necessary for air bag deployment. Vehicle 2 underwent a calculated delta V of 16.6 km/h (10.3 mph).

Figure 1. Pre-impact trajectory of Vehicle 1

Figure 2. Pre-impact trajectory of Vehicle 2

Figure 3. Exterior deformation to Vehicle 1 (Mercury Sable)

Figure 4. Exterior deformation to Vehicle 2 (Honda Accord)

Vehicle 1 rotated approximately 115 degrees in a counterclockwise rotation and was deflected in a northerly direction. Vehicle 1 came to rest facing northeast and was straddling the northbound travel lane. Vehicle 2 was deflected to the right and subsequently departed the roadway at the northeast intersection quadrant where it came to rest facing northeast.

The driver of Vehicle 1 sustained a comminuted fracture of the distal fibula bimalleolar (AIS-2) and a oblique fracture of the left distal tibia medial malleolous (AIS-2). She also sustained contusions of the chest (shoulder belt webbing) , hip (lap belt webbing), thigh (steering wheel rim) and left knee (knee bolster). In addition, Driver 1 sustained a right wrist abrasion (air bag) an abrasion of the left knee (knee bolster) and a cervical neck strain attributed to the deploying air bag unit. The driver of Vehicle 2 was apparently injured, however, the severity of her injuries is unknown.

Table 1. Delta V[1]

	Case Vehicle		Other Vehicle	
	km/h	mph	km/h	mph
Total	13.6	8.5	16.6	10.3
Longitudinal	-11.8	-7.3	-14.4	-8.9
Lateral	-6.8	-4.2	8.3	5.2

Exterior of Case Vehicle

Table 2. Vehicle Information

Model year, make and model	1998 Mercury Sable
VIN	1MEFM53S1WG
CDC	01FDEW2

Figure 5. Exterior, Vehicle 1 (1998 Mercury Sable)

Figure 6. Exterior, Vehicle 2 (1991 Honda Accord)

[1] Calculated using the Damage Only mode of the WinSmash 1.2.1 program

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.
Front Bumper	152	10	4	6	9	14	24
	59.8	3.9	1.6	2.4	3.5	5.5	9.4

Interior of Case Vehicle

The interior of the Mercury Sable sustained minor damage which can be attributed to the passenger side, air bag deployment. The front, right passenger air bag module flap (top mount) impacted and broke the laminated windshield glazing. The passenger air bag apparently impacted and dislodged the center, rear view mirror during the deployment The passenger compartment maintained its integrity and there were no intruding components. The case vehicle is equipped with front bucket seats with a rear bench seat with a folding seatback. The driver's seat was adjusted to the rearmost track position while the right, front seat was adjusted at the middle position. The front seats have adjustable head restraints which were not damaged during the collision. The rear, outboard seated positions are equipped with integral head restraints.

Figure 7. Interior of case vehicle

Figure 8. View showing the deployed driver's air bag

Case Vehicle Occupant Protection Systems

The Mercury Sable four-door sedan was equipped with a redesigned air bag system which consists of a single, centrally located electronic crash sensor (ECS)[2]. This crash sensor is located on top of the center console, adjacent to the floor heater duct. The ECS discriminates between those events that warrant deployment and those that do not. In addition the ECS signals the air bag indicator lamp when fault is identified or when the system is ready.

The front, left air bag was housed in the steering wheel hub and was concealed by asymmetrical H-configuration cover flaps. The concentrical air bag was 672 mm (26.5 in.) in diameter and was equipped with two tether straps and two exhaust vent ports. At full inflation, the air bag volume is 2.0 cubic feet and fully inflates in approximately 40 milliseconds. The nylon air bag fabric was void of any detectable occupant contact points.

Figure 9. View showing the deployed passenger air bag

[2] Refer to the attached 1998 Taurus/Sable Passive Restraint Systems and Wiring Views

The front, right air bag unit was located on the top surface plane of the instrument panel, above the glove compartment. The module flap cover is a “D”-shape and opened at its designated tear points. The porous nylon air bag material is not equipped with tethers or vent ports. The air bag fills to a total volume of 5.1 cubic feet. There were no indications of damage or contact to either the air bag or the module cover flap.

Case Vehicle Occupant Demographics

	Occupant 1	
Age/Sex:	61/Female	
Seated Position:	Front Left	
Seat Type:	Bucket	
Height (cm/in:):	170	66.93
Weight (kg/lbs).:	76	167.6
Pre-existing Medical Condition:	None Reported	
Body Posture:	Normal/Upright, presumably facing forward her right foot on accelerator pedal and left foot on floor	
Hand Position:	Both hands were reportedly on steering wheel rim/unknown position	
Foot Position:	Right foot on accelerator pedal, left foot on floor	
Restraint Usage:	Manual, three-point lap and shoulder belt	
Air bag:	Drivers air bag deployed as a result of the frontal impact	

Occupant Injuries

Table 4. Injuries

Injury	Injury Severity (AIS)	Injury Mechanism
Left chest contusion	1	Shoulder belt webbing
Right wrist abrasion	1	Air bag
Right hip contusion	1	Lap belt webbing
Right thigh contusion	1	Lower steering wheel rim
Left knee abrasion	1	Knee bolster
Left knee contusion	1	Knee bolster
Cervical Strain	1	Air bag
Left, distal oblique tibia fracture	2	Toe pan
Left, distal fibula comminuted fracture	2	Toe pan

Occupant Kinematics

The 61 year-old-female driver of the 1998 Mercury Sable fully restrained by the available three-point, manual lap and shoulder belt. She was in an upright position and was reportedly in a normal seated fashion. She had both hands on the steering wheel rim, however, the exact position is unknown. Her right foot was on the accelerator pedal and her right foot was on the floor.

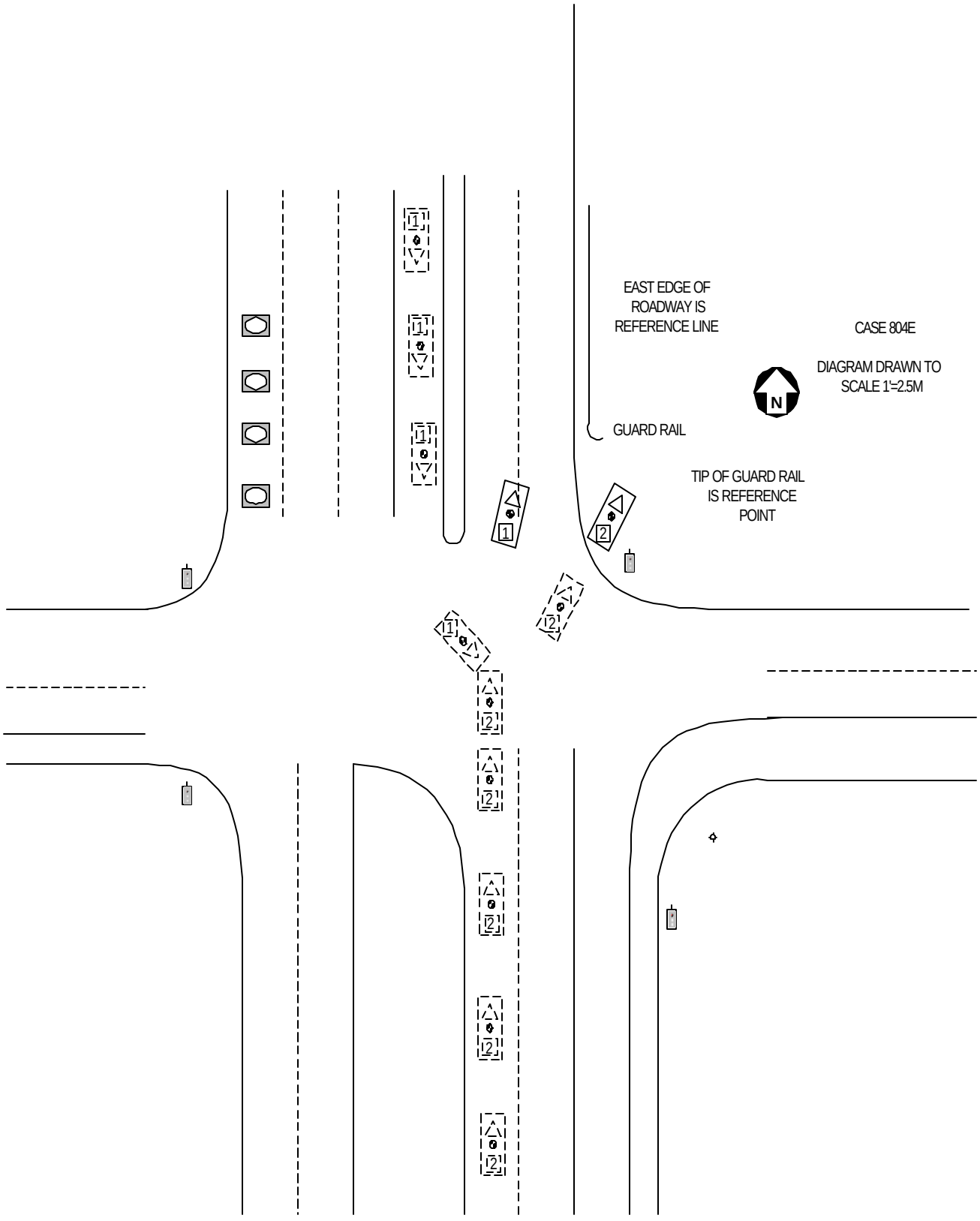
Figure 10. View showing driver's seated position

Driver 1 responded to the 1 o'clock direction of force by moving forward and to her right. Her upper torso loaded the applied shoulder belt webbing which resulted in a contusion to her left chest region (AIS-1). Her lower torso was prohibited from extended forward motion as she loaded the lap belt webbing. She sustained a right hip contusion due to the lap belt. Her left knee made contact with the knee bolster which resulted in an abrasion and contusion (AIS-1). Her right thigh impacted the lower steering wheel rim which resulted in an area of contusion (AIS-1). As the air bag deployed, her chest and head probably contacted the air bag fabric. She sustained a right wrist abrasion (AIS-1) as the air bag deployed and a cervical neck strain.

Figure 11. Deployed driver's air bag

The driver's most serious injuries came as a result of her left foot significantly loading the toe pan. She sustained a comminuted fracture of her left distal fibula (AIS-2) and an oblique fracture of her left distal tibia (AIS-2). She rebounded back into the seatback support as she came to rest.

Scene Diagram



ıts, Passive—Supplemental Air Bag

ve air bag supplemental restraint system esigned to provide increased collision for front seat occupants **IN ADDITION TO** ed by the three point safety belt system.

elt use is necessary to obtain the best t protection and to receive the full ges of the supplemental air bag.

ECOMMENDS THE USE OF SAFETY YSTEMS FOR ALL VEHICLE ANTS.

Section 01-20A for information on the lt restraint system.

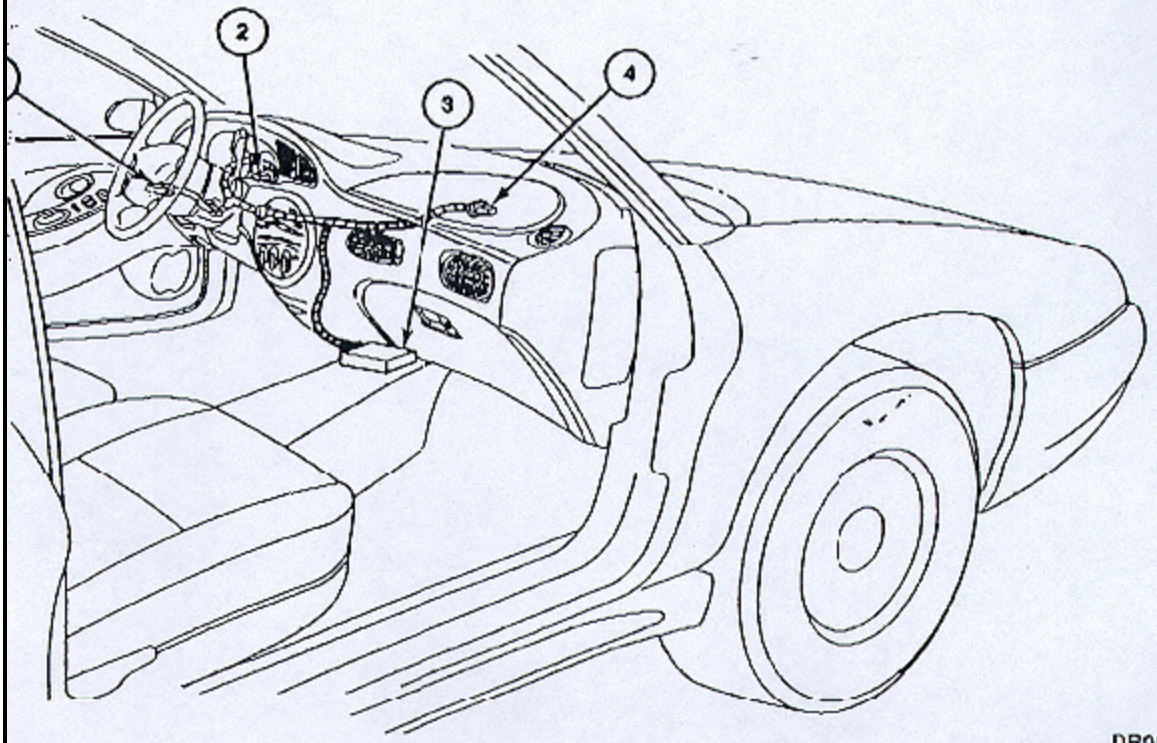
The SRS consists of two basic subsystems:

- driver air bag module and passenger air bag module
- electrical system, including air bag electronic crash sensor (ECS) module

The subsystem components are located as follows:

- driver air bag module—steering wheel (3600)
- passenger air bag module—above glove compartment (06010)
- air bag sliding contact (14A664) —behind steering wheel
- electronic crash sensor (ECS) module — on the center tunnel under instrument panel (04320)

t Location



DR0548-A

Part umber	Description
13	Driver Air Bag Module
	Air Bag Warning Indicator (Part of 04320)

Item	Part Number	Description
3	14B321	Air Bag Electronic Crash Sensor (ECS) Module
4	044A74	Passenger Air Bag Module

DESCRIPTION AND OPERATION (Continued)

Air Bag Module, Driver

NOTE: The driver air bag module is serviced as a complete assembly. Perform proper disposal procedure as described.

The driver air bag module is mounted in the center of the steering wheel (3600). The driver air bag module consists of the following components:

- inflator
- air bag
- mounting plate and retainer ring
- steering wheel trim cover

Inflator

The inflator assembly is not a serviceable item.

- When the sensors close, signaling a crash, electrical energy flows to the air bag inflator.
- Inside the inflator, an igniter converts the electrical signal to thermal energy (heat), causing the ignition of the inflator gas generant.
- This ignition reaction causes combustion of the sodium azide/cupric oxide gas generant in the inflator, producing nitrogen gas which inflates the air bag.

Air Bag

The driver air bag:

- is constructed of nylon.
- is 672 mm (26.5 inches) in diameter.
- fills to a volume of about 0.057 cubic meter (2.0 cubic feet) in approximately 40 milliseconds.
- is not a serviceable item.

Mounting Plate and Retainer Ring

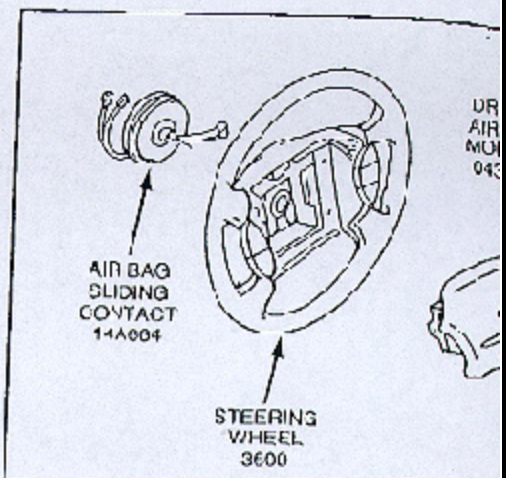
The mounting plate and retainer ring:

- attach and seal the air bag assembly to the inflator.
- also attach the trim cover and mount the entire driver air bag module to the steering wheel.
- are components of the driver air bag module and cannot be serviced.

Steering Wheel Trim Cover

The steering wheel trim cover:

- encases driver air bag module.
- has moulded-in tear seams that separate to allow inflation of the bag.
- is a component of the driver air bag module and is not serviceable.
- must not be repainted for any reason.



Air Bag Module, Passenger

NOTE: The passenger air bag module is servi
complete assembly. Perform proper disposal
procedure as described.

The passenger air bag module is mounted in th
position of the instrument panel (04320) above
glove compartment (06010). The passenger
module consists of the following components:

- inflator
- air bag
- reaction housing with mounting hardware
- trim cover

Inflator

The passenger air bag inflator operates as follo

- An igniter inside the inflator converts electric
energy to thermal energy (heat), causing ign
the gas generant.
- The ignition reaction causes combustion of th
potassium nitrate gas generant, producing n
to fill the bag.
- The passenger air bag module is much large
the driver air bag module, more gas is releas
the passenger air bag inflator to fill the large
passenger air bag.
- It is a component of the passenger air bag m
and is not serviceable.

Air Bag

The passenger air bag:

- is constructed of nylon.
- fills to a volume of approximately 0.145 cubic
(5.1 cubic feet).
- is not a serviceable item.