Restraint Systems Damage Analysis (DAM11)

Textbook

I-CAR®

Version: 13.4

DAM11-STMAN1-E

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Contents

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Introduction

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Obligations To The Customer And Liability

The collision repair industry has an obligation to correctly repair the customer's vehicle. Collision repairs must be performed using:

- recommended or tested procedures from vehicle makers, I-CAR, and other research and testing organizations.
- quality replacement parts and materials.
- repair processes and parts as written and agreed upon in the repair order. If items on the repair agreement are not consistent with the repair order, it can be considered fraud.

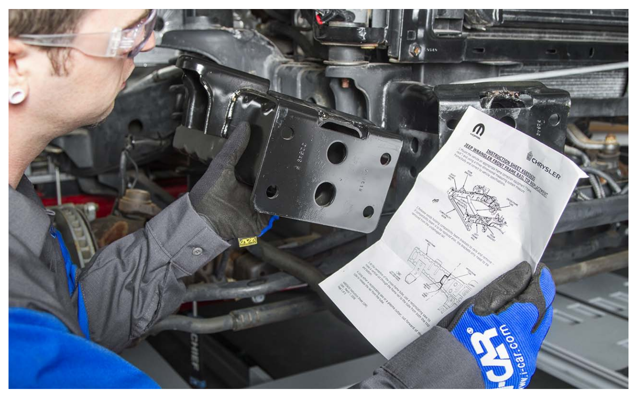
Performing proper collision repairs requires using parts and procedures that keep remaining warranties intact.

Collision repairs must restore:

- safety.
- structural integrity.
- durability.
- performance.
- fit.
- finish.

Throughout the damage analysis and repair process the repairer and insurer must:

- communicate with each other.
- maintain constant communication with the customer.
- be in agreement with each other and the customer on how repairs will be performed.
- inform the customer of any changes in the repair plan from the original repair agreement, and explain the changes and why they have to be made.



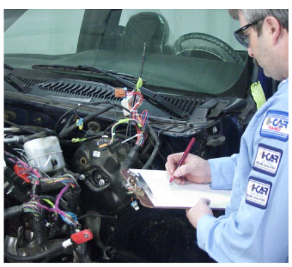
To reduce liability:

- make sure that all repairs are performed thoroughly, correctly and as listed in the damage report.
- follow proper procedures.
- have documentation of required repairs with detailed record keeping available for customers.

Technicians are considered the experts and are expected to be knowledgeable on how to perform a quality repair.

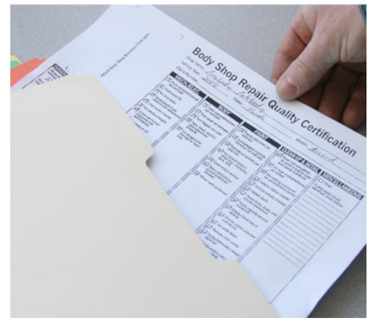
Liability insurance that covers the repair facility may not always cover all damages. For example:

- the policy may not cover faulty repairs, leaving liability responsibility completely on the facility.
- a shop owner may find that repair facility liability coverage may not cover the full amount awarded in a lawsuit. The shop owner would have to pay the difference.



It is difficult to reduce the risk of liability exposure. The part that the repairer can control is the chance of being found at fault. Chances can be minimized by:

- using recommended or tested procedures from the vehicle makers, I-CAR, or other research and testing organizations.
- using quality replacement parts and materials that restore fit, finish, durability, and perform at least as well as the original.
- keeping thorough records.



Keeping thorough records includes more than recording the date, mileage, and pre-existing damage. Record keeping also includes:

- making sure all notes are legible.
- verifying the repairs that were made or not made.
- having the customer sign a waiver for repairs that they do not want performed. Repairers must determine their liability on not repairing safety systems such as restraint and anti-lock brake systems.
- keeping computer printouts or worksheets on file showing wheel alignment readings or vehicle dimensions before and after repairs.
- keeping scan tool printouts and records of computer codes for airbag, anti-lock brake, emission, and powertrain control module (PCM) systems.

- attaching the OEM or other tested procedure printout to the vehicle repair order.
- keeping receipts for all sublet work performed.

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Module 1 - Restraint Systems Damage Analysis

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Restraints Overview

Learning objectives for this module include:

- identifying the various types of restraint systems.
- identifying restraint system parts.
- determining deployment of restraint systems.
- determining required replacement or inspections for restraint system parts.
- identifying additional damage and determining repair and replacement decisions.
- identifying seat belt system parts and proper operation.
- determining replacement considerations for damaged seat belt system parts.
- identifying seat damage and determining repair and replacement decisions.

Ford Fiesta

This 2011 Ford Fiesta cutaway shows several airbags frozen in their deployed state.

Various mechanical and electronic restraint system parts are used to protect the vehicle occupants during a collision. These include:

- impact sensors. There are often multiple impact sensors on a vehicle. The locations and names of these sensors may vary.
- the restraints control module (RCM). The RCM is the electronic control module for the supplemental restraints system (SRS).
- seat belts and seat belt pre-tensioners.
- airbags.
- a collapsible steering column.
- seats.

Refer to "Video: Inspecting Restraint Systems" in the presentation. This video discusses inspecting restraint systems.

Toyota Venza

The right side airbags have deployed on this Toyota Venza.

To ensure an accurate estimate, it is important to identify what restraint systems the damaged vehicle is equipped with. The next step is to determine what parts or systems have deployed. To identify deployed restraint systems on the vehicle, check the:

- airbags. Deployed airbags are fairly obvious to identify. It may also be good practice to identify the number and location of airbags equipped on the vehicle. Airbag locations may be identified with the supplemental restraint system (SRS) acronym printed on a tag or label, or embossed on an interior trim panel.
- seat belts and seat belt pre-tensioners. A thorough inspection of the seat belt assemblies, including retractors, buckles, anchors and height adjusters, may be necessary. Some seat belt pre-tensioners may require the use of a scan tool to determine deployment.
- airbag warning lamp. An airbag warning lamp that remains lit may indicate that restraints have deployed. The 2010 Ford Escape sounds five sets of five chimes after the ignition is started to indicate an airbag fault if the airbag warning lamp is not working properly.

As part of a thorough inspection, identifying which seats were occupied during the collision will help to determine the proper part replacement procedure.

Refer to "Video: Inspection Safety Precautions" to see an airbag deploy.

It is important to take certain precautions before or during inspection of airbags and other SRS parts. These precautions include:

- disabling the restraint system to prevent accidental deployment. Even if an airbag looks fully deployed, it may be capable of a second deployment. Disabling the restraint systems is commonly done by disconnecting and isolating the negative battery cable. Time must also be allowed to pass for the system to completely discharge. Refer to vehicle-specific service information for the proper procedure to disable the restraint system. Disabling the SRS may also need to be done to protect parts during some types of repairs, such as welding.

- wearing the proper personal protective equipment. The powdery residue present after front airbag deployment may contain a small amount of sodium hydroxide, which may irritate the eyes, nose, mouth, or throat. Protective equipment that may reduce the chance of skin contact may include nitrile gloves, safety glasses or goggles, and a long-sleeved shirt.
- avoiding biohazards. Biohazards such as blood and other body fluids may be potentially infectious. Bloodborne pathogen training is required to clean up or work around blood spills. Always wear personal protective equipment when working around blood. This may include rubber gloves, and eye and respiratory protection. More information on the dangers of working around blood can be found in the December 30, 2002 issue of the I-CAR Advantage Online.
- cleaning up broken glass. When analyzing damage, be aware of broken glass from door glass, backglass, or the windshield. Also, do not cause additional damage to upholstery by kneeling on the glass and cutting the fabric.
- ensuring airbags are deployed before disposing. Some airbags have two igniters. Depending on the severity of the collision and the vehicle make, the igniters may be designed to fire simultaneously, milliseconds apart, or only one may fire. This may require manual deployment before disposing the airbag module. Vehicle-specific service information must be referenced for safe handling and disposal procedures for deployed front airbags, and recommended steps to ensure that the second stage is deployed.

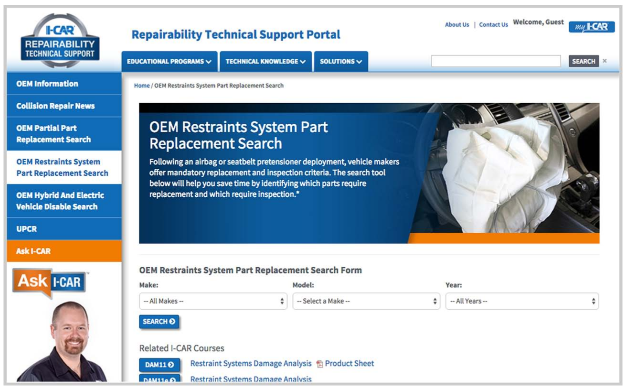
A front impact (left) will deploy different restraints than a side impact (right).

Determining the direction of impact may also help determine deployment of restraint systems. For example, a:

- front impact may deploy the front airbags and seat belt pre-tensioners or only the seat belt pre-tensioners.
- front / side impact may deploy the front and side airbags, or only the seat belt pre-tensioners.
- side impact may deploy the side airbags, curtain airbags, and seat belt pre-tensioners.

- rear impact may deploy active head restraints. The seat back hinge may also be designed to absorb the collision.
- rear / side impact may deploy side and curtain airbags.

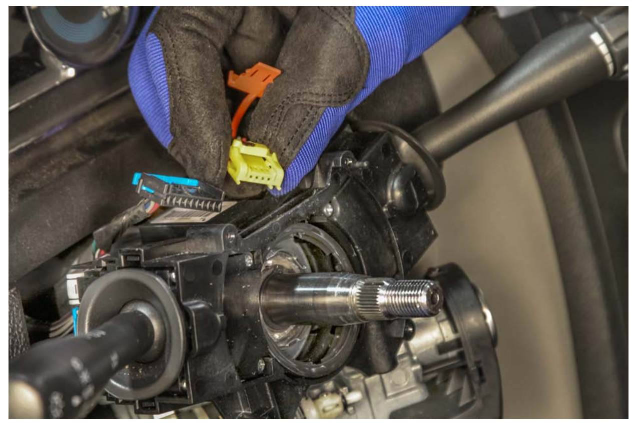
These are only some examples to think about. It is important to remember every vehicle is designed differently and may or may not deploy the restraint systems described.



An example of a source for replacement / inspection information includes the I-CAR Repairability Technical Support (RTS) website.

Vehicle-specific required replacement and inspection items can be obtained from various information sources, including:

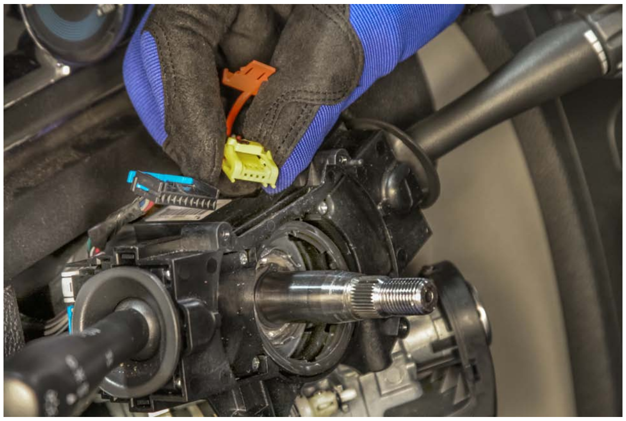
- vehicle-specific service information. Vehicle makers provide service information on the Internet. There are also other options, such as ALLDATA, that provide service information for most vehicle makes and models.
- airbag parts replacement recommendations charts. This information may be provided in computerized estimating systems, printed estimating guides, and I-CAR. The Airbag Parts Replacement Recommendations Chart, which is developed and maintained in cooperation with AudaExplore, a Solera company, can be accessed from www.i-car.com.



Deployed airbags (left) and seat belt pre-tensioners (right) are common replacement items after a deployment.

When inspecting the restraint system, identify all required replacement items associated with the type of impact or deployment. Required replacement parts may include:

- all deployed restraints such as airbags and seat belt pre-tensioners.
- impact sensors and control modules.
- a collapsed steering column.
- any physically damaged parts, such as adjacent trim panels and brackets. Some parts are expected to be damaged and are identified by the vehicle maker to be replaced.



The connectors on this steering column are being inspected for damage.

When inspecting the restraint system, identify all required inspection items associated with the type of impact or deployment. Required inspection parts may include:

- impact sensors and control modules.
- mounting surfaces and brackets.
- adjacent trim panels.
- the steering column.
- wiring and connectors.

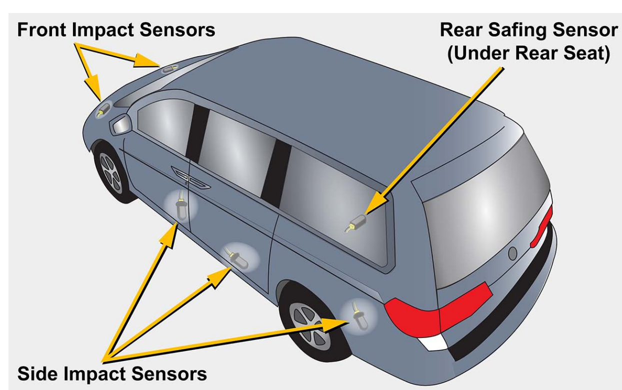
The technician may have to use a scan tool to reveal electronic problems with the restraint system.

A scan tool is often required to read the diagnostic trouble codes (DTCs) associated with the SRS. The SRS may require a scan tool to run a diagnostic check:

- when the airbag warning lamp remains lit. The airbag warning lamp should turn off after a period of time to indicate proper operation of the SRS.
- to validate and identify deployment of the SRS. The scan tool is used to read airbag codes, which indicate deployed systems.
- before disconnecting the battery. If possible, the fault codes should be printed out and kept with the damage report for proper documentation.

The scan tool or software may have to be OEM-specific. OEM-specific equipment and software may or may not be available for independent repair facilities.

Impact And Safing Sensors

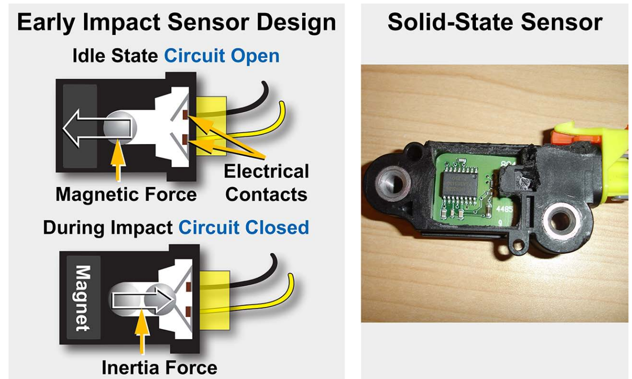


Sensors positioned around the vehicle are used to detect a collision.

Restraint system sensors include:

- front impact sensors, designed to detect front collisions.
- side impact sensors, designed to detect side impact collisions.
- safing or arming sensors. A safing or arming sensor is a secondary sensor that must close with the front or side impact sensors to confirm that a collision is taking place. This is done to prevent an accidental deployment caused by a problem in the front impact sensor circuits. Safing or arming sensors may be located inside the restraints control module (RCM) or as a separate sensor in the passenger compartment. Some systems use three separate sensors to determine airbag deployment. The 2011 Honda Civic has a rear safing sensor located under the rear seats and requires replacement following curtain airbag deployment.

The 2011 Honda Odyssey has a total of nine impact sensors. Two front sensors are located behind the bumper, mounted on the radiator core support brackets. Six side sensors are located on the B-pillars, floor, and rear wheelhouses. A safing sensor is located under the rear floor pan.

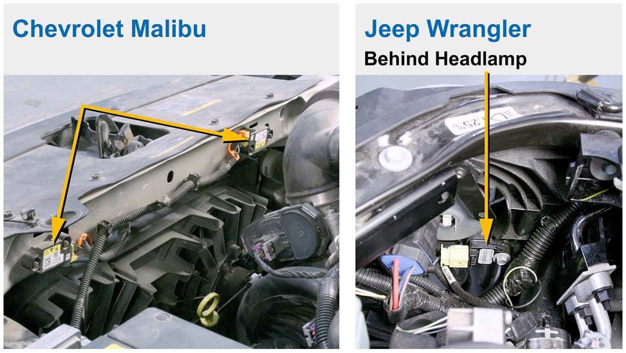


Impact sensors used to be electromechanical, where a steel ball is pushed forward by collision forces to complete a circuit (left). Solid-state sensors perform the same function, but do it with no moving parts (right).

Impact sensors are designed to detect sudden deceleration or velocity change at or near the point of impact. Impact sensors:

- today are typically solid state, with no moving parts. Early impact sensors used mechanical parts. One type used a magnet and a ball to close the electrical circuit of the sensor. Although antiquated, this type of sensor illustrates the basic function of an impact sensor.
- send the information to the RCM. The RCM calculates the information from the impact sensor and other sensors and determines which, if any, restraint systems should be deployed.

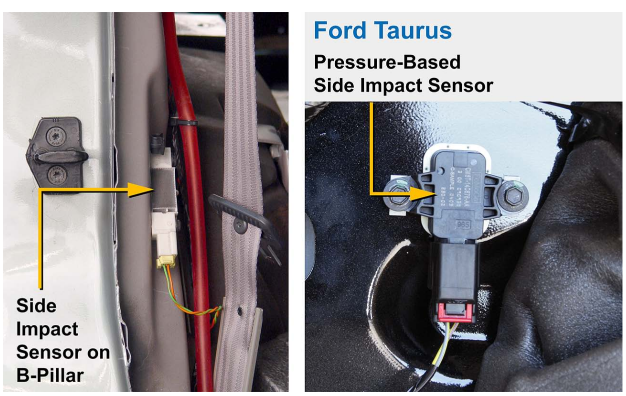
To protect passengers from injury from an unnecessary deployment, restraint systems are programmed with specific parameters. Airbags and other types of restraint systems may not deploy if the required parameters are not met.



Front impact sensors are located in the front, but their exact locations vary.

Front impact sensors are located on the front portion of the vehicle. Front impact sensors may be located:

- on the front lower rails.
- on the radiator core support.
- behind the headlamps, such as on the 2009 Jeep Wrangler.
- on the front frame rail crossmember, such as on the 2010 Cadillac Escalade.



Side impact sensors must react quickly due to the small space between the door and the occupant, prompting the development of pressure-type sensors.

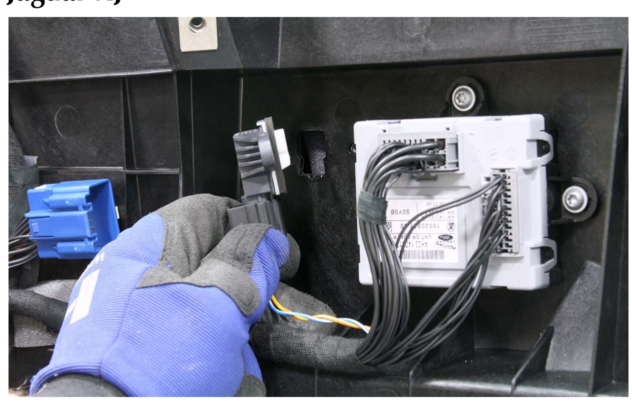
Side impact sensors are located on both sides of the vehicle. Side impact sensors may be mounted:

- in doors.
- on B- and C-pillars.
- behind or under seats.
- on the rear wheelhouse, such as on the 2010 Ford Taurus.

Some vehicles are using a new type of pressure-based side impact sensor, located in the doors. These types of sensors are designed to detect a quick increase of pressure inside the door cavity during a side impact. These types of side impact sensors have a 30% faster response time, but require other impact sensors located in other areas in case the door is not impacted during a collision. Examples of vehicles that use pressure-based, side impact sensors include:

- several BMW and Mercedes-Benz models, some since 2007.
- Ford on the 2009 F-150, 2010 Taurus, 2011 Fiesta, and the 2012 Focus.
- Jaguar on the 2011 XJ.
- Volkswagen on the 2011 Touareg.

Jaguar XJ



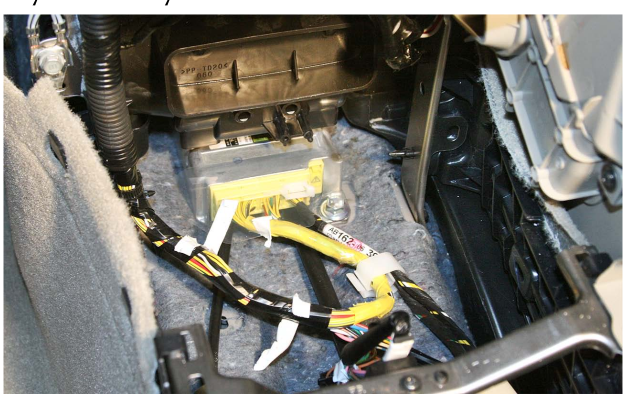
A pressure-based, side impact sensor on the door of a 2011 Jaguar XJ is being inspected.

The left or right side impact sensors may require replacement depending on which side airbag deployed. Refer to vehicle-specific service information to determine replacement recommendations for impact sensors. When inspecting sensors for damage, check for:

- cracked or deformed cases.
- bent brackets.
- damaged wires and wire connectors. Impact sensor wires or connectors may be cut or crushed in the area of impact.
- internal electronic damage indicated by a lit airbag warning lamp. This may require the use of a vehicle-specific scan tool.
- corroded cases, brackets or connectors.

Restraints Control Module

Toyota Camry



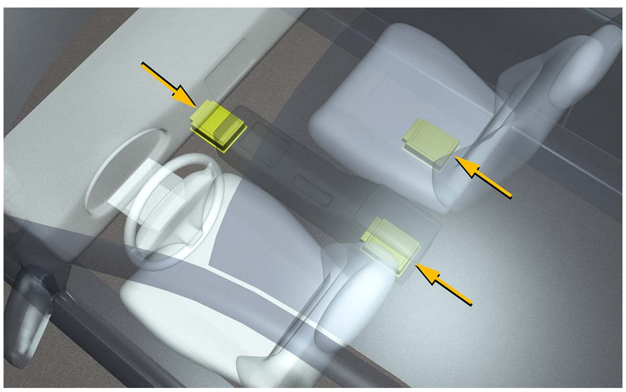
The restraints control module processes the information received from various sensors to make a deployment decision.

The restraints control module (RCM) can be considered the brains behind the SRS. Vehicle makers may use different names for the RCM. For example, Volvo calls it the SRS module. The Chrysler Group calls it the occupant restraint controller (ORC), and General Motors calls it the sensing and diagnostic module (SDM). Functions of the RCM may include:

- deploying restraints. Deployment of the restraints may be based on the perceived severity of the collision, deceleration rate, seat belt use, occupant position, and passenger occupant weight. Following deployment, the RCM may also communicate with the body control module (BCM) to turn on the interior lights and unlock the doors. The RCM may also initiate a call to 911 through systems like On-Star.
- checking the system for faults. Most RCMs perform a self-diagnostic test when the ignition key is turned on. If the RCM is not working properly, or if it detects a problem with the restraint system, the airbag warning lamp will light and remain lit until the problem is corrected. An airbag warning lamp that does not light during the initial bulb-check sequence may also indicate a problem.
- processing information. The RCM is designed to process information from various input sources. Input sources may include impact sensors, seat belt use sensors, the brake pedal switch, vehicle speed sensors, seat position sensors, and information from other control modules such as the occupant

classification system (OCS) for the front passenger seat.
- using capacitors to store enough energy to deploy restraints if battery power is lost during a collision.
- storing data from the collision, such as the number of deployments and for which systems.

The RCM may also contain an impact or a safing sensor.



The restraints control module is usually mounted in the center area of the vehicle, out of harm's way.

RCM mounting locations may include, but are not limited to:

- under the lower center portion of the instrument panel. For example, the restraints control module on the 2010 Chrysler Town & Country is located under the instrument panel, forward of the center console.
- under the center console, between the front seats. An example of this is on the 2011 Ford Explorer.
- under a seat. An example of this is on the 2009 Cadillac Escalade. As of the 2010 model year, the RCM on the Escalade is located under the center console.
- behind a kick panel. An example of this is on the 2005–2007 Ford Econoline.

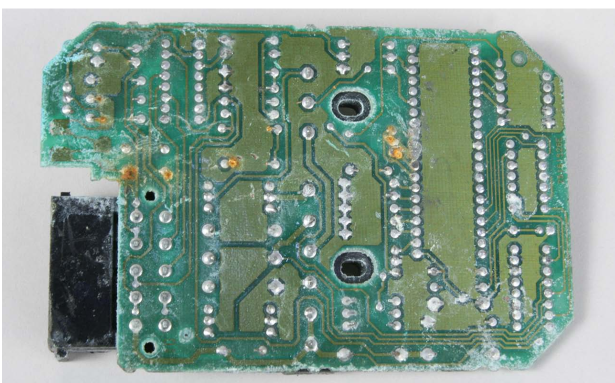
It is important to refer to vehicle-specific service information to properly locate and identify the RCM.

It is a common recommendation for the RCM to be replaced after a deployment or a certain number of deployments.

Refer to vehicle-specific service information for RCM replacement guidelines. Vehicle-specific recommendations may require the RCM to be replaced:

- after any type of SRS deployment, such as an airbag or seat belt pre-tensioner. Nissan requires replacing the RCM after any type of SRS deployment.
- only if damaged. The RCM on the 2010 Jeep Liberty does not require replacement after a deployment.
- after a certain number of deployments. The RCM on the 2010 BMW 550 requires

replacement after three deployments.
- if a certain code is present. DTCs are checked using a scan tool. Problems when trying to clear codes may indicate that the RCM requires replacement. Internal electronic damage may light the airbag warning lamp.
- for other reasons called out by the vehicle maker. The 2011 Volvo XC90 requires replacement of the RCM if codes will not clear, there is damage to the RCM or the floor mounting panel, or if the vehicle is equipped with On-Call.



A restraints control module circuit board was exposed to flood water and has corroded.

Some collisions do not deploy any restraints, however, the RCM should be inspected for damage if located near the area of damage, such as damage to the floor pan. When inspecting the RCM, check for:

- cut or crushed wires or connectors.
- bent mounting brackets.
- flood damage or corrosion. As stated previously, the RCM is usually mounted to the lower portion of the vehicle interior. For this reason, flood damage is a concern. Restraint system parts exposed to flood damage or that show signs of corrosion should be replaced.

Vehicle Protection

Always wear an electrostatic discharge strap when handling an electronic control module.

Reprogramming the restraints control module typically requires a vehicle maker scan tool.

A new RCM may have to be programmed. Programming a new RCM may require:

- transferring data from the original module to the new one. This may require keeping the original RCM on hand until the replacement procedure is complete.
- subletting the replacement procedure to a local dealer. Downloading the RCM programming data may be provided by the vehicle maker

service information website. This may require a subscription with special dealer access. Doing the procedure incorrectly may require obtaining another new RCM.

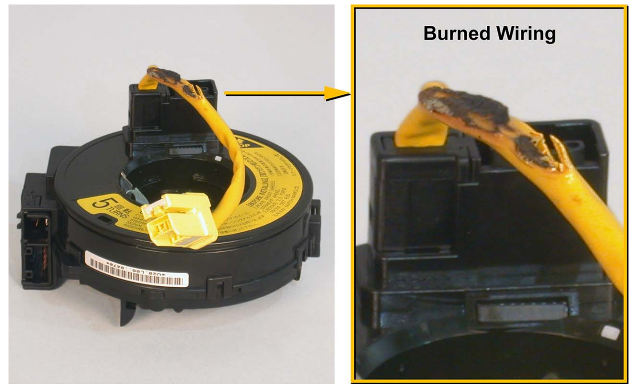
The codes should not be forced to reset. If the vehicle maker requires replacement of the RCM following a deployment, it needs to be replaced with a new one. The safety of the passengers during another collision is at stake.

Front Driver Airbag

Refer to "Video: Front Driver Airbag" to see a front driver airbag deploy.

Parts of the front driver airbag system include the:

- airbag module, which is located in the center of the steering wheel. The airbag module contains the airbag, inflator, electrical connectors, and trim cover.
- clock or coil spring which is mounted behind the steering wheel. This part is designed to provide a continuous electrical connection for the front driver airbag module while the steering wheel is being turned. Other names include supplemental inflatable restraints (SIR) coil, cable reel, spiral cable, sliding contact, or slip ring.



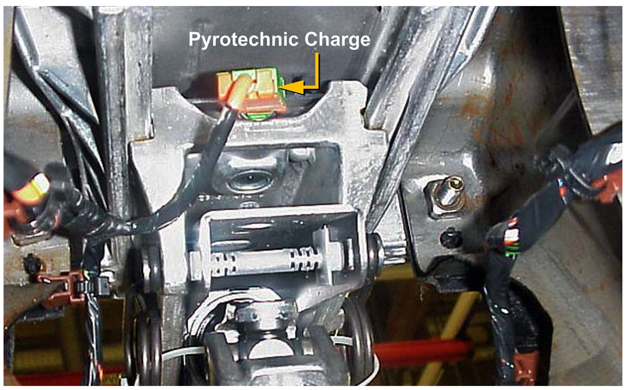
The wiring pigtail on this clock spring was scorched due to heat from the airbag deployment.

The clock spring may require replacement after deployment. If replacement is not required, inspect the clock spring for:

- heat damage. Heat generated from airbag deployment can cause scorching or melting of the coil housing, or electrical connectors. Also inspect wire insulation and the connector that plugs into the back of the airbag module for heat damage.
- coil housing damage. This can be caused by installing the steering wheel puller bolts too deep.
- a broken ribbon wire. The ribbon wire is the electrical connection to the driver airbag and other electrical circuits to the steering wheel. Damage may be caused by turning the steering wheel with the steering rack or gear

removed, or by not centering the coil properly before installation. A DTC may identify a problem with the circuits to the steering wheel.
- electrical connector problems. This can be caused by corrosion or broken terminals.

Volvo XC90

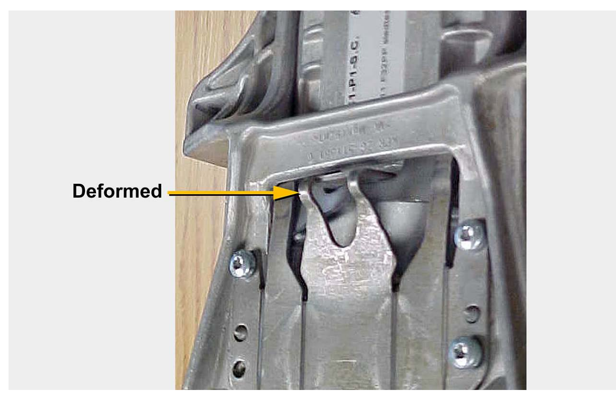


Vehicle makers collapse steering columns by various methods, including the use of a pyrotechnic charge.

An energy-absorbing, or collapsible, steering column is designed to collapse during a collision to reduce driver injury. Steering columns may be designed to collapse:

- in the upper column. Some upper columns have two shafts that are designed to function similar to a telescope during a collision. This type of design uses a solid shaft that compresses into a hollow shaft to shorten the overall length of the steering column. The shafts may be locked with plastic inserts that shear off upon impact. Upper steering columns may also be designed with a steel mesh or accordion-like convolutions that collapse under collision forces.
- in the lower steering sections. These sections may be linked by offset universal joints to allow the sections to fold during an impact. This keeps the lower steering column from entering the passenger compartment.
- at the steering column mounting brackets. Some steering columns are designed to collapse at the bracket that holds the column to the instrument panel frame. This may also be done with plastic inserts that shear upon impact.
- using a pyrotechnic charge. The 2011 Volvo XC90 uses a pyrotechnic charge to deploy the collapsible steering column.

Volvo XC90



The deformation of the steering column bracket indicates it is collapsed.

Collapsed steering columns may require replacement of the complete steering column. Inspecting steering columns for signs of collapse may include:

- checking for sheared plastic pins or inserts. These may be located on the steering column and mounting brackets.
- measuring. Vehicle makers may recommend measuring the overall length of the column or between specific points. The measurements are compared to listed specifications.
- checking for a tight gap between the steering wheel and steering column cover. This may cause the steering wheel to rub against the steering column cover.

Some vehicle makers have mandatory replacement recommendations for steering columns following an airbag deployment. For example, the steering column on the 2011 Ford Taurus requires replacement following front airbag deployment. Refer to vehicle-specific service information to determine if the steering column requires replacement following airbag deployment.

Do not test-drive or release the vehicle to the owner if damage to the steering column is suspected.

There is a collapsible brake pedal assembly on the 2011 Chevrolet Cruze, which allows the pedals to detach during a moderate-to-severe collision to reduce the risk of trapping the driver's feet, reducing the risk of leg or ankle injuries.

The knee bolster is mounted under the instrument panel and may provide extra protection to the knees.

The knee bolster:

- is designed into the lower portion of the instrument panel.
- may provide an extra cushioned area to protect the knees.
- prevents sliding under the instrument panel during a collision.

A damaged knee bolster, such as a crack like this, requires replacement.

Knee bolsters should be inspected for:

- deformation.

- damaged brackets and braces that attach the knee bolsters to the instrument panel.
- misalignment to adjacent trim panels.

Damaged knee bolsters should be replaced.

Knee airbags are used on more vehicles today than ever before.

Some vehicles are equipped with knee airbags. Knee airbags:

- are designed to cushion the impact of the knees on the knee bolster during a collision while keeping the driver in position.
- are designed to deploy with the front airbags.
- may only be located on the driver side, or on both the driver and passenger sides of the vehicle.
- require replacement if deployed. Follow vehicle maker's recommendations for replacing knee airbags.
- may require inspecting adjacent panels and parts following deployment.

Some manufacturers require complete instrument panel replacement following a knee airbag deployment. An example of this is on the 2006 – 2010 Chrysler PT Cruiser.

Refer to "Video: Front Driver Airbag Considerations" in the presentation. The video shows a front driver airbag deployment. Answer the question at the end of the video before continuing to the next screen.

Refer to "Video: Front Driver Airbag Considerations (cont'd)" in the presentation. This video discusses considerations for front driver airbag deployment and answers the question from the previous video.

Front Passenger Airbag

Refer to "Video: Front Passenger Airbag" to see a front passenger airbag deploy.

Passenger airbag modules may:

- be located on the passenger side of the instrument panel, facing the passenger seat.
- be mounted on top of the instrument panel and use the windshield to deflect the deployment in the proper direction toward the passenger.
- not deploy by design. Some pickup trucks are equipped with a disable switch that allows the driver to turn the passenger airbag off. Vehicles equipped with an occupant classification system (OCS) may also disable the passenger airbag when the seat is not occupied or the passenger does not meet the specified weight.

Personal Safety
It is good practice for appraisers and technicians to assume that all deployed front airbags may be capable of a second deployment. Refer to vehicle-specific service information for safe handling and disposal procedures for deployed front airbags, and recommended steps to ensure that the second stage is deployed.

Ford Taurus

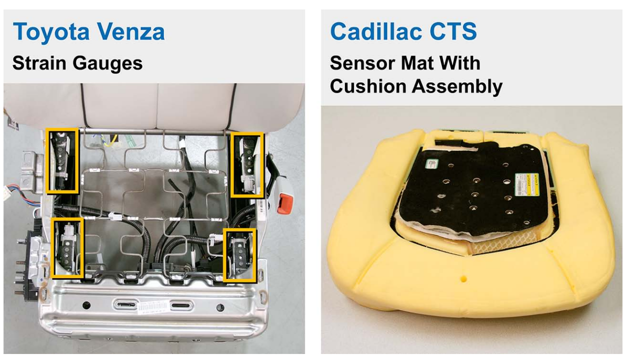
This cutaway passenger seat from a 2011 Ford Taurus reveals the bladder sensor that is part of the occupant classification system.

An OCS may use various types of sensors to provide input to the RCM to determine if the front passenger restraints should be deployed. An OCS may use a:

- weight sensor or sensors to determine the size of the occupant or if the seat is occupied. Vehicle makers use various types of weight-sensing systems to determine if the seat is occupied. Different types of weight sensors may be used on different vehicles made by the same manufacturer.
- seat-belt-use sensor to determine if the seat belt is in use.
- seat-position sensor to determine how close the occupant is to the airbag.
- status lamp on the instrument panel or rearview mirror to

communicate the status of the passenger airbag. Status lamps are used differently on different vehicles. For example, the passenger airbag status on General Motors and Toyota vehicles is indicated by illuminating either the “Passenger Airbag ON” or “Passenger Airbag OFF” lamp. Ford vehicles have a single “Passenger Airbag OFF” lamp, which turns on when a light weight is detected in the passenger seat, or if the passenger seat belt is buckled and no weight or light weight is detected.

Most front passenger seats in vehicles built after the 2006 model year are equipped with an OCS.



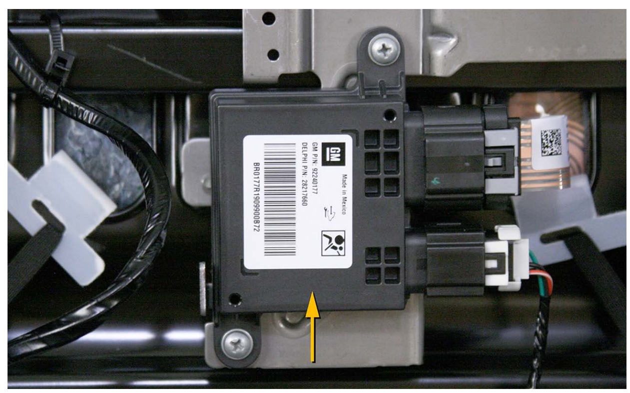
Two types of OCS weight sensors are shown, including strain gauges (left) and a sensor mat within the seat cushion (right).

Various methods used to determine front passenger occupant weight for the OCS include, but are not limited to:

- a silicone-filled pressure bladder, for example on the 2010 Ford Escape.
- a sensor mat integrated with the seat cushion, for example on the 2009 Cadillac DTS and Chevrolet Impala.
- strain gauges. Four strain gauges attached to the front passenger seat on the 2010 Toyota Venza are used to determine occupant weight. Two strain gauges are used to determine occupant weight on the 2010 Ford Explorer front passenger seat.

New designs and methods for occupant detection are continually being developed. Refer to vehicle-specific service information to determine proper replacement of parts and if calibration procedures are required.

Chevrolet Camaro

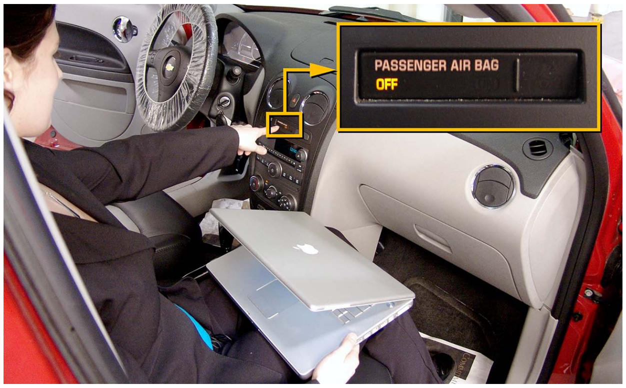


The OCS has its own control module, which on this vehicle is directly under the passenger seat.

An OCS will typically include a separate control module, which:

- communicates with the RCM.
- may be located under the front passenger seat or under the center console.

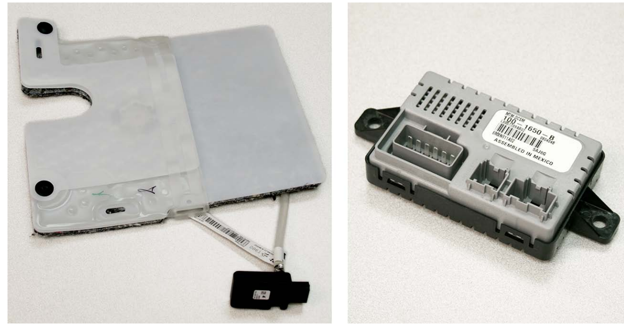
Chevrolet HHR



The passenger airbag status indicator lamp indicates that this passenger airbag is off, but the passenger seat is occupied, indicating a possible system problem.

A DTC may indicate that the OCS requires replacement or recalibration. Proper operation of the OCS may be determined by verifying that the passenger airbag status indicator lamp is functioning properly. This may be done by turning on the vehicle and sitting in the front passenger seat. However, the OCS may disable the passenger airbag if the person conducting the test weighs less than the weight specified for that system. On a 2010 Toyota Camry, the OCS disables the passenger airbag if it detects a weight less than 36 kg (79 lb).

Inspection of the seat and seat frame may indicate physical damage to parts of the OCS. Similar to the RCM, the OCS control module may be mounted directly to the floor pan and require inspection if there is damage to the floor.



The vehicle maker may require all or part of the OCS be replaced, including the sensor bladder (left) and the control module (right).

Depending on vehicle maker recommendations, OCS parts that must be replaced after a collision may include:

- the entire calibrated assembly, including the sensor pad, seat cushion foam, and control module. Do not repair parts of an OCS assembly. Also, do not remove and replace individual parts from a new OCS assembly. The OCS will not work properly if parts are replaced separately.
- only the damaged parts. Two examples of this recommendation apply to the 2010 Chevrolet Camaro and Buick LaCrosse. On these vehicles, the sensor pad and control module can be replaced separately.

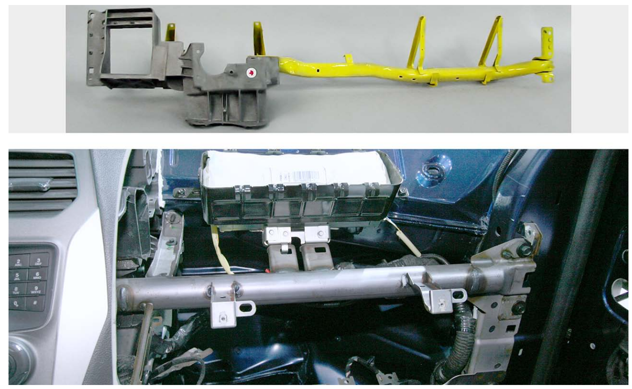
Some vehicle makers, such as Toyota, require specific weights be used when recalibrating the OCS.

Vehicle makers have various recommendations regarding recalibration of the OCS. OCS recalibration:

- may be required following a collision.
- may be required if the seat is removed or replaced.
- is typically done using a vehicle maker-specific scan tool.
- may require weights. Recalibration of the OCS may require a specific set of weights provided by the vehicle maker, in addition to a scan tool. For example, Toyota vehicles require 20 kg (44 lb) and 30 kg (66.14 lb) solid metal weights and a scan tool for calibrating bladder-type systems. Only a 30 kg (66.14 lb) solid metal weight and scan tool is required to calibrate seats with a weight sensor-type system on Toyota vehicles. Any other type of weight, including a liquid weight, should not be used to prevent inaccurate results.

General Motors vehicles require a scan tool when calibrating the passenger presence system to zero. No weight is added to the seat.

Ford vehicles require a scan tool when calibrating the occupant classification sensor. No weight is added to the seat.



An instrument panel frame adds to the vehicle structure and should be inspected for damage.

Instrument panel frames:

- are attached from A-pillar to A-pillar and may have an attached steering column and passenger airbag in addition to the instrument panel.
- are called different names. For example, Ford calls it the instrument panel reinforcement. General Motors calls it the cross-car beam. Other vehicle makers may call it a type of crossmember.
- should be inspected for damage. Inspect the instrument panel frame for visible damage such as cracks or deformation. Also check the gaps between the dash and trim panels. Gaps that exceed vehicle maker specifications may

indicate a damaged instrument panel frame. Damage to the lower instrument panel, knee bolster, or brackets may also indicate damage to the instrument panel frame. Damaged instrument panel frames should be replaced. Some vehicle makers may require inspection of the instrument panel frame following front passenger airbag deployment.

Refer to "Video: Front Passenger Airbag Considerations (Pt. 1)" in the presentation. This video shows a front passenger airbag deployment. Answer the question asked at the end of the video before continuing to the next screen.

Refer to "Video: Front Passenger Airbag Considerations (Pt. 2)" in the presentation. This video discusses considerations for front passenger airbag deployment and answers the question from the previous video. Answer the question asked at the end of the video before continuing to the next screen.

Refer to "Video: Front Passenger Airbag Considerations (Pt. 3)" in the presentation. This video discusses considerations for the occupant classification system following airbag deployment and answers the question from the previous video.

This instrument panel was torn during the passenger airbag deployment.

Replacement considerations for a front passenger airbag deployment may include:

- replacing the entire instrument panel assembly. Some top-mounted passenger airbags may cause damage to the instrument panel. Instrument panels damaged by a passenger airbag deployment should not be repaired.
- only replacing the airbag module. Some front passenger airbag modules have a built-in cover and may not require replacing the instrument panel following deployment. Damaged airbag covers should not be repaired. The passenger airbag cover on the 2010 Dodge Caravan is serviced as a separate replacement part.
- windshield damage. Top-mounted front passenger airbags designed to deflect off the windshield during deployment may damage the windshield, which will require replacing the windshield. The windshield is considered a structural part of the vehicle and requires specific repair procedures for proper replacement. These procedures must be followed to ensure the windshield remains intact in the event of another collision. More information on proper replacement of stationary glass can be found in the I-CAR live "Stationary Glass (GLA02)" training course.
- replacing melted wiring harnesses or connectors. Some vehicle makers have SRS wiring repair solutions built into the vehicle design. For example, the passenger airbag system wiring on the 2011 Nissan Altima includes a built-in secondary wiring harness secured behind the main harness. After passenger airbag deployment, the original passenger airbag wires must be cut and taped off and replaced with the secondary built-in harness and connector.

Side Airbags

Suzuki Kizashi

This Suzuki Kazashi display shows side airbags frozen in their deployment state.

Many vehicles have side airbags to offer extra protection in side impact collisions. A side airbag may be located:

- in the seat backs.
- along the roof rails from the A-pillar to the rear pillar. Airbags located in these areas are typically referred to as curtain airbags.
- in the door trim panels. The side airbags on the 2010 BMW M5 are located behind the door trim panels. The door trim panel will require replacement, and the door water barrier and insulation must be inspected following side airbag deployment.

Refer to "Video: Seat Side Airbags" to see seat side airbags deploy.

Side airbags may be located on the exterior-facing side of the seat back. They may be equipped in the front seats only or both front and rear seats. After deployment, the vehicle maker may:

- require replacement of the seat frame or complete seat back assembly. The seat back assembly must be replaced on the 2011 Nissan Maxima following seat side airbag deployment.
- require replacement of damaged seat covers. Damaged seat covers should not be repaired. Seat covers that split during airbag deployment should not be re-sewn. This is because they use a special thread that allows the seam to split and the airbag to properly deploy.
- require replacement of the foam padding.
- only require replacement of the airbag module if the module has a built-in cover. The seat side airbag on the 2011 Ford Fusion has a built-in cover.

Refer to "Video: Side Curtain Airbags" to see a side curtain airbag deploy.

Side curtain airbags are located along the roof rails. They typically extend from the A-pillar to the C- or D-pillar. Some larger vehicles may have multiple curtains on both sides to provide protection for both the front and rear occupants. After deployment of a side curtain airbag, the vehicle maker may require:

- inspecting for damaged interior trim panels and replacement of certain trim panels.
- removal or replacement of the headliner.
- replacing clips, fasteners, and tethers. Some interior trim panels that cover curtain airbag modules use tethers to prevent them from becoming projectiles during deployment. These need to be replaced to protect the occupants during another collision.

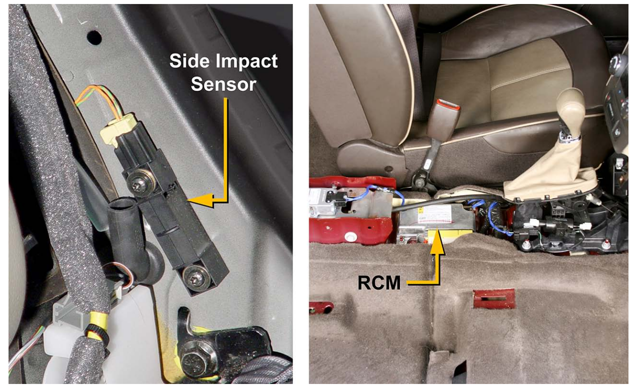
Refer to vehicle maker service information or an airbag chart to determine required replacement and inspection recommendations for deployed side curtain airbags. Service information for the 2009 Jeep Grand Cherokee specifies that the A-, B-, C-, and D-pillar trim (on the side of deployment) and the headliner must be replaced following curtain airbag deployment. The service information also states that the sunroof drain tubes and hoses must be inspected for damage.

The 2011 Volvo S80 may receive windshield damage during curtain airbag deployment.

The airbag label on this door panel indicates an airbag within.

Side airbag modules may be located behind the door trim panel. The airbag module may have a built-in cover. Door panel side airbags that do not have a built-in cover will require door trim panel replacement.

Damaged moisture barriers must also be replaced.



The side airbag sensor on this B-pillar (left) and the restraints control module (right) may require replacement after a side airbag deployment.

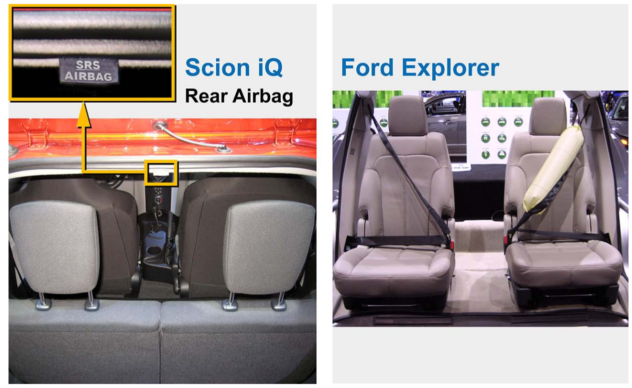
Side airbag deployments may require replacement of:

- any deployed airbag modules.
- side impact sensors. Some vehicle makers only require replacing side impact sensors on the side of the collision.
- the RCM.
- damaged wiring.
- damaged interior trim panels. Interior trim panels, including the moisture barrier, may require mandatory replacement if specified by the vehicle maker, even if they appear undamaged.

Refer to vehicle-specific information sources to determine what is required following a side airbag deployment.

More information on front and side airbag replacement can be found in the I-CAR live “Advanced Restraint Systems (RES02)” training course.

This sunroof is dislodged due to the pressure of airbags deploying in the passenger compartment.



Two novel types of airbags include the rear window curtain airbag on the 2011 Scion iQ and the Ford rear inflatable seat belt.

After an airbag deployment, also inspect for:

- impact damage, cracks, corrosion, or deformation.
- heat damage.
- misalignment to adjacent parts and panels.
- damaged wiring harnesses. Depending on vehicle maker recommendations, SRS wiring repair may be allowed.
- damage caused by excessive interior air pressure from airbag deployment. Areas on the vehicle that are not associated with the airbag system may be damaged by the pressure, or force, of an airbag deployment. These may include sunroofs, plastic door panels, the roof, or movable and stationary glass.

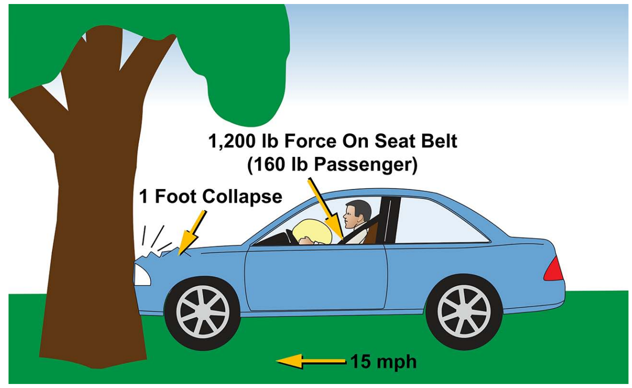
Vehicle makers are constantly inventing new ways to use airbags to protect the occupants in the event of a collision. A few examples of new types of airbag systems recently introduced on new vehicles include:

- a rear curtain airbag on the 2011 Scion iQ. The rear curtain airbag deploys downward in front of the backglass in a rear collision. The rear seat occupant's head is very close to the backglass on this vehicle.
- rear inflatable seat belts on the 2011 Ford Explorer. Each inflatable seat belt uses two seat belt retractors, a retractor for the shoulder belt and for the lap belt. The lap belt may be used for installing a child safety seat. The shoulder strap, which has the potential to inflate during a collision, is not used to secure the child safety seat. Ford plans to eventually equip all Ford and Lincoln vehicles with rear inflatable seat belts.

Refer to "Video: Curtain Airbag Considerations" in the presentation. This video shows a curtain airbag deployment. Answer the question asked at the end of the video before continuing to the next screen.

Refer to "Video: Curtain Airbag Considerations (cont'd)" in the presentation. This video discusses considerations for a curtain airbag deployment and answers the question from the previous video.

Seat Belt Systems



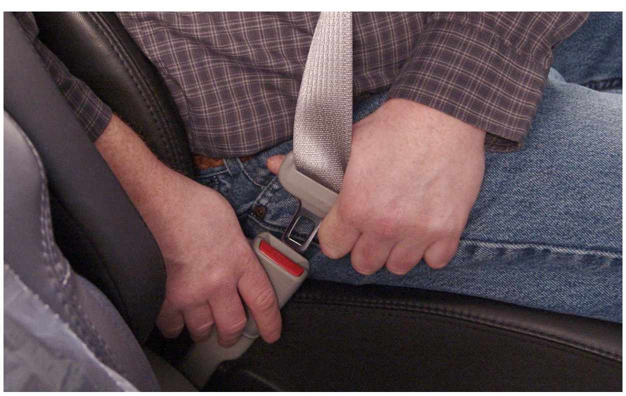
This illustration shows the tremendous force on a seat belt in a low-speed collision.

A damaged seat belt system could lead to occupant injury in the event of a collision. The technician, damage appraiser, collision repair facility, or insurer may be held liable if seat belts are not serviced properly. When inspecting or replacing seat belts:

- follow vehicle maker recommendations. Many vehicle makers require replacement of all seat belts that were in use during an airbag deployment or a collision of specific severity. General Motors requires replacement of any seat belts that were in use during a collision.
- ask the driver the approximate speed the vehicle was traveling at the time of the collision and which seat belts were being used. Also ask if a child safety seat was in use. Information about the collision may help to determine which seat belts will require replacement.

- replace all mounting fasteners that are damaged or are required by the vehicle maker.
- do not install recycled seat belt parts.
- it may be necessary to determine whether the damage is collision-related or pre-existing.

To understand the importance of properly replacing seat belt assemblies, consider the amount of force that is exerted on the seat belt during a low-speed collision. This can be explained with a basic collision scenario using a non-load-limiting seat belt, vehicle speed, occupant weight, and stopping distance for criteria. For example, a vehicle carrying a 72.5 kg (160 lb) occupant crashes into a tree at 15 mph. The front of the vehicle crushes inward about 30 cm (12") to absorb some of the impact force. Even with the crush zone reducing some of the force, it will still take about 544 kg (1,200 lb) of force to stop the momentum of the occupant. This means that 544 kg (1,200 lb) of force will be exerted on the seat belt.

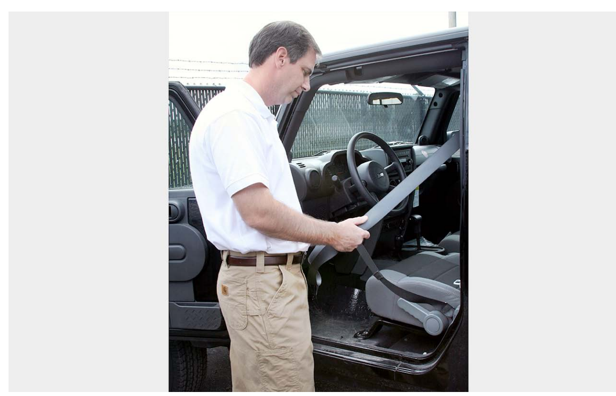


Among the checks when inspecting a seat belt is listening for an audible click when the tongue is inserted.

Check seat belt buckles for:

- an audible click when the tongue is inserted. Ensure that it remains buckled.
- cracks.
- a loose release button.
- excessive pressure required to release the tongue.
- indications of stress such as deformation or flaking chrome.

When inspecting seat belt buckles, verify that the seat belt warning lamp is operating properly. A seat belt buckle that is not functioning properly may cause the seat belt warning lamp to remain lit. The seat belt warning lamp should turn off when the driver seat belt is buckled. Some vehicles that have an OCS also require verifying that the seat belt warning lamp turns off when the passenger seat belt is buckled. The seat belt warning lamp may be designed to light when the passenger seat belt is unbuckled while the passenger seat is occupied.

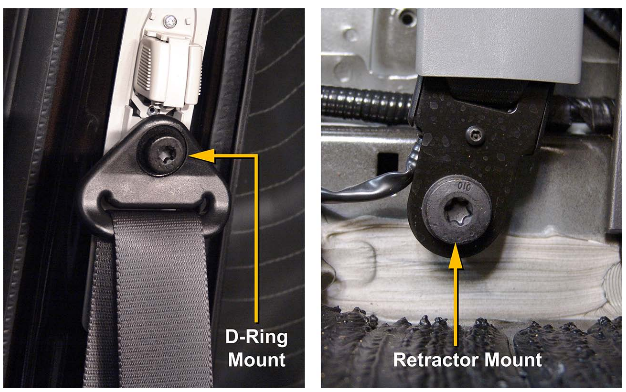


Check seat belt webbing for any signs of stretching or damage.

The entire seat belt webbing and retractor assembly may require replacement if damaged or worn. Seat belt webbing should be extended and inspected for:

- tears, cuts, or broken threads.
- signs of stretching or bowing.
- visible seat belt replacement warning or indicator labels.
- stains. Stains on seat belt webbing should not be cleaned using solvents.
- cigarette burns or other types of burn damage.
- deterioration.

Seat belt webbing inspection may require determining whether or not damage is related to the collision.

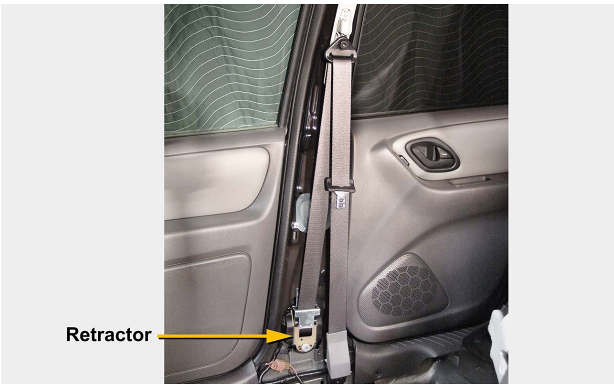


Seat belts must be anchored properly to operate, so check the top and bottom anchoring locations.

Common locations for seat belt anchors include the pillars, outside seat frame rail, and floor pan areas. Inspect anchors and anchoring locations for:

- cracks and distortion of mounting locations. This includes mounting locations for retractors, D-rings, and the height adjuster. Ford service information specifies that the seat belt mounting locations should be inspected and straightened, if necessary, before installing a new seat belt assembly. Always refer to vehicle-specific service information to determine required inspection or replacement recommendations for seat belt assembly mounting bolts and mounting locations. Also inspect the panel flange areas of mounting locations for damaged spot welds. Damaged spot welds located near the anchoring point may create a weak link and may affect the function of the seat belt system.
- cracks, distortion, or looseness of anchoring bolts. Seat belt assembly mounting bolts should be replaced with the seat belt assembly.
- dirt and corrosion. Although dirt may be cleaned, corroded parts should be replaced. Inspect anchoring areas for damaged spot welds.

Never replace individual parts that should be replaced as an assembly. Dismantling and only using parts of a seat belt assembly may compromise the safety of the vehicle occupants in another collision. Refer to vehicle-specific service information for proper torque specifications, which can also be printed and provided with the repair order.

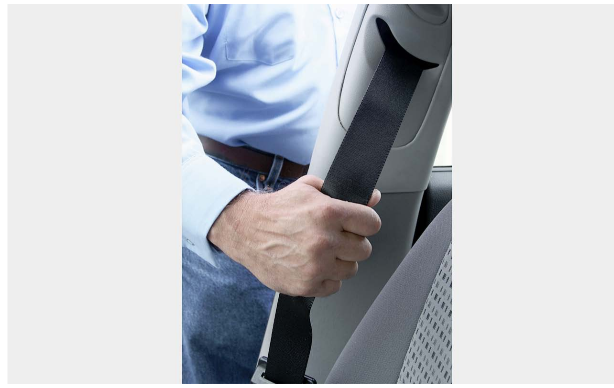


The retractor is designed to both store the seat belt webbing and lock the belt in place when extracted quickly.

Besides winding the seat belt into the assembly and allowing it to be pulled out, seat belt retractors may have other functions, such as:

- emergency locking. Most retractors have this feature and are commonly referred to as emergency locking retractors (ELR). Many retractors have a pendulum that causes the webbing to lock when the webbing is extracted from the retractor quickly. The webbing may also lock when the speed of the vehicle changes abruptly or when the vehicle is on a steep upgrade or downgrade, cornering hard, or during a rollover.
- automatic locking. Retractors that have this feature are commonly referred to as automatic locking retractors (ALR). These types of retractors allow child safety seats to be held tightly in place. Some vehicle makers refer to these as child hold-out or cinch mechanisms.

Most retractors are designed to be used on only one side of the vehicle and are not interchangeable.



Inspection of a retractor should include pulling on it quickly to determine if it locks like it should.

Check for proper extension and retraction of the webbing. If the action is not smooth and easy, inspect for:

- twisted webbing.
- dirt or other contamination on the webbing or in the retractor housing.
- proper movement on the anchor bolts.

The operation of the ELR should also be inspected. The retractor should lock the seat belt when it is pulled out quickly or when the retractor is tilted. Follow vehicle maker recommendations for testing the proper operation of the ELR.

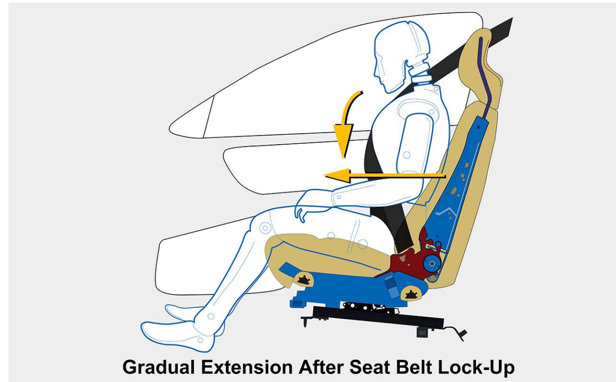
An improper ELR function may require replacement of the seat belt and retractor assembly.

On seat belts that are designed to hold a child safety seat, check the belt for proper operation.

The ALR function of the seat belt, which is used to secure a child safety seat, should be tested for proper operation. To test the operation of an ALR:

1. Pull the seat belt all the way out of the retractor.
2. Allow the seat belt to retract into the retractor slowly. This typically causes an audible clicking sound.
3. At regular intervals, pull on the seat belt with normal force with the intention of extracting it from the retractor. The belt should lock up.
4. If the seat belt does not lock up at any point, replace the retractor.

The ALR function is a common feature and may be found on all seats on equipped vehicles with the exception of the driver seat. The operation of an ALR is similar for most vehicles.

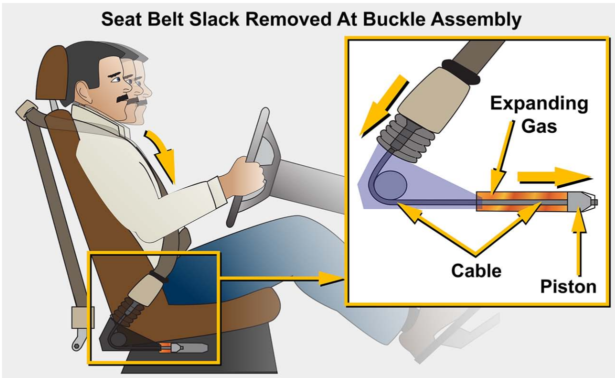


The illustration shows how a load-limiting seat belt absorbs some of the energy as the occupant is forced forward during a collision.

Some seat belts have load-limiting capabilities. These are designed to release the seat belt at a determined rate when it becomes locked during a collision or sudden stop. Load-limiting seat belts:

- are designed to reduce the force exerted on the occupant by the seat belt webbing, absorbing some of the force created from the forward momentum of the occupant.
- may use a deformable torsion bar located in the retractor assembly.
- should be inspected for signs of strain or activation. Check the seat belt webbing for signs of strain and proper retractor operation, such as locking up. Refer to vehicle-specific service information for seat belt replacement requirements. As stated earlier, seat belts may require replacement if worn during airbag or pre-tensioner deployment.

Seat Belt Pre-Tensioners



A deploying seat belt pre-tensioner tightens the seat belt during a collision to better hold the occupant.

Seat belt pre-tensioners:

- remove seat belt slack.
- hold the driver and passengers in proper position during a collision. These, along with the airbags, increase occupant protection.
- may use an expanding gas to move mechanical parts during operation.
- generally use the restraint system sensors and the RCM. They may also work with information from the OCS to determine if the front passenger seat belt pre-tensioner should deploy.

Seat belt pre-tensioners may deploy with or without airbag deployments. For example, the RCM may determine that the force of the collision warrants only the seat belt pre-tensioner to deploy.

Buick Verano

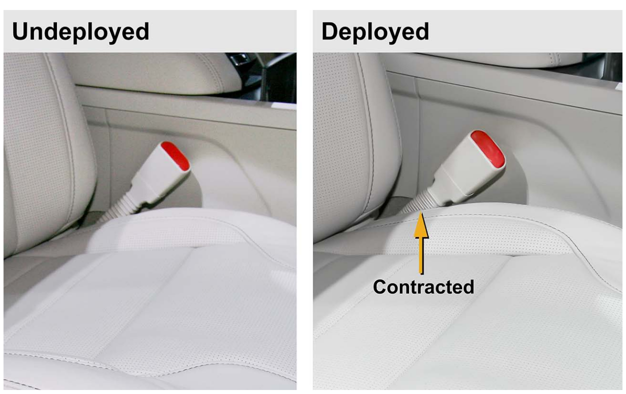
This type of seat belt pre-tensioner shortens the anchoring point when it deploys.

Seat belt pre-tensioners may work by:

- winding the seat belt retractor.
- shortening the seat belt buckle assembly with a piston and cable system. Rather than winding the retractor when the cable is pulled, the seat belt buckle assembly is shortened.
- shortening at the seat belt anchoring point.
- deploying the seat-belt pre-tensioners at the retractor point and buckle assembly or anchoring point simultaneously. For example, the 2010 Buick LaCrosse deploys both pre-tensioners in the retractor assembly and at the seat belt anchor point for the front seats.

There are other less common deployment methods. The 2010 Acura RL, for example, has a precollision detection system option called the collision mitigation braking system (CMBS). The CMBS uses motorized seat belt pre-tensioners. When the system detects that a collision is imminent, the driver is warned, the seat belt pre-tensioners are engaged, and the brakes are automatically applied. The motorized seat belt pre-tensioners allow disengagement if the CMBS detects that the collision is no longer imminent.

Refer to "Video: Seat Belt Pre-Tensioners" in the presentation to see a video on seat belt pre-tensioner deployments and explains how to determine deployment during damage analysis.



This type of seat belt pre-tensioner shows evidence of deployment with a shortened buckle assembly.

Inspect seat belt pre-tensioners to determine if they have been deployed. The conditions under which seat belt pre-tensioners deploy vary depending on the system. Deployment may occur when the airbags deploy or during minor collisions with no airbag deployment. Inspecting seat belt pretensioners may require:

- checking the instrument panel for a lit airbag warning lamp. Deployment may cause the seat belt or airbag warning lamps to light.
- extracting the seat belt from the retractor. The seat belt may lock up following deployment of the seat belt pre-tensioner. Rough operation or grinding noises may or may not indicate a deployed pre-tensioner.
- checking the seat belt buckle assembly. A shortened buckle assembly may indicate a deployed pre-tensioner. For this type of system, it may also be helpful to compare a suspected deployed seat belt pre-tensioner with one that is known to be undeployed. A front passenger seat belt pre-tensioner may not deploy if the seat belt was not in use during the collision.
- a scan tool. Some retractors, such as on Hyundai vehicles, may not lock up after deployment and a scan tool is required to determine deployment.

To ensure the safety of the occupants in another collision, it is vital to replace any deployed seat belt pre-tensioners, even if the seat belt retractor seems to be operating properly. Seat belt retractors that lock up when deployed may unlock when removed from the vehicle. This does not mean that it can be reinstalled.

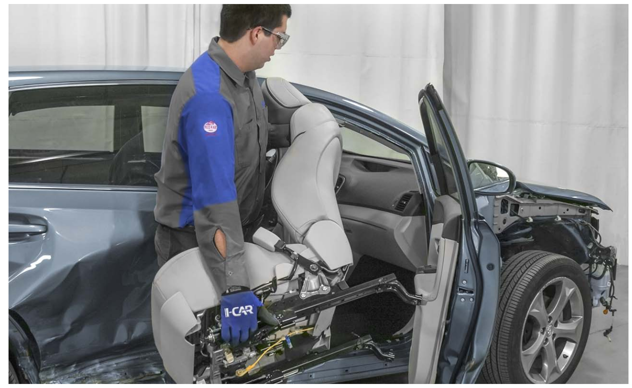
Volvo XC90

Any signs of damage on a seat belt pre-tensioner requires replacement of the unit.

When inspecting seat belt pre-tensioners:

- check for signs of visible damage. Damaged seat belt pre-tensioners will require replacement.
- refer to vehicle-specific service information for instructions on how to properly inspect seat belt pre-tensioners. Vehicle-specific service information should also provide replacement and disposal recommendations.

The 2011 Volvo XC90 may require all rear seat belt assemblies to be replaced after any airbag deployment. This is because all rear seat belts, including optional third row seating, are equipped with built-in seat belt pre-tensioners. Because the rear seat belt assemblies are not equipped with seat belt use sensors, the SRS module may deploy all rear seat belt pre-tensioners with an airbag deployment. The only exception to this is when a front airbag deploys during a minor collision because a front seat belt is not in use. In this case, the rear seat belt pre-tensioners are not deployed.

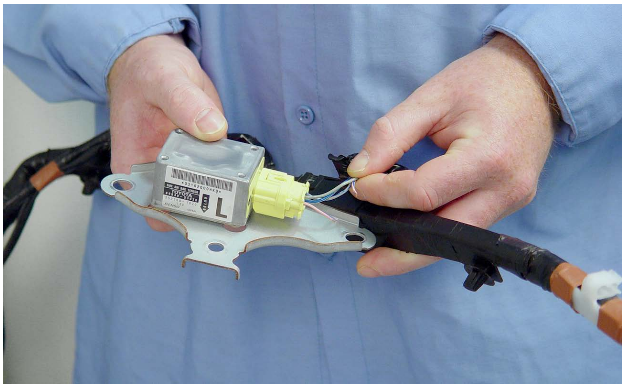


A deployed seat belt pre-tensioner may require removal of the seat.

Other considerations for deployed seat belt pretensioners include:

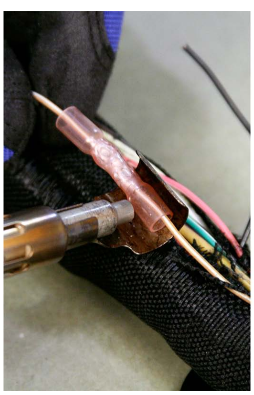
- damage to adjacent parts. Seat belt pre-tensioners may damage trim panels during deployment. For example, seat belt pre-tensioner deployment may damage the interior B-pillar trim panel on a 2010 Hyundai Azera sedan.
- that the seat assembly may require replacement, overhaul, or removal, which will likely require calibrating the OCS.

SRS Wiring



SRS wiring connectors are often yellow in color for easy visibility.

Repairs to SRS wiring harnesses, terminals, and connectors may or may not be allowed by the vehicle maker. Most vehicle makers do not recommend repairing damaged pigtail wires and connectors. Pigtail wires are short wiring harnesses that are hard-wired to electronic parts, such as impact sensors, airbag modules, and clock springs. SRS parts with damaged pigtail wires should generally be replaced. In some cases, however, pigtail wire replacement kits may be available. These may include connectors that allow the replacement pigtail wires to attach directly to the SRS part.



SRS wiring repairs may require wire splice sleeves (left) and a special repair kit (right).

SRS wiring repairs may require:

- using a special kit for splicing wires together. Examples of vehicle makers that require the use of a specific wiring repair kit for splicing SRS wiring include General Motors and Chrysler.
- crimping or soldering the wires together.
- the use of heat shrink tubes that prevent moisture from entering the splice seal. The wire ends may be positioned in the heat shrink tubes then heated to seal the splice. Heat shrink tubes may be color-coded according to wire gauge.
- offsetting splice locations.

Depending on the situation, it may be more practical to replace short wiring harnesses, rather than repairing them.

Vehicle maker that allow repairs to damaged SRS wiring include:

- General Motors
- Chrysler
- BMW (limited)
- Ford
- Mitsubishi (damaged connectors require replacing entire harness)
- Volvo

Vehicle makers that do NOT allow repairs to damaged SRS wiring include:

- Toyota / Lexus

- Honda / Acura
- Hyundai
- Kia
- Mazda
- Nissan
- Subaru

There are two I-CAR Advantage articles that discuss passive restraint wiring repairs. These can be accessed by visiting www.i-car.com and navigating to Technical Information and Advantage Online. You can search for the articles by typing "Wiring Repairs" in the Topic / Keyword text field. The article that discusses General Motors' recommendations is titled "Restraint System Wiring Repairs." The other article discusses Chrysler recommendations and is titled "Restraint System Wiring Repairs For Chrysler Group Vehicles."

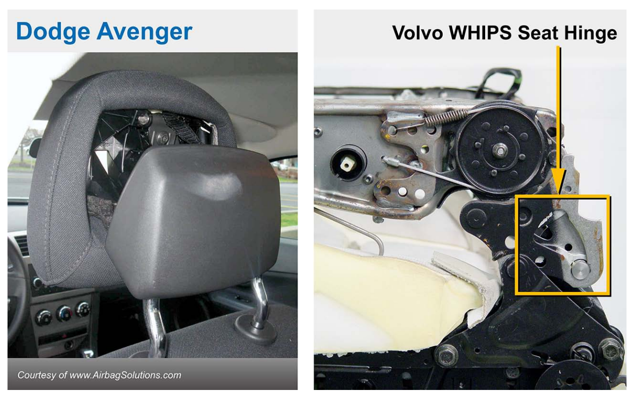
Seats

Seats are designed with safety features for occupant protection.

Seat assemblies work to protect the vehicle occupants during a collision. In a collision, the seat backs may:

- help restrain the occupants and prevent them from being ejected through the backglass.
- include headrests to help protect the occupants from whiplash injury.
- include advanced energy management systems. Active headrests are automatically positioned closer to the occupant's head to help reduce whiplash injury during a rear collision.

Both front seats on Volvo vehicles built since 2000 may be equipped with an energy-absorbing function called the whiplash head impact protection system (WHIPS). The front seats on both the 2011 Volvo C70 and S80 are equipped with WHIPS.



An example of a safety feature built into seats includes a whiplash protection system built into the hinge.

When inspecting seat assemblies, check:

- headrests for damage and proper operation. Some vehicles are equipped with active headrests, which are designed to move forward during a rear collision to reduce the chance of whiplash injury. Some active headrests are mechanical and may automatically reset or are reset manually. The active headrest system used on a 2010 Toyota Venza uses a pressure plate in the seat back to move the headrest forward. A spring automatically returns the headrests to the original position following the rear impact. Pressurized gas may also be used for activating an active headrest system. These types of systems may be reset by replacing a pressurized gas cartridge, such as on the 2010 BMW 7 Series. The cartridge can be replaced up to five times, while the active headrest system on the BMW 3 Series requires the complete headrest be replaced. Always refer to vehiclespecific service information to determine the proper repair / replacement procedures.

- seat backs for damage and proper operation. This includes determining if the seat is designed for energy absorption. When inspecting the WHIPS on a Volvo C70, the seat back is adjusted and the hinge mechanisms on both sides of the seat are checked for a gap between the rivet and fitting. If there is a visible gap, the mechanism must be replaced. Inspection procedures for WHIPS may vary depending on the year and model of the Volvo vehicle. Always refer to vehicle-specific service information for inspecting these types of systems.

Side impact damage caused damage to the bottom of this seat, perhaps even damage to the seat frame.

Seat assemblies should also be inspected for:

- loose or bent seat-to-floor mounting brackets and fasteners.
- damaged or non-functioning hinge locks or reclining mechanisms. The brackets connecting the seat back to the seat bottom should be inspected for distortion and cracking. These brackets and mechanisms may be serviced separately or as part of an assembly.
- bent seat frames.

A seat that does not move smoothly on the seat tracks, or is loose, may be damaged. Also check seat back frames for deformation and corrosion. Most vehicle makers do not recommend straightening damaged seat frames. This is because straightening may not restore the original integrity designed into the seat and may compromise the safety of the vehicle occupants. A seat frame may become distorted or twisted due to the deployment of a side seat mounted airbag. Some manufacturers recommend replacing the seat back frame following seat side airbag deployment. Removal or replacement of the front passenger seat assembly may require recalibrating the OCS.

The child safety booster seat is part of the seat on some Volvo models.

Some vehicles include child safety seats that are integrated into the rear seat. Integrated child safety seats:

- may be designed to be folded into the seat. This allows the seat to be used by an adult if the safety seat is not being used.
- may be designed as a booster seat. Booster seats are intended for older children that are too short for the vehicle seat belts. Volvo vehicles built after 1991 may be equipped with an integrated child booster seat.
- should be inspected for damage. Parts of an integrated child safety seat that should be inspected may include webbing, buckles, bolts or fasteners, hinges, and upholstery. Check these parts for gouges, scratches, cracks, tears, distortion, or damaged webbing.
- must be replaced if damaged or in use during a collision. This may include replacement of the entire seat assembly or it may be available as a separate module. Refer to vehicle-specific service information for replacing damage integrated child seats.

2010 Dodge Caravan minivans may be equipped with an integrated child seat or child booster seat.

Removable child safety seats must be closely inspected for damage. Some may require replacement after a collision even if not damaged.

Removable child safety seats should also be inspected for damage. When inspecting removable child safety seats:

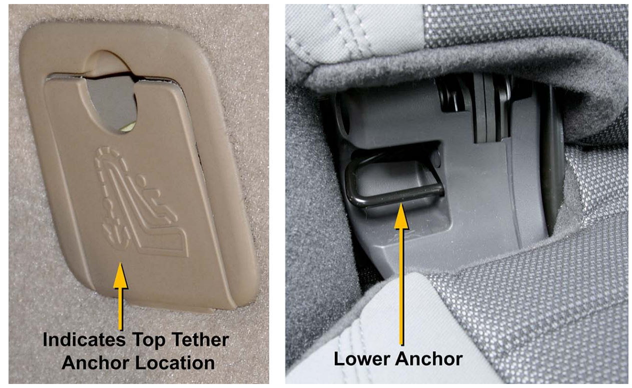
- determine and document if the seat was in use during the collision. This may require a consultation with the vehicle owner.
- replace the seat and notify the owner if it shows any signs of damage. Signs of damage

may include cracks, tears, or deformation on any part of the child safety seat.
- check with the seat maker or local regulations to determine if the child safety seat requires mandatory replacement even if no damage is found.

The child safety seat may require removal during the repair process. If so, ensure that it is reinstalled by a qualified person. Local law enforcement personnel, fire departments, or hospitals may offer this service free of charge. Another option would be an employee who is trained to properly inspect and install child safety seats. To locate training offered in your area, contact the National Highway Traffic Safety Administration (NHTSA) or visit www.nhtsa.dot.gov.

The Insurance Institute for Highway Safety is another resource for information regarding child safety seats.

Child seats that are damaged or determined to be unusable should be dismantled or destroyed before disposing. This will help prevent anyone retrieving it from the trash for reuse.



Check the child safety seat tether locations for damage.

Lower anchors and tethers for children (LATCH) systems are designed to allow child safety seats to be installed without the use of the vehicle seat belts. LATCH systems:

- were mandated by the Federal government to be installed in the rear seats of all vehicles built after September 2002.
- have lower anchors attached to the seat frame. Lower anchors provide an anchoring point for the straps that secure the base of a child safety seat. These are located between the seat back and seat bottom cushions.
- have top tether anchors that may be attached to the seat back frame, rear shelf panel, or floor pan. Top tethers provide an anchoring point for the straps that secure the top of the child safety seat.
- should be inspected for damage after a collision. Cracked, torn, or distorted anchors should always be replaced following vehicle maker recommendations. Anchors that are attached with welds may require replacing the entire

part. For example, the top tether anchors on the 2005 Chevrolet Tahoe are welded to the seat back frame and cannot be replaced separately.

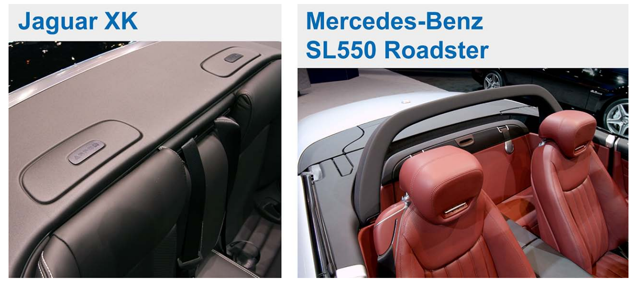
This anchorage system may be called ISOFIX in Canada, Australia, and New Zealand. ISO is in reference to the International Standards Organization.

Among items to inspect on a seat are the various electronic adjustment controls.

Seats should also be inspected for damaged:

- upholstery or missing trim.
- binding track assemblies.
- non-functioning adjustment controls.
- lumbar supports.
- side bolsters.
- arm rests.
- improperly functioning electronic accessories, such as heating elements and cooling fans, DVD players, and speakers built into the seat. A seat may also be equipped with a massage option. Some vehicles have flat screen displays mounted on the backside of headrests for rear occupants.

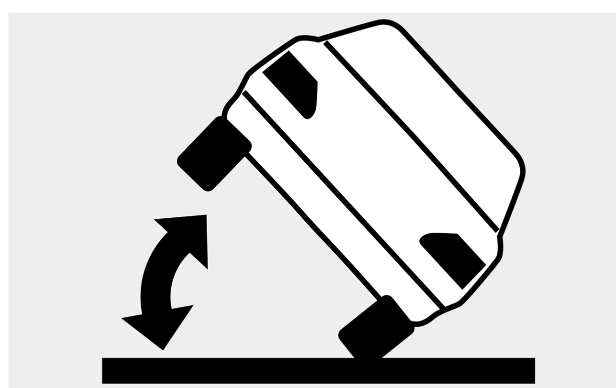
Pop-Up Roll Bars



Pop-up roll bars may be two pieces (left) or one piece (right).

Pop-up roll bars are common on European vehicles. Pop-up roll bars may:

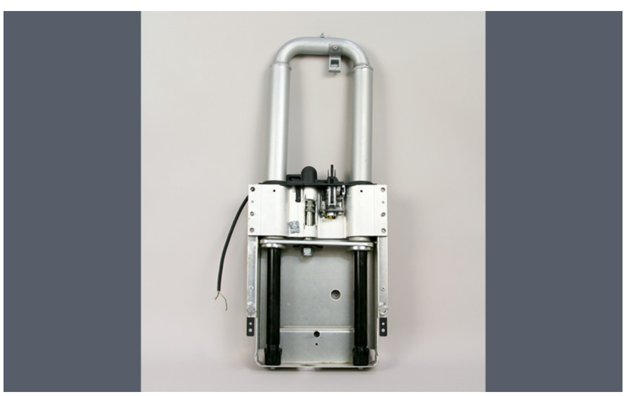
- be one bar that extends the width of the vehicle. There may be two individual pop-up roll bars on the left and right sides.
- be made of steel or aluminum.
- have either hydraulic cylinders or compressed springs.



Pop-up roll bars are designed to deploy if the vehicle tips a certain degree.

Pop-up roll bar activation:

- may occur when a vehicle leans on its side at a specific angle.
- may occur when the vehicle wheels leave the ground. This type of system may use a sensor that monitors suspension-to-chassis position change. There are multiple requirements that must occur at the same time for roll bar activation to occur. Roll bars will not activate unless all necessary criteria is met such as vehicle speed, deceleration, and roll angle.
- is determined by various types of sensors that detect when a rollover is imminent. These may include yaw rate sensors or lateral accelerometers, which may be integrated with the RCM.



Pop-up roll bars may be serviced as separate cassette assemblies.

Pop-up roll bars with physical damage must be replaced. Roll bar parts that are damaged require replacement. However, surface imperfections, such as scratches or blemishes, may be refinished as long as there is no damage affecting the integrity and operation of the part.

Inspect convertible tops for damage or deformation.

Some pop-up roll bars may be reset if there is no damage. Resetting pop-up roll bars may require a special tool or may be as simple as pushing them back down into place. Some hydraulic roll bars are lowered by pressing a switch on the vehicle instrument panel.

A malfunction indicator lamp (MIL) may indicate a malfunction with the pop-up roll bar system.

When removing a pop-up roll bar, do not attempt to remove the roll bar while it is in the armed position. Some roll bars can be activated using a screwdriver.

Left and right pop-up roll bars may be serviced as separate cassette assemblies.

Examples of pop-up roll bar replacement parts:

- 2009 Audi S4 Cabrio has roll bar cassette replacement parts (right and left parts are the same)
- 2009 BMW 3 Series Convertible roll bars are replaced as an assembly
- 2009 Jaguar XK has roll bar cassette replacement parts (right and left sides are the same)

- 2009 Mercedes-Benz SL has a one-piece pop-up roll bar

Mazda MX-5 Miata

Roll bars may not be pop-up at all but be part of the vehicle profile.

Some vehicles use stationary roll bars designed to limit occupant injury during a vehicle rollover. Inspection of stationary roll bars should include:

- evaluating the structure of the vehicle where the roll bar is attached.
- replacing damaged mounting hardware and fasteners.
- inspecting the roll bar and mounting areas for damage. Do not repair damaged stationary roll bars, although some vehicle makers may allow refinishing.

Examples of convertible vehicles equipped with a stationary roll bar include the 2009 Nissan 350Z Roadster and the 2009 Mazda MX-5 Miata.

Module Wrap-Up

Topics discussed in this module included:

- types of restraint systems.
- restraint system parts.
- deployment of restraints.
- required replacement and inspections.
- repair and replacement decisions.
- seat belt system parts and operation.
- considerations for damaged seat belt system parts.
- considerations for seat damage.

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