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**The Air Bag Systems in Your Car
"What the Public Needs to Know"**

1. **Scope**—This SAE Information Report provides basic information about supplemental air bag systems. This report is made available by SAE as a service to the public to explain the value of these systems as they improve the safety of motor vehicles. It also addresses some misconceptions and answers many questions about the operation of air bag systems.
 - 1.1 **Rationale**—This document has been cancelled due to its outdated content and diminished need. The NHTSA has established and maintains a reference for this information on their website <http://www.safercar.gov> which is up to date and consistent with current laws and regulations.
2. **References**—There are no referenced publications specified herein.
3. **What is an Air Bag?**
 - 3.1 **Passive/Automatic Crash Protection**—On September 1, 1989, all new cars sold in the United States were required to have an automatic crash protection system as standard equipment. Air bags provide the automatic crash protection.

Air bag systems help reduce the severity of torso, head, and facial injuries. Highway fatality rates have been reduced as air bags are installed on more vehicles. While air bags have significantly improved the safety of motor vehicles, they are not designed nor intended to be a substitute for safety belts. Safety belts help to secure occupants in all kinds of collisions, and they keep the occupant in position to receive the maximum benefit from an air bag in frontal or near-frontal collisions. This is why air bag systems are usually referred to as "supplemental" restraint systems.

According to the National Highway Traffic Safety Administration (NHTSA), in 1997, 32 213 occupants of passenger vehicles (cars, light trucks, vans, and utility vehicles) were killed in motor vehicle traffic crashes, 77% of the 41 967 traffic fatalities reported for the year. Among passenger vehicle occupants over 4 years old, safety belts saved an estimated 10 750 lives in 1997.

Research has found that lap/shoulder safety belts, when used, reduce the risk of fatal injury to front-seat passenger car occupants by 45% and the risk of moderate-to-critical injury by 50%. For light truck occupants, safety belts reduce the risk of fatal injury by 60% and moderate-to-critical injury by 65%.

Recent NHTSA analyses indicate an overall fatality-reducing effectiveness for air bags of 11%. Research on the effectiveness of child safety seats has found them to reduce fatal injury by 69% for infants (less than 1 year old) and by 47% for toddlers (1 to 4 years old).

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3.2 Air Bags are Supplemental to Seat Belts—Whether or not your vehicle is equipped with air bags, you must wear a safety belt. Safety belts are an occupant's primary restraint because they are designed to reduce the risk of injury in most types of crashes, including low-speed-frontal, rear-end, side, rollover, and multiple collisions. In these types of crashes, safety belts help to keep occupants from being thrown from the vehicle, and reduce the chances and severity of contacting the vehicle's interior. Air bags are designed to supplement the protection offered by safety belts in moderate to severe frontal or near-frontal collisions. However, field data have demonstrated only 10% of all accidents are significant enough to require deployment of air bags. Even in collisions where air bags deploy, it is important that a safety belt be worn to insure that the occupants are in the proper seating position to receive the maximum benefit from both the belts and air bags. Most injuries from an inflating air bag are minor, such as facial abrasions and bruises. However, the risk of these injuries can be reduced if an occupant sits back comfortably in the seat and wears a safety belt. For a driver, sitting back in the seat means he or she can still maintain the ability to operate the vehicle and its controls safely.

In a frontal crash, the vehicle begins to stop when an impact occurs, but the occupants continue to move forward at the vehicle's original speed. Unbelted occupants or occupants wearing improperly adjusted belts impact the windshield, instrument panel, or the steering wheel, possibly causing severe injuries. Occupants wearing properly adjusted safety belts are stopped more gradually by the belts as the car stops because the safety belts distribute the vehicle's energy of motion more evenly across the body. In more severe collisions, however, even belted occupants could contact objects in the vehicle's interior because their forward motion is so great that they contact the interior before the belts can bring them to a complete stop.

Air bags supplement the safety belts by reducing the chances of such contact with the vehicle's interior and by distributing the impact more evenly over an occupant's head and torso. Air bags help absorb the energy of the driver and passenger. Motorists should realize, however, that the use of safety belts is critical to keeping them in position so that the air bags can provide the intended benefit to the occupants in the event of a frontal or near-frontal collision.

Some vehicles are equipped with side air bags to supply additional protection in the event of a side impact. The side impact air bag system supplements the protection offered by the doors and the vehicle structure. The side impact air bag system deploys an air bag from the side of the seat. A side crash of sufficient force will deploy a side air bag.

In addition, some vehicles are equipped with seat belt pretensioners. The seat belt pretensioners remove slack from the seat belts during a collision. The system deploys the seat belt pretensioners with the air bags. Pretensioners work only once. If they activate in a crash, they will have to be replaced to ensure proper operation.

3.3 Identifying Vehicles Equipped With Air Bags—Words or initials such as “Air Bag,” “SRS” (Supplemental Restraint System), or “SIR” (Supplemental Inflatable Restraint) may be embossed somewhere on the surface of the steering wheel hub and/or on the instrument panel for vehicles equipped with a passenger-side air bag. The vehicle identification number (VIN) may also indicate the presence of an air bag. Some manufacturers indicate the presence of an air bag system by placing placards under the hood and on the driver-side windshield pillar. Air-bag-equipped vehicles include a label somewhere in the passenger compartment making reference to the air bag system and any applicable maintenance requirements. The location differs but most manufacturers place the label on a sun visor or inside the glove box.

The driver's air bag is stored within the steering wheel hub, concealed by a trim cover which provides a neat, totally integrated appearance (Figure 1). The passenger's air bag is concealed within the instrument panel. The bag is secure within the module and deploys quickly through its cover in a precise fashion in a frontal or near-frontal collision.

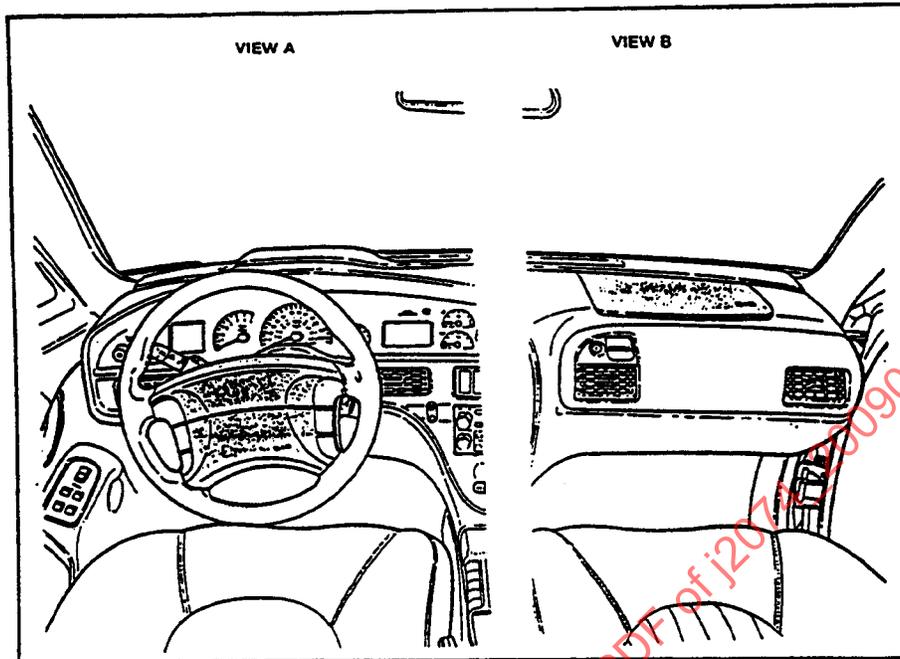


FIGURE 1—AIR BAG MODULE FOR DRIVER—VIEW A, AND PASSENGER MODULE—VIEW B

Some vehicles are equipped with an air bag disabling switch. The switch gives the vehicle operator the ability to enable or disable the passenger front air bag deployment should the vehicle be involved in a collision. The operator may choose to disable the passenger side air bag if there is no occupant in the front seat, or if there is a child in a rear-facing child seat in the front seat. An indicator light on the disabling switch informs the occupants the switch has disabled the air bag.

Air-bag-equipped cars have an indicator light on the instrument panel that lets the driver know about the status of the air bag system. The vehicle owner's manual explains the function of this light and whether a vehicle manufacturer has specified any maintenance or inspection requirements to ensure that the air bag system is in working order. Most air bag systems, however, do not require routine maintenance.

4. **How the System Works**

- 4.1 **How an Air Bag Inflates**—In a frontal or near-frontal impact of sufficient severity (comparable to a collision into a solid wall at a speed of 10 to 14 mph or above), sensors in the vehicle detect the sudden deceleration and send an electrical signal to the air bag module to trigger the inflator. This event causes the material, which is made of sodium azide, alcohol, Hydrogen, compressed Argon gas or some other compound sealed inside the inflator, to undergo a rapid chemical reaction that produces primarily nitrogen gas. This is the same gas that makes up 80% of the air we breathe.

The nitrogen gas inflates a sturdy fabric bag packed inside the steering wheel hub for the driver and the instrument panel for the front passenger. Upon inflation, the protective cover opens and the bag inside inflates in front of the occupant. As an occupant contacts the air bag, the nitrogen gas is vented through openings in the sides of the bag, thus absorbing the forward motion of the occupant's impact. While the gas is hot inside the bag, it cools rapidly when vented to the passenger compartment. Air bags inflate in less than one-twentieth of a second, which is less than a third of the time it takes to blink an eye, and they begin to deflate immediately.

In many crashes severe enough to inflate an air bag, the vehicle's windshield may be broken by vehicle deformation. Additional windshield breakage may also occur from the right front passenger air bag being deployed.

Air bags are designed to inflate only once and cannot be reused. After an air bag inflates, new air bag modules and possibly other parts will need to be installed. The service manual for your vehicle explains the requirement to replace other parts.

- 4.2 Sensor Systems**—Vehicles can have multiple sensors used to trigger air bag inflation. These sensors are designed to help discriminate between significant and minor collisions. Sensors are not interchangeable. Each sensor is calibrated to a specific vehicle model and mounting location. This calibration ensures proper deployment for a specific vehicle's ability to withstand collisions of various types and levels of severity.

5. Common Misconceptions

- 5.1 Smoke and Residue**—Smoke and residue from the deployment of air bags, which are the result of chemical reactions, are normal and not harmful. The air bags are not burning or ruptured. Chemical analysis of the smoke and dust shows little reason for concern. The powdery residue which occurs after air bag deployment consists largely of corn starch or talcum powder and sodium compounds. This dust is used to keep the bag from sticking to itself when it is folded inside the module and to help the bag inflate. Trace amounts of sodium hydroxide dust are produced that interact with moisture in the air to convert quickly to sodium carbonate and sodium bicarbonate (baking soda). Very small deposits of sodium hydroxide may be a temporary irritant if they contact the skin or eyes. However, this material poses little long-term health hazards. The powder is slightly alkaline, but is not considered toxic.

After air bags inflate, no detectable amount of harmful materials will be present in the passenger compartment because it is converted chemically into nontoxic nitrogen and carbon dioxide. There is virtually no chance that you or rescue workers would ever contact harmful chemicals.

- 5.2 Inadvertent Deployment**—The sensors that trigger inflation of the air bags are deceleration switches that are activated by significant crashes only. Air bags cannot be triggered by sudden braking or any similar circumstance. Slamming doors, sitting on the hood, or manually shaking the bumper will not create an impact strong enough to activate the sensors. It is highly unlikely that air bags will inflate when driving over rough or uneven pavement. The sensors are designed to discriminate between sudden stops and significant frontal or near-frontal collisions. In fact, the maximum force generated by the braking system is only about 1/10 of that necessary to activate the air bag system.

- 6. Child Restraints and Air Bags**—Children or infants riding in a motor vehicle must always be properly restrained. This is especially true in vehicles with air bags. Children, as with any occupants that are not properly restrained, are at a much greater risk of injury in a crash. There is also the additional risk of injury from the inflating air bag if the child is near or against it as it inflates (Figure 2). The best way to minimize that risk is to have the child properly restrained in the rear seat of the vehicle.

The speed and force of an inflating air bag poses a particular risk for rearward-facing infant/child restraints in the front seats of vehicles with front-passenger air bags. These restraints are often very close to the location in the instrument panel where the air bag will emerge during its inflation. If the inflating air bag strikes the infant restraint, the back of the restraint may be accelerated into the infant's head. Because of this risk, rearward-facing infant restraints should never be placed in seating positions that have a passenger air bag. Instead, an infant restraint should be placed in the rear seat.

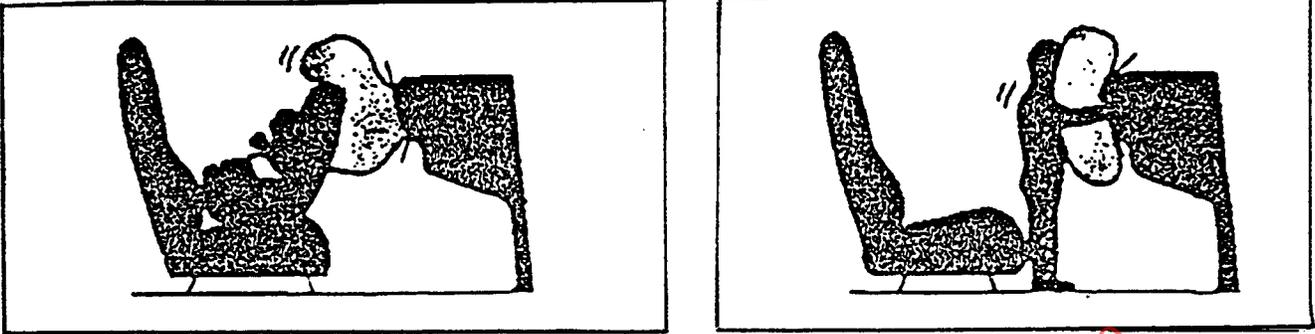


FIGURE 2—HOW AN AIR BAG AFFECTS INFANT/CHILD RESTRAINTS OR A STANDING, OUT-OF-POSITION CHILD

A car-bed restraint, in which the infant lies flat with its head toward the center of the vehicle, may be used in the front seat of such vehicles, but the vehicle seat must be moved as far back as possible. If a car bed is not available and the infant must be watched for medical reasons, have another adult ride in the rear seat with the rear-facing infant, or use another vehicle.

A forward-facing child restraint may be used in the front seat of a vehicle equipped with a passenger air bag if the child's age and weight meet the restraint manufacturer's requirements and the vehicle seat is moved as far back as possible. This will place the child in a similar position relative to the air bag as a restrained adult, for whom the air bag is primarily designed. However, as always, it is best to put an infant or child restraint in the rear seat whenever possible.

Always read and follow the vehicle owner's manual and the child restraint instructions for specific directions on where and how to install a particular child restraint in a particular vehicle. If specific instructions are not available, use the child restraint in the rear seat or use another vehicle.

Further research is being conducted on how infant restraints and child restraints interact with an air bag. Always follow the warning labels and instructions provided on your vehicle and in your owner's manual regarding the proper method for restraining infant and child seats in vehicles equipped with air bags.

7. *Air Bags and Disabled Vehicles*

- 7.1 Towing**—In normal towing and recovery operations, air bags are unlikely to deploy from vibrations or bumps in the recovery, loading, or towing of a disabled vehicle. When a vehicle has been damaged in a crash, and the air bags are not deployed, the air bag electrical system might also be damaged, making the system susceptible to an unwanted deployment. As a precaution, always disconnect the battery cables to assure no further damage to the system. Air bag systems have an energy reserve feature. This feature enables the air bag to deploy properly when required even if the battery has been destroyed, but only for a short period of time. Do not place your body or any object close to the air bag locations after a collision.

After an air bag has deployed, normal towing procedures should be used. Immediately after deployment, the air bag will be warm; however, some parts deep inside the module will be hot. You should not have to come into contact with these parts. These components are located inside the steering wheel hub or behind the instrument panel when there is a deployed passenger-side air bag. If the air bag fabric contacts the hot components of the inflator module after deployment, the fabric can feel hot; however, the modules are relatively inaccessible and should pose no threat to rescue personnel or vehicle occupants. The steering column, steering wheel rim, and spokes will not be hot.