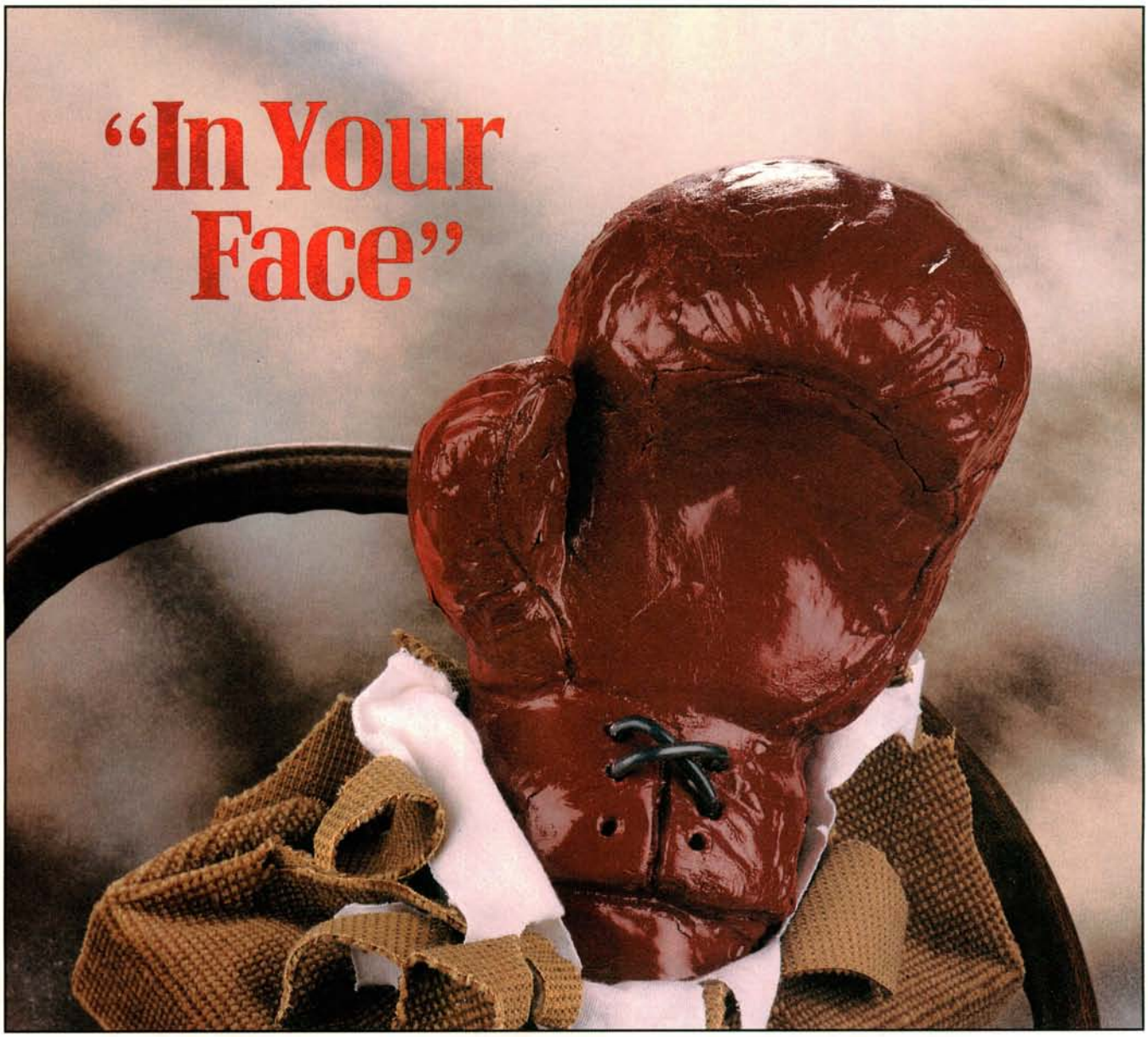


"In Your Face"

Some technicians have become very apprehensive about working on or around cars equipped with Supplemental Restraint Systems (SRS). Their fears are easily understandable when you consider the possibilities for liability.

Perhaps they've heard one too many horror stories about an air bag that went off without warning while a service technician was working on the vehicle. Even if no one gets hurt during an accidental air bag deployment, the cost to return the customer's car to its pre-deployment condition can be staggering. Who's going to pick up the tab? Certainly not the customer.

Considering how many hungry lawyers we have in this country, there are other liability factors to think about as well. Let's suppose you work on an SRS-equipped vehicle that is later involved in an accident. If the owner decides the SRS didn't function properly, the lawyers are probably going to be looking for someone to blame. You may not have as much money as a major auto maker, but you would make a much easier target.

So what do you do? A growing number of air bag-equipped cars are entering the vehicle population every year. A couple of years from now, federal laws will require all new cars to be equipped with air bags. Unless you're going to become a Volkswagen Beetle repair specialist, you'll have to get familiar with air bags if you're going to continue working on cars.

We're here to help. This article will give you a basic introduction to SRS. We'll look at how the system works; describe the basic components that are common to all systems; compare the self-diagnostic and testing procedures for different manufacturers; and discuss recommended repair procedures.

In Your Face

This article complements the SRS diagnosis and repair information in a service manual, but it can't replace it. Many service manuals devote entire sections to SRS diagnosis and repair. If you're going to get serious about SRS repair, this additional information should be considered essential. As you'll see, uninformed SRS testing or repairs can have disastrous consequences.

How It Works

It seems that every description of a computer controlled automotive system begins with inputs and outputs. Supplemental Restraint Systems are actually much simpler than many of the computer-controlled systems you are already familiar with. The number of inputs to the SRS control unit is small, and the driver and passenger air bags are the system's only outputs.

We'll begin with system inputs.

Crash Sensors. Early SRS systems used one centrally located crash sensor to detect front end collisions. The air bag must not deploy during a side impact, rear impact, or rollover accident, so the crash sensor must determine the direction, duration, and intensity of the impact. For increased accuracy and sensitivity, later systems may have as many as four separate crash sensors spread around the car. Center, left, and right crash zone sensors are located at the front of the vehicle. A tunnel sensor located in the center of the interior of the vehicle provides the fourth input.

Safing Sensor. With information coming in from several different crash sensors, it would be easy for the control unit to become confused. To prevent false alarms caused by an error from any of the crash sensors, some systems use an additional input called a safing sensor. The safing sensor is housed in the same unit with the tunnel sensor and acts as a referee to prevent accidental air bag deployment.

Control Unit. During the "sudden deceleration" of a collision, the SRS control unit must sort out the information it receives from its sensors, then decide whether the air bag(s) should be deployed. In a multiple sensor system, the ignition must be on and the control unit must simultaneously receive a signal from any of the four sensors (right front crash zone, center front crash zone, left front crash zone, or tunnel sensor) and the safing sensor before the control unit will deploy the air bag. Most SRS control units also include self-diagnostic ability.

Air Bag Module. The air bag module is the only SRS output. When the air bag module receives an electrical signal from the control unit, an explosive charge called a squib is ignited. Ignition of the squib spreads to other chemicals contained in the air bag module and a chemical process begins. This chemical process rapidly produces the nitrogen gas that fills the air bag to capacity in less than one-twentieth of a second. The filled air bag cushions the driver and/or passenger as they are pitched forward during the front end collision. To soften the impact, special vents in the air bag cause it to begin deflating as soon as it has filled.

Special Handling Precautions

While SRS designs vary from one manufacturer to the next, observing the following list of SRS precautions (gathered from several manufacturers) makes sense on any SRS-equipped vehicle. If you follow them, you shouldn't have to worry about an air bag going off "in your face."

Battery Backup. Most SRS systems have a backup power supply. This allows the system to function for a short time if battery power is interrupted. If you're planning to work on or around the system, start by turning the ignition off. Disconnect the negative battery cable (never the positive cable), then wait for at least 10 minutes before beginning work. This depletes the backup power supply (usually a capacitor) and prevents accidental deployments.

SRS Sensors. Use care when handling the SRS crash sensors. Never strike or jar a sensor because it could cause air bag deployment and personal injury. Improper operation of the SRS could also result later on.

Sensor Mounting. All sensors must be rigidly attached to the vehicle, and all mounting bracket bolts must be properly torqued to assure proper operation of the system. Sensors may be activated if they are not properly attached to the vehicle, which could cause an accidental deployment when the system is powered up. Also, a loose sensor mounting could cause incorrect operation of the system during a collision.

Handling Inflator Modules. Use extra care when handling a "live" inflator module. When carrying a live inflator module, make sure the air bag and trim cover always face away from you. In case of an accidental deployment, the bag will then open away from you and reduce the chance of injury. If you're carrying a steering column that is equipped with an air bag, use the same caution by making sure the air bag and trim face away from you. Never dangle an SRS component by the wires or harness connector.

Inflator Module Storage. When placing a live inflator module on a bench or other surface, always face the air bag and trim cover up and away from the bench surface. This provides the necessary free space for the air bag to expand if it were to deploy accidentally. Facing the inflator module toward the bench surface could turn the module into a projectile during an accidental deployment.

Damaged Sensors. Some manufacturers give a two

foot "drop limit" for all SRS sensors and control units. Arbitrary pass/fail drop limits make me nervous, but I'll repeat them anyway. Components that have been dropped less than two feet should be carefully inspected for damage, and replaced if necessary. Components that have been dropped two feet or more should be automatically replaced. Installing a component that may be damaged isn't worth the liability risk. Don't drop components, and you won't have to worry if they will work properly when they are supposed to.

Wiring and Component Handling. Don't attempt any repairs to the inflator module, sensors, or control unit. Some manufacturers allow wiring harness and terminal repairs, others do not. Consult a service manual before attempting any wiring or terminal repairs. Don't apply electrical power or use diagnostic equipment on any of the SRS wiring or components, unless you're following an authorized diagnostic procedure in a factory service manual.

Deployed Inflator Module Handling. Always wear gloves and safety goggles when handling a deployed inflator module to avoid possible skin or eye irritation. Wash your hands with a mild soap and water after handling the deployed inflator module.

SRS Troubleshooting and Repair

It's important to note that different manufacturers take decidedly different approaches to SRS diagnosis and repair. While all SRS systems have some self-diagnostic ability, what you do with the information varies widely from one system to the next.

Nissan allows no DMM testing of any of their SRS components. Harness repairs are also not allowed. If the control unit self-diagnostics tell you to replace a component, you must replace the component with no further testing or questions asked. After replacing the required component, the system is retested. If a fault code is still present, the next required part must be replaced. This test and replace procedure continues until all trouble codes have been cleared.

A Nissan SRS diagnostic sequence may call for the replacement of several components, including the wiring harness. This may seem like an expensive approach to troubleshooting and repair, but there is one advantage. If you stick to the required repair sequence, nothing has been left to chance and your liability is reduced. When you are finished, you can be certain the system will function as it is designed to during a collision.

Toyota and other manufacturers apparently place more trust in repair technicians. Diagnostic procedures

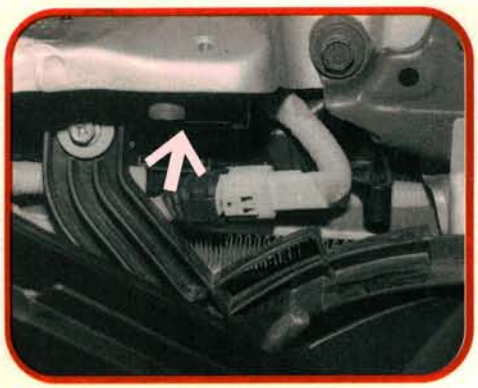
from these manufacturers include standard DMM tests of various SRS components and wiring. If the results of a test indicate that a component is faulty, it's your job to make the correct choice and replace the component. If tests indicate that the wiring harness has been damaged, wiring harness repairs using crimp connectors (horrors) are even recommended.

We'll look at several SRS components in the following photo captions. As we mentioned earlier, this article serves as an introduction to SRS. It can't replace the vehicle-specific information contained in a service manual. If you are planning to diagnose and repair an SRS system, don't start backprobing connectors with your DMM or crimping wires together without the necessary service information for the vehicle. The risk and liability exposure just aren't worth it.

— By Karl Seyfert

1

Supplemental restraint systems are most effective in front or front-angle collisions. The control unit must know the direction and strength of the impact so that it can decide whether the air bag(s) should be deployed. A series of sensors like this front crash zone sensor are used to gather this information.



2

This Nissan 300 ZX has three crash zone sensors at the front of the vehicle. One sensor is mounted at each front corner, while the center crash sensor is mounted below the hood latch (arrow). The number and placement of these crash zone sensors will vary from vehicle to vehicle.

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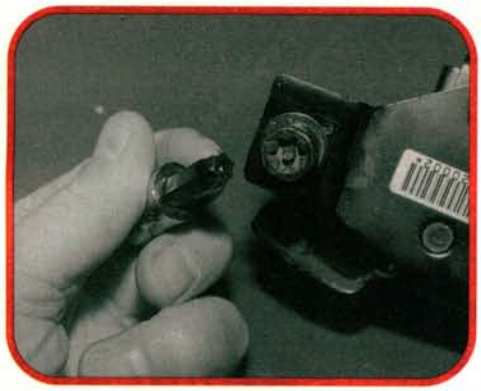
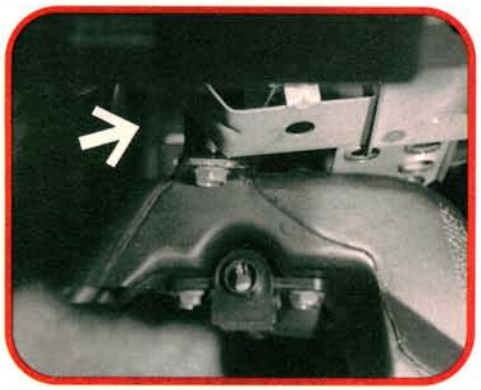


3

Anti-tamper Torx bolts attach the sensors to the body. A special hollow center Torx bit is required to engage the bolts. All bolts have locking compound applied to their threads and must not be reused if they are removed. The position indicator on the sensor assures proper sensor operation.

4

For an extra measure of sensitivity, this Nissan system includes a tunnel sensor and a safing sensor. Both sensors are contained in one unit. Before the control unit will deploy the air bag, it must receive a signal from at least one of the front crash sensors or the tunnel sensor, plus the safing sensor.

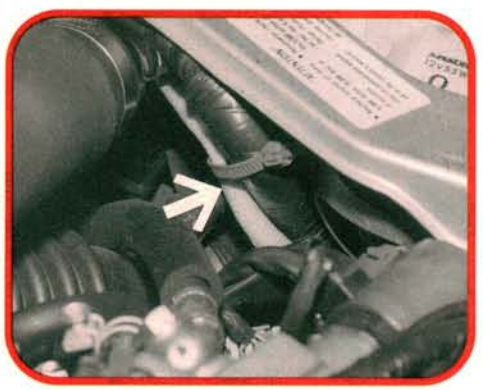


5

Some early SRS systems combine the control unit with a single, centrally located crash sensor. The Nissan control unit (arrow) receives all of its information from separate crash sensors, and is buried under the driver's side of the dash. The control unit can store nine different diagnostic codes.

6

Every system we have seen uses a special harness connector color to identify SRS components and wiring. There's no mistaking the orange connectors in this Volvo SRS harness. However, this unprotected air bag module wiring easily could be damaged by a careless cellular phone installation.

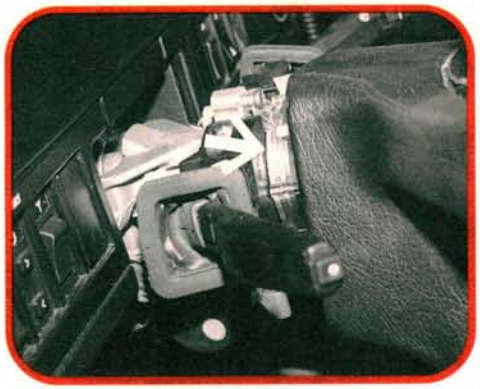


7

Nissan uses yellow SRS wiring harness connectors, and they also separate the SRS wiring harness from all other vehicle wiring and wrap it in a yellow plastic sleeve (arrow). Nissan allows no SRS wiring harness repairs. If any harness damage is found, the whole harness must be replaced.

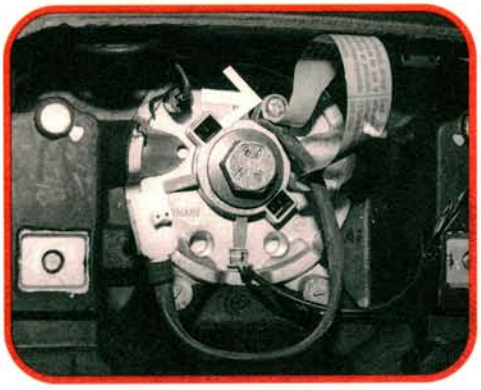
8

Most systems have connectors in the harness between the control module and the air bag module. If you must remove the module to center a steering wheel during a wheel alignment, separating one of these connectors (arrow) will reduce the possibility of an accidental air bag module deployment.



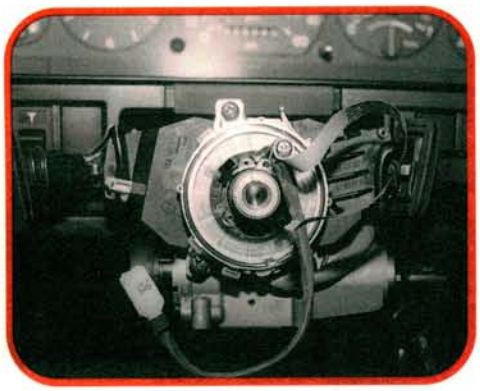
9

The air bag module is connected to the steering column wiring by a spiral cable mechanism (arrow). Unlike the simple slip rings used for steering wheel horn control wiring, the spiral cable maintains a reliable physical connection between the control unit and the air bag module at all times.



10

We've removed the air bag module in this photo. However, before we can remove the steering wheel, the spiral cable mechanism must be locked in place. On this Volvo, a special screw (arrow) is threaded into the spiral cable mechanism to lock it in place. The plastic ribbon explains the locking procedure.



11

Spiral cable designs and locking procedures vary among manufacturers. Checking a manual before you try to yank the wheel will help avoid damage or extra work. If the wheel is removed without locking the spiral cable, the spiral cable must be centered before the steering wheel can be reinstalled.

12

This air bag module was intentionally deployed during a test. The force of the expanding gases tore the outer module cover as the bag opened. Two large vents (arrows) allow the nylon mesh bag to start deflating as soon as it has filled. This cushions the impact as the driver hits the bag.

13

The air bag module is a sealed unit, so we can't show you the igniter squib and chemicals contained inside. A small amount of chemical dust is vented when the air bag is deployed. Use hand and eye protection when handling a deployed air bag module. These chemicals can cause skin and eye irritation.

14

Always store a "live" air bag module with the outer cover facing upward as shown. If the module accidentally was deployed (an unlikely occurrence), this position allows room for the bag to harmlessly expand. If the cover is facing down, accidental deployment could turn the module into an unguided missile.

15

The SRS warning light informs the driver of system operation. If the system is working normally, the light should go out several seconds after the ignition is switched on. The warning light will stay on or flash to indicate a problem. This will also disable the system until the problem in corrected.

16

Nissan technicians can plug this dedicated CONSULT diagnostic unit into the main diagnostic connector for air bag diagnosis. The control unit has three self-diagnostic modes (USER MODE, PRESENT MODE, and INITIAL MODE.) to help determine if a fault is hard (PRESENT MODE), or intermittent (INITIAL MODE).

17

The CONSULT unit includes a thermal printer to provide a written record of the SRS problems that CONSULT has found and the repairs that it suggests. With the legal implications that we discussed earlier, establishing a "paper trail" to document the steps of any SRS repair seems like a great idea.

18

If you don't have a spare $3,500 for a CONSULT unit, Nissan SRS trouble codes can still be retrieved without using any special tools. Once the system is shifted into the self-diagnostic mode, fault codes are flashed by the AIR BAG warning light. You can begin by turning the ignition on.

19

Diagnostic mode shifting takes some practice. Press the driver's door switch more than five times within seven seconds after turning the ignition on. This moves us from USER to PRESENT MODE and any stored trouble codes should begin to flash. One more tap of the door switch moves us to INITIAL MODE.

20

Other SRS systems may require you to jumper a test terminal or connect the terminal to ground to retrieve fault codes. The SRS test terminal on this Volvo is located near the center fuse panel. Always consult a service manual for the vehicle you're servicing before you try to retreive codes.