

TITLE: Airbag Update 2007
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AUDIENCE

EMS and Firefighters, particularly those involved and trained in vehicle extrication procedures

SYNOPSIS

While airbag systems help to protect vehicle occupants during a crash, they pose many special hazards to fire, EMS, rescue and law enforcement responders assisting at crash scenes, particularly during extrication. For their own safety, first responders must be familiar with current technology that exists in today's vehicles. Join training expert Ron Moore as he reviews the newest supplemental restraint airbag systems and the safety concerns they pose for first responders. He will identify practices and procedures that you need to know to mitigate the hazards of today's airbag systems.

OBJECTIVES

1. Identify various designs, locations, and functions of supplemental restraint airbag systems presented.
2. Outline the safety concerns associated with each airbag system and how they are likely to affect those present at a motor vehicle incident scene.
3. Identify the cause and effect influences of each airbag system item on present medical, fire suppression, safety, and rescue operations at motor vehicle incidents.
4. Identify how to initiate the necessary practices and procedures to mitigate the hazards presented by each airbag system, thereby rendering the scene safe for the patients and emergency personnel.

STATEMENT OF NEED

At a crash incident undeployed airbags pose a very real danger to fire, EMS, rescue and law enforcement on the scene when they attempt to extricate patients from vehicles. It is imperative that first responders understand the new technology that they may encounter on the job, procedures that avoid further injury to patients and proper procedures to mitigate the dangers posed by airbags.

INTRODUCTION

Airbags in vehicles are one of the newest of the new technologies confronting responders to crash and vehicle fire incidents. Airbags save lives and reduce the chance of injury. Occupants are walking away from crashes today that would have been non-survivable in years past. Responders are arriving to find everyone already out of their mutilated vehicles, usually with no injuries or just minor complaints. Occupants today who are restrained and also protected by airbag deployment have the greatest chance of survival in a vehicle crash scenario.

Airbags also present a challenge to fire, EMS, rescue and law enforcement responders. The possibility of having undeployed airbags within the immediate patient care area is a new risk for all involved. Accidental deployment of an airbag during extrication has already happened and can happen again. Before responders can fully protect themselves from the risks of the new technology of airbags, they must understand design and function of these systems and be able to quickly identify supplemental restraint airbag systems on the scene. This program will review

this material and update you on the most current designs, locations, and functions of airbag systems, along with the concerns associated with each and how they are likely to affect those present at a motor vehicle incident scene. We will also review cause and effect influences and identify procedures and practices that you need to know in order to stay safe on the job.

OBJECTIVE 1: Identify various designs, locations, and functions of supplemental restraint airbag systems presented.

Airbag Identifiers and Tags

Utilizing information from this presentation, the participant can improve their ability to quickly locate and comprehend the information presented by the airbags IDs found airbag-equipped vehicles.

We all agree that it is vital for responders to quickly identify all potential safety concerns at a crash scene. Determining the presence of airbags inside the vehicle is no exception. When airbags were located only on the driver and front passenger areas of a vehicle, it was easy to scan for airbags. With a quick look at the steering column and another glance at the glove compartment area, you would have the whole story. Now with the advent of knee airbags, airbags in the doors, seats, and along the roofline, even airbags for rear-seat passengers, rescuers have a more difficult task determining where airbags are located.

Before we can learn how to scan the vehicle's interior, we first need to know what we are looking for. Automakers are offering some form of visual identification indicating the presence of airbags in a vehicle in almost all vehicles sold today. One exception is the Volvo XC-90 roof airbag systems. Unfortunately, there is no standardization as to type or location of these "airbag ID" labels.

Let's begin by studying the means of identifying the newest supplemental restraint systems, side-impact airbags. Side-impact airbags are occupant safety features that an increasing number of automakers are designing into their vehicles. **Side-impact airbag locations can include the following:**

- **Windshield/VIN plate**
- **Front door**
- **Front seat**
- **B-pillar**
- **A-pillar/roofline**
- **Rear seat**

Seat Airbag IDs

One type of airbag ID found on seat airbags is a plastic blowout panel. There are three other types of seat airbag IDs used by automakers today. 'Shirt tag' airbag IDs are used by several manufacturers for their seat airbags. The airbag ID is a cloth tag actually sewn into the seam of the seat. Remember, the patient or their clothing can also easily obstruct this design of airbag ID.

Door Airbag IDs

Mercedes, like BMW and others, place their side impact airbags inside their doors. The ML430 SUV, for example, has an airbag ID on both the front and rear door panels. Nothing new here but make sure you scan the door panel closely to see the ID. Notice how it really blends into the interior trim colors of the vehicle. **Remember, for door-mounted airbags, the airbag unit will generally be towards the latch end of the door and above the level of the armrest.** The ID will be right in this area as well. The exception to this is the new Volvo door airbags that pop straight upward from the top edge of the door. This author refers to this system as the 'toaster' door airbag.

Roof Airbag IDs

For a roof-mounted side impact airbag system, the airbag ID can be found anywhere along the interior trim from the A-pillar to the very rear of the vehicle. Look along the top of the B-pillar and the C-pillar. Having two airbag IDs along the same side roofline is also a possibility.

For the Volvo roof-mounted Inflatable Curtain(IC) airbag IDs, the small plastic button is found at top of B-pillar. It doesn't say airbag or SRS like many of the others. It says 'IC Inflatable Curtain'. Besides not knowing what that might mean, a responder may find that it is completely missing after a crash. If the front airbags have deployed, the blast from the explosive charge of the seatbelt pre-tensioner located inside the B-pillar trim will dislodge the indicating little plastic piece. All evidence of a roof airbag system will be lying on the floor of the Volvo. In addition, the Volvo XC-90 is one example of a vehicle with two separate roof airbag systems on each side of the roofline.

Dual-Stage Airbags

Explain what a dual stage or dual threshold airbag system is, how it operates, and what influence these systems can have on fire, EMS, and rescue operations if present at an incident scene.

Airbags can deploy a second time. If that's news to you, then you aren't familiar with the technology of dual-stage or dual threshold airbag systems. Over the past few years, this system has become so commonplace that it is actually advertised by automakers as a selling point for their vehicles and is commonly listed as a safety feature on the window sticker of a new vehicle.

A dual-stage airbag actually has two inflator modules connected to one airbag. Each inflator module has a different power rating; say for example, a 70% charge in one inflator and a 30% charge in the other. Depending upon conditions such as speed, crash severity, occupant seating position, and seatbelt use or non-use, the airbag may deploy by firing only one of these two charges leaving a second 'live' charge. Generally, the more severe the crash, the greater chance that both inflator modules will deploy in rapid succession. Some dual stage airbags deploy both inflator modules, one after the other, in every crash situation. From a responder's point of view, this is the safest system design for fire, rescue, and EMS personnel.

With a typical dual stage airbag system, the 'first' firing utilizes one charge of propellant and initially deploys the airbag. If needed and called for by the airbag 'brain', the 'second' firing utilizes the other propellant charge and more fully inflates the bag during the few milliseconds of the collision.

The way the system is supposed to work, in a minor impact with a properly seated and belted occupant, the airbag system may deploy the airbag using only the lower power charge. Mercedes Benz is one of the manufacturers that does this. In some Mercedes cars for example, they only fire one stage, leaving the second stage active. This minimizes the chances of an occupant becoming injured in any way by the deployment of the airbag. It is this desire to prevent airbag-induced injuries that has brought about the creation of dual-stage airbags in the first place. If just one charge fires off, then it is possible for a deployed airbag to fire off a second time.

Dual-stage airbags can have two chemical inflators or may actually be dual stage stored gas units containing two newer stored gas inflators. The two-inflator modules can deploy with a varying time-delay, one after the other, dependent upon accident severity.

How does dual stage airbag technology affect our fire, rescue, and EMS actions at vehicle incidents? The first and obvious difference is that now, with dual stage airbags, a deployed airbag can deploy a second time while we are at the scene. The deployed airbag hanging from the steering wheel or dashboard, which up until now has been considered a 'dead' airbag, must now be thought of as 'live'. We need a renewed respect for the airbag inflation zones: 10 inches for the driver's frontal airbag, 18 inches for the passenger's frontal airbag, and the 5 inches of thickness for any roof airbag or a new knee airbag system.

We must review our EMS and extrication practices and procedures. Now, even with a bag hanging out of the steering wheel or drooping over the dashboard, we cannot become complacent and place our medical equipment, rescue tools, our patient, or ourselves within an airbag inflation zone. The importance of working from the side and always respecting the airbag inflation zones is now more important than ever before.

The importance of taking away a vehicle's electrical power should now be considered an essential action if medical or rescue work will take place. **Early in an incident, efforts to simply disconnect or double-cut the battery cables must be initiated. Taking away the power begins the airbag capacitor draining process.** The sooner this is started, the sooner the capacitor loses its' power and the less likely a dual stage airbag that has already deployed once will be to deploy a second time during an extrication.

Rescuers continue to dream up unorthodox procedures for dealing with loaded 'live' or the newer generation of 'dead' airbags. One question that is frequently asked is "Can't I just cut the nylon bag off the deployed airbag unit? That way if it deploys a second time, the airbag can't inflate and hurt me." Automakers continue to discourage this action or any other effort that would cause the rescuer to tamper with, cut, restrain, or otherwise alter the airbag system. If you did cut away a dual stage airbag with a live second charge, if the second inflator ever fired, it would be like being in front of a sawed-off shotgun blast of heated gases.

Emergency response personnel who deal with vehicle crashes or fire situations can study this new technology to better their understanding of the systems available. The best place to start is a body shop or repair service center. Ask permission to rummage through their junked airbag units. Look on the backside of the unit or the end where the wiring connects to the inflator. If you find one with two plugs, two connectors on the same inflator unit, or two hockey puck-size inflator modules side by side, then you've got yourself a great training prop - your own dual stage airbag. Show this to all your personnel so that they too can become familiar with dual stage airbag systems and can better understand the reality of this new technology.

The actual nylon airbag on Mercedes SL-Class convertibles have a warning about undeployed second charges printed on the airbag itself. Clearly stated in five languages; German, English, French, Italian, and Spanish, the printed warning states;

Risk of Injury!

Two-stage airbag system! Airbag could trigger a second time.

Use the same safety precautions as if the airbag had not deployed.

Good advice for us all. Welcome to the world of dual stage airbags!

KNOWLEDGE ASSESSMENT

The best way to deal with a dual stage airbag that has deployed once, preventing it from discharging unexpectedly a second time is to _____.

- cut the nylon bag off the unit
- encourage an anticipated secondary discharge by tripping the charge
- disconnect or double-cut the battery cables
- remove the chemical inflators

Answer: C

Rationale: Early in an incident, efforts to simply disconnect or double-cut the battery cables must be initiated. Taking away the power begins the airbag capacitor draining process. The sooner this is started, the sooner the capacitor loses its power and the less likely a dual stage airbag that has already deployed once will be to deploy a second time during an extrication.

Knee Bag Update

Given actual vehicles equipped with knee airbags, identify the location of the knee airbag, explain its operating features, and describe responder safety considerations for operating near an undeployed knee airbag system.

Currently there are 10 vehicle models sold in the United States equipped with either a driver's knee airbag system or dual, driver and front passenger, knee bags. According to one US-based airbag manufacturer, 3 million model year 2004 vehicles were produced, in that year alone, with 'inflatable knee bolsters'. *

Researchers at USA TODAY report that hip injuries accounted for 48% of car-crash leg injuries in 1993-2001 vehicles.** To address this injury concern and to help keep front seat occupants away from frontal airbag inflation zones, manufacturers have dramatically increased their use of knee airbag systems.

Knee airbags are installed relatively low along the instrument panel, below the glove compartment on the passenger's side of the dash. On the driver's side, the knee bag is positioned beneath the steering column. This relatively new technology works simultaneously with seatbelts and pre-tensioners to improve overall occupant survival in a frontal collision. In a frontal collision that initiates deployment of one or both frontal airbags, knee bags deploy outward from the dash toward the front edge of the seat.

There are two basic knee airbag designs. One style uses the inflated knee bag itself to press against the knees of the front occupants. The other knee bag design has a 'knee bolster' panel permanently attached to the bag itself. It is this padded panel that actually presses against the occupant's knees, not the actual airbag.

This pressure against the knees and legs, along with the firing of the seatbelt pre-tensioners, holds the occupants in their seated position properly at the moment of a frontal collision. An inflated knee bag increases the chance of the driver and front seat occupant remaining out of the 10-inch and 18-inch inflation zones of the frontal airbags. It also reduces the risk of "submarining", the gliding of an occupant under their seatbelt, crushing them under the dash and instrument panel on the floorboard.

The popularity of knee airbag systems among automakers is also due, in part, to the fact that having knee airbags allows the 'show surface' of the instrument panel to be designed further away from the front seats giving the front seat occupant more legroom.

The Lexus RX 330 vehicle is an excellent example of how knee bags are being integrated into a vehicle's total crash protection system. The RX's safety systems include a driver's multistage airbag that deploys at one of three speeds depending on many factors including crash severity and seat track position. Similarly, the front passenger dual-stage airbag uses weight and crash-severity sensors to monitor its deployment. For side impacts, there are seat-mounted side-impact airbags for front occupants. There are also roof-mounted side-impact airbags along with the new driver's-knee airbag. In addition, if either frontal airbag deploys, seatbelt pre-tensioners fire to remove slack from the seatbelt system as the vehicle's Automatic Collision Notification system engages the Lexus Tele Aid SOS telemetry system.

OBJECTIVE 2: Outline the safety concerns associated with each airbag system and how they are likely to affect those present at a motor vehicle incident scene.

Windshield Crash Damage & 'Spider Webs'

Given a crash-damaged vehicle, responders shall determine if there is damage to the windshield, if the damage can be described as a windshield 'spider web', and if the damage was caused by collision damage, frontal airbag deployment, contact by an unrestrained vehicle occupant, or impact with loose objects.

It is important that responders realize that valuable information can be gained from the windshield of a vehicle that has been involved in a collision. The glass can indicate a lot about what happened to your patients during the few seconds of the crash. Once extrication crews cut out the glass, the information that it holds can easily be lost.

In a minor collision, for example, there may be no damage to the laminated glass at all, no cracks or slivers visible in the glass. That, in and of itself, is a piece of information responders should take into consideration during incident size-up and patient assessment. It may indicate that once you get close to the vehicle and make patient contact, you may find that there are no injuries and most likely, the occupants will sign release forms refusing treatment.

On the other hand, if you approach a crash-damaged vehicle and observe significant windshield damage, you are arriving at a more significant incident. There is a greater probability of patient injury and the potential for entrapment.

There is one certain type of windshield damage that is best described as a 'spider web'. Similar to a real spider's web, this damage has a central point around which all the breakage seems to focus. A windshield spider web can be in a circular pattern or a long horizontal arrangement. By studying windshield spider webs, you will learn exactly what windshield spider webs are able to tell us at crash scenes and you will become more proficient at 'reading the wreck'.

In the most common spider web scenario, the passenger frontal airbag or the airbag cover itself fractures the laminated glass as the bag deploys. In this specific case, the concentrated horizontal line of glass breakage indicates that the edge of the airbag cover did the damage.

Dual spider webs present two different stories. Damage to the passenger's side of the windshield is typical of an airbag spider web. A spider web on the driver's side of the glass however tells a completely different story - unrestrained driver! Remember this critical point; a spider web on the driver's side of the windshield cannot be caused by a deploying driver's frontal airbag. The steering wheel-mounted airbag is aimed away from the windshield and will not strike it as it deploys. A high spider web indicates contact by an unrestrained driver occupant.

KNOWLEDGE ASSESSMENT

A high spider web on the drivers side of a crashed vehicle is an indicator that _____.

- a. the drivers airbag deployed improperly.
- b. the driver was not wearing a seatbelt.
- c. the vehicle is equipped with a dual stage airbag system.
- d. that the driver was properly restrained.

Answer: B

Rationale: Damage to the passenger's side of the windshield is typical of an airbag spider web. A spider web on the driver's side of the glass however tells a completely different story - unrestrained driver!

Pressurized Vessels on Vehicles

Identify real-world incidents of airbag system stored gas inflators exposed to high heat levels during vehicle fires and establish procedural guidelines for operating at vehicle fires, including engine compartment fires, which assure maximum safety for suppression personnel from the hazard of airbag system stored gas inflator failures.

Pressurized vessels are used primarily to deploy roof-mounted airbags but they can also be found connected to seat or door-mounted airbags, the passenger frontal airbags and knee bag systems. The inflator is a cigar-shaped unit that contains argon and helium gas. The gases are pressurized at up to 4,000psi. During a crash sequence, the gases are released from the inflator and flow into the airbag.

Responders already know that pressurized vessels on vehicles can fail violently during vehicle fires, but stored gas inflators are a new challenge for fire suppression crews and brings up the question of how well do they hold up during a fire.

An interesting vehicle fire occurred in Flagler County, Florida involving a 2001 Nissan Altima sedan that was stolen and then torched. The post fire investigation revealed a hole in the roof above the passenger's front seat area. A closer examination of the totally burned out vehicle revealed that the stored gas inflator from the side-impact air bag mounted in the passenger front seat had failed during the fire. Investigators determined that the top portion of it flew upward, making the hole in the roof.

In another incident in McKinney Texas, firefighters arrived at the scene of a fully involved 2002 Dodge vehicle. Because it was an arson fire, the stolen vehicle had been torched and was well involved when the firefighters arrived. After extinguishment, the crew found two large pieces of the passenger frontal airbag unit lying in the roadway approximately 120 feet ahead of the vehicle.

The passenger frontal airbag on an Altima uses a stored gas inflator unit for deployment. The large unit, which resembles a thermos bottle in size, is pressurized to 4,000psi. During the fire, the pressurized stored gas inflator cylinder itself had failed violently prior to the arrival of the engine company. The heat from the fire caused the vessel to rupture with enough force that the vessel broke free of its mounting and flew into the air.

Captain Lee Junkins, Training Officer of the Sansom Park (TX) Fire Department, has developed an entire training program based on the hazards of burning vehicles. As part of his research for that project, Captain Junkins obtained 100 identical stored gas inflator units from automobile airbag systems. Using a homemade field testing assembly, he exposed each of the pressurized inflators to the flame from a standard highway flare. In 93 out of the 100 tests he conducted, the inflator simply heated and deployed the airbag. In 7 of the 100 tests however, the stored

gas inflator failed violently resulting in an uncontrolled explosion of shrapnel as the vessel disintegrated.

What's the bottom line on stored gas inflator units and fires? The reality is that these 4,000psi cylinders have no relief valve built into them. Any vehicle today can contain several of these airbag inflator units: two for the roof airbags, two for the front seat airbags, and another one for the passenger front airbag, for example. In most cases, nothing out of the ordinary will happen as the vehicle burns. The fire will heat the inflator and once a certain amount of heat is built up inside the inflator, it will 'vent' by firing off the airbag. The nylon bag will deploy into the flashover conditions that exist inside the vehicle and the bag melts away.

The 'Real World' also tells us that things can and will go wrong as a vehicle burns. Our airbag fire case studies verify this. Stored gas inflators for airbag systems can be heated to the point that the cylinder itself fails violently. That failure may result in a small projectile being shot out through a window or roof as with the 2001 Altima incident. In a worst case scenario, the rupture of the cylinder may send large chunks of hot metal flying out in all directions as in the McKinney TX incident. Either way, it is a dangerous situation for fire suppression personnel.

As firefighters, we cannot predict exactly what will happen but we must anticipate what can happen. Any vehicle with open flame upon arrival must be thought of as a 'total loss' vehicle. It's a loser already and that's not your fault. But it is your fault if a member of your crew is injured during the fire fight. The burning vehicle is worth nothing. Your safety is worth everything.

Assure that your department's guidelines for attacking vehicle fires require full protective clothing with SCBA. Emphasize an initial attack from a safe approach angle with an adequate size handline that can initially sweep water beneath the vehicle to cool the undercarriage. Encourage crews to begin hitting the fire from a distance as they move in to cool the vehicle especially if it is a well-involved interior fire.

OBJECTIVE 3: Identify the cause and effect influences of each airbag system item on present medical, fire suppression, safety, and rescue operations at motor vehicle incidents.

SMART Airbags

Identify how SMART airbag systems deploy airbags depending upon occupant position and crash information. Become familiar with the operation of SMART airbag technology in order to understand and anticipate unusual deployments of one or more airbags in a crash scenario.

In their 1988 model year, Mercedes-Benz was first to introduce a dual deployment threshold for its driver front airbag. The following year, a passenger front airbag was introduced with the same dual deployment feature. Having the airbag deploy at higher or lower crash speeds is now common among automakers.

Besides knowing the speed at which a crash occurred, this early Mercedes system was smart enough to know if there were occupants in the front seats and if they had their seatbelts on or not at the moment of the crash. If the driver or front passenger were not wearing their seatbelt for example, the smart airbag system would deploy their frontal airbag at a lower speed during impact than if that same occupant were properly buckled up.

The smart 'brain' of the Mercedes system can even figure out who needs an airbag the most or can determine if, in fact, the crash is minor enough that a belted occupant does not need an airbag to protect them. For example, if the driver of a Mercedes was belted in a low speed crash and the passenger was not, potentially only the unbelted passenger's airbag would deploy. This was the beginning of what has now been termed 'SMART' airbag technology.

In 1994, the strategy announced by the National Highway Traffic Safety Administration, NHTSA, to address concerns about airbag deaths included a required phase-in of the next generation of **'SMART' technology airbags by the 1999 model year. These systems sense the position or the weight of the passenger and adjust deployment to provide the best protection.**

What this means for responders is that we will encounter any possible combination of deployment of front airbags. With a standard airbag system, if the crash sensors deploy the driver's airbag, then the passenger's front airbag will deploy also.

A SMART airbag system knows that no one is in an empty passenger's front seat. A weight sensitive grid installed in the cushion of the front seat weighs everyone who sits there. If the seat detects that no one is in that riding position, at the moment of the crash, it will automatically shutoff the passenger's frontal airbag. There is no need for the bag to deploy. The SMART system just saved the insurance company some repair cost.

Rescuers entering the vehicle and placing weight on the passenger seat cushion may actually trip the seat weight sensor and deploy the airbag if the electrical system has not been shutdown. **The critical weight of 40 pounds or more must be present at the moment of the collision to allow the crash signal to go to the passenger's frontal airbag.**

Dealing with SMART airbag technology at a vehicle incident is like a roll of the dice for responders. We won't know what combination of airbags will deploy until we get to the crash and find out for ourselves. Scan the vehicle, be alert for loaded airbags and be cautious!

KNOWLEDGE ASSESSMENT

In a vehicle equipped with SMART airbag technology, a weight sensitive grid installed in the cushion of the front seat weighs everyone who sits there. The critical weight of _____ or more must be present at the moment of the collision to allow the crash signal to go to the passenger's frontal airbag.

- a. 20 lbs
- b. 40 lbs
- c. 80 lbs
- d. 100lbs

Answer: B

Rationale: The critical weight of 40 lbs or more must be present at the moment of the collision to allow the crash signal to go to the passenger's frontal airbag.

OBJECTIVE 4: Identify how to initiate the necessary practices and procedures to mitigate the hazards presented by each airbag system, thereby rendering the scene safe for the patients and emergency personnel.

Airbag Cut-Off Switches

Identify the influence of airbag cut-off switches on rescue and EMS procedures at vehicle crash incidents. Using the Dodge Dakota Sport case study, develop a plan of action for dealing with a driver trapped in the vehicle with a loaded passenger airbag.

A Dodge Dakota Sport pickup truck, driven by an alcohol-impaired driver, slams into the back of a stopped vehicle at an intersection. The Dakota's driver's front airbag deploys but the passenger front airbag doesn't. Why not?

This case study is a great example of a situation where emergency responders will encounter airbags in vehicles that have not deployed. In this incident, the driver at some time prior to the crash, had activated the dash-mounted airbag cut-off switch to disable the passenger front airbag, preventing it from deploying.

Since the 1996 model year, the federal agency that regulates vehicle safety equipment has allowed airbag on-off switches to be placed in certain models of pick-up trucks, sports cars, or other vehicles. The agency, the National Highway Traffic Safety Administration (NHTSA) published a final rule permitting vehicle manufacturers to offer manual on-off switches for the passenger airbag for new vehicles with no rear seats or with rear seats that are too small to accommodate rear-facing infant restraints.

Currently, there are millions of vehicles with airbag switches installed as original equipment. Analysis of NHTSA data reveals that this includes over 219 vehicle models with the availability of the manufacturer-produced on-off switches.

An on-off switch allows the activation signal to an airbag to be turned on and off. To limit misuse, a key must be used to operate the on-off switch. When the airbag is turned off, a light comes on. There is typically a message on or near the light saying "PASSENGER AIR BAG OFF." With the switch in the 'off' position, when the crash occurs, that bag never receives the signal to deploy. The airbag will remain off until the key is used to manually turn it back on.

How does the presence of an on-off switch influence the actions of the responders at the scene? It all starts with airbag detection. Hopefully, the first crew to reach this vehicle will scan the interior for the presence of deployed or undeployed airbags as part of their size-up routine. This can be done almost simultaneously with patient contact. Once the airbag scanning detects the loaded airbag, responders must determine why the bag did not deploy. A closer scan of the instrument panel of this pickup near the radio or heater controls, reveals the cut-off switch installed by the manufacturer. The switch is clearly in the 'off' position.

Now that the reason for having a loaded airbag is known, rescuer safety is the priority. Battery shutdown is essential. In addition, at this crash scene, it is safe for rescuers to work on the injured driver from the driver's side of the vehicle. Any rescuer however who opens the passenger door and tries to access the driver from that side is in danger of being within that airbag's inflation zone. Because it is a passenger airbag, its' inflation zone extends out at least 18 inches from the instrument panel airbag cover.

Airbag cut-off switches may be installed by the vehicle manufacturer or installed by vendors after the original purchase. Regardless, cut-off switches result in loaded airbags. Loaded airbags result in increased risks to emergency responders. Greater risk means greater chance for things to go wrong. Be alert to the presence of loaded airbags for whatever reason and have a plan for dealing with this situation. Stay clear...stay safe!

KNOWLEDGE ASSESSMENT

Since the 1996 model year, why has NHTSA allowed airbag on-off switches to be placed in certain models of pick-up trucks, sports cars, and other vehicles?

- a. to accommodate rear-facing infant restraint seats
- b. to save insurance companies money
- c. to allow occupants the choice to turn off the air-bag option
- d. to prevent passenger injury from accidental airbag deployment

Answer: A

Rationale: NHTSA has allowed vehicle manufacturers to offer manual on-off switches for the passenger airbag for new vehicles with no rear seats or with small rear seats in order to accommodate rear-facing infant restraints.

Roof Airbag Systems and A-Pillar Stored Gas Inflator Modules

Identify procedures to determine the presence of stored gas inflator modules mounted on or near vehicle A-pillars.

It is now common knowledge among rescue personnel that if a vehicle is equipped with a roof-mounted airbag system, there will be stored gas inflator modules present somewhere on the vehicle. Stored gas inflators can be found installed as the propellant for all airbags except the driver's frontal airbag unit.

The most common location for the inflators that deploy a roof airbag system is mounted to the rearmost roof pillars, typically the C- or D-pillar. There are several recent models of vehicles however, that have pressurized inflator modules mounted on or near the front A-pillars. To assure safety during extrication, the location of cylinders in this new location must be identified prior to any roof removal evolutions or dash and firewall assignments being undertaken.

A typical stored gas inflator module for a roof airbag system contains a small, pressurized cylinder inside of a slightly larger inflator housing. There are various designs but all designs use stored gas pressures ranging from 1,400psi to 4,000psi. When activated due to a collision, the pressurized gases inside the inner cylinder are vented into a 'burn chamber' inside the inflator housing. As they pass through this small chamber, the special liquid fuel that is present there burns in a hot flash fire, heating the gases. Hot gases expand to fill the volume of the airbag. The nylon-coated rubber fill hose secured to the A-pillar then directs the gases into the various chambers of the airbag itself.

Engineers who designed the roof airbag system for the new E-class sedan from Mercedes Benz chose to secure the pressurized inflator modules directly on the A-pillars, exactly in our roof removal 'cut zone'. The inflator module is only visible by stripping away the trim along the inside of the A-pillar. This will expose the airbag fill hose and the inflator at dashboard level.

BMW has positioned the airbag inflator module for their roof-mounted HPS system near the front A-pillar, underneath the instrument panel cover. The cylinder resembles an old-time ink bottle with a white hose attached to its top. The short and stubby design of the inflator fits neatly into place within a bracket inside the dashboard and below the instrument panel. The inflator actually bolts to the inside of the A-pillar, just below dash level. When in place, although the cylinder cannot be seen normally because the dash covers it, it is even with the level of the top door hinge.

Once again, the presence of these inflators can only be identified by stripping away the trim along the A-pillar. If you observe a white nylon fill hose, it indicates that the inflator module is underneath the instrument panel.

Standard Operating Procedure for Determining the Presence of
Stored Gas Inflator Modules Mounted On or Near the A-Pillar

- 1) Scan vehicle for airbag ID for a roof-mounted airbag system
 - Middle of A-pillar
 - Top of A-pillar
 - Top of B-pillar
 - Top of C-pillar
- 2) Pry or strip interior trim off A-pillar
 - Inspect for presence of actual stored gas inflator module
 - Inspect for presence of rubber hose covered with white nylon
- 3) Determine location of stored gas inflator module
 - On A-pillar at dashboard level
 - Beneath instrument panel at level of top door hinge
- 4) Report findings of Command or assigned Rescue Sector Officer

KNOWLEDGE ASSESSMENT

In order to determine whether there is a stored gas inflator module mounted on or near the A-Pillar, you should first try to identify airbag ID for what a roof-mounted airbag system . Which of the following is NOT a likely location for a visible airbag ID?

- a. the middle of A-pillar
- b. the top of A-pillar
- c. the middle of the B-Pillar
- d. the top of B-pillar

Answer: B

Rationale: The first step in the standard operating procedure for determining the presence of stored gas inflator modules mounted on or near the A-Pillar is to scan the vehicle for airbag ID tags for a roof-mounted airbag system. The locations of this ID include the middle of A-pillar, the top of A-pillar, the top of B-pillar and the top of C-pillar. The middle of the B-pillar is not a possible option.

Stored Gas Airbag Inflator Modules

Understand safety concerns and changes in rescue procedures necessary when working near stored gas airbag inflator modules and identify the two possible locations of BMW stored gas airbag inflator modules and describe how extrication tasks can be affected by the presence of these units.

The Warning

For all responders who have worked and practiced the technique of 'rolling' a dash off a trapped driver, there is something new and very important for you to be aware of. For those who are trained in 'jacking' the dash, you too should study this information before you make your next cuts in an A-pillar. Even crews who may have to pry a door off a car must take note of the following 'discovery'.

The New Technology

The BMW side impact airbag system, available since the 1998 model year, has added a very important new twist to dash and jammed door rescue evolutions. BMWs' side-impact airbag system consists of two airbags: a door airbag and an inflatable tubular Head Protection System (HPS) airbag mounted along the roofline.

The BMW door and the roof airbag do not use a chemical reaction to deploy the airbags, they utilize high pressure stored gas cylinders inside the car. The stored gas, held inside a small metal cylinder until impact, flows out of the inflator module, through a plastic tube and into the airbag, deploying the airbag instantly.

The door airbag inflator module is secured inside the door airbag unit itself. It is somewhat protected by the door collision beam. The stored gas inflator for the BMW roof airbag is mounted to the inside of the A-pillar, level with the top door hinge. The bolts of the top door hinge actually point toward this inflator module. The cylinder is mounted underneath the instrument panel and is not readily visible. The concern for responders is obvious. We now can have a pressurized cylinder within our rescue tool prying or cutting zone.

If the tubular HPS airbag has deployed from the roof or the door-mounted airbag has deployed through the door panel, that particular stored gas cylinder is empty and is of little concern to rescue personnel. If the BMW roof or door airbag is still 'loaded' however, the inflator modules are still pressurized.

Affect on Vehicle Rescue Tasks

There are several considerations for modifying our standard rescue evolutions when encountering a BMW with a loaded door or roof airbag. When removing a door by forcing it off at the hinges, be alert to any inward crushing of the A-pillar when you are prying at or near the top door hinge. Movement of the A-pillar may cause unwanted contact with the pressurized gas cylinder. Consider a power cutter or reciprocal saw to cut through the actual hinge itself as a safer alternative technique. Remain aware of the position, location and inflation zone of door and the roof airbag inflator modules if there are loaded airbags within your work zone.

When moving the dash, instrument panel and firewall off a trapped front seat occupant, the pressurized roof airbag cylinder is again right within your work area. To roll the dash, the A-pillar relief cut or cuts are generally low, usually near the bottom door hinge or into the rocker channel. Remain aware of any cutting near the top door hinge.

Relief cuts are also made in the A-pillar when jacking the dash. With a loaded roof airbag, make these two cuts between the door hinges about two inches apart. Make your first cut at the top of the bottom hinge and the second cut just a few inches above the initial cut. These locations will allow you to avoid any A-pillar cuts up near the top door hinge. Our hydraulic cutters are powerful enough to not only cut the A-pillar but could at the same time, puncture the pressurized airbag inflator module. This will result in a catastrophic failure of the cylinder with potentially fatal results to anyone in the hot zone.

POST-TEST

1. Side impact airbags are located in or on doors, seats, and _____.
 - A) steering wheels
 - B) instrument panels
 - C) roofs
 - D) B-pillars

2. For door-mounted airbags, the airbag unit will generally be located _____.
 - A) towards the latch end of the door and within the armrest unit.
 - B) towards the latch end of the door and above the level of the armrest.
 - C) towards the hinge end of the door.
 - D) inside the door at the top edge.

3. Windshield damage that has a central point that all the breakage seems to focus around is referred to as _____.
 - A) a windshield fracture.
 - B) a laminated glass fracture.
 - C) windshield 'crazing'.
 - D) a windshield spider web.

4. Airbag systems that deploy specific airbags depending upon occupant position and crash information are referred to as _____.
 - A) SMART airbags.
 - B) weight sensor in seat airbags.
 - C) airbag cutoff switch systems.
 - D) frontal airbags.

5. Rescuers entering a vehicle and placing weight on a passenger front seat cushion may actually trip the seat weight sensor and deploy the frontal airbag if the electrical system has not been shutdown. The critical deployment weight is _____.
 - A) 10 pounds or more.
 - B) 25 pounds or more.
 - C) 40 pounds or more.
 - D) 55 pounds or more.

6. An airbag system that actually has two inflator modules connected to one airbag is referred to as a _____.
 - A) two unit airbag
 - B) dual stage airbag.
 - C) dual inflator airbag
 - D) Multi threshold airbag.

- 7) The importance of taking away a vehicle's electrical power should now be considered an essential action if medical or rescue work is to take place with any degree of safety. Taking away the power, _____.
 - A) prevents airbags from deploying
 - B) causes loaded airbags to deploy
 - C) stores electrical energy within the airbag capacitor
 - D) begins the airbag capacitor draining process.

8. Researchers at USA TODAY report that hip injuries accounted for 48% of car-crash leg injuries in 1993-2001 vehicles. To address this injury concern and to help keep front seat occupants away from frontal airbag inflation zones, manufacturers have dramatically increased their use of _____.

- A) frontal airbags.
- B) roof airbag systems.
- C) knee airbag systems.
- D) side-impact airbag systems.

9. It is now common knowledge among rescue personnel that if a vehicle is equipped with a roof-mounted airbag system, somewhere on the vehicle there will also be _____.

- A) stored gas inflator modules present.
- B) deployed roof airbags.
- C) dual airbag 'brain' control modules.
- D) knee airbags.

10) Pressurized vessels can be used to deploy passenger frontal airbags, door airbags, roof airbags, and _____.

- A) seat airbags
- B) a steering wheel airbag.
- C) a seatbelt pretensioner
- D) a driver's frontal airbag

POST-TEST (Answer Key)

1. Side impact airbags are located in or on doors, seats, and _____.

- A) steering wheels
- B) instrument panels
- C) roofs
- D) B-pillars

Answer: C

Rationale: Side-impact airbag locations can include the Windshield/VIN plate, Front door, Front seat, B-pillar, A-pillar/roofline, Rear seat (Objective 1)

2. For door-mounted airbags, the airbag unit will generally be located _____.

- A) towards the latch end of the door and within the armrest unit.
- B) towards the latch end of the door and above the level of the armrest.
- C) towards the hinge end of the door.
- D) inside the door at the top edge.

Answer: B

Rationale: Remember for door-mounted airbags, the airbag unit will generally be towards the latch end of the door and above the level of the armrest. (Objective 1)

3. Windshield damage that has a central point that all the breakage seems to focus around is referred to as _____.

- A) a windshield fracture.
- B) a laminated glass fracture.
- C) windshield 'crazing'.
- D) a windshield spider web.

Answer: D

Rationale: There is one certain type of windshield damage that is best described as a 'spider web'. Similar to a real spider's web, this damage has a central point that all the breakage seems to focus around. (Objective 2)

4. Airbag systems that deploy specific airbags depending upon occupant position and crash information are referred to as _____.

- A) SMART airbags.
- B) weight sensor in seat airbags.
- C) airbag cutoff switch systems.
- D) frontal airbags.

Answer: A

Rationale: 'SMART' technology systems sense the position or the weight of the passenger and adjust deployment to provide the best protection. (Objective 3)

5. Rescuers entering a vehicle and placing weight on a passenger front seat cushion may actually trip the seat weight sensor and deploy the frontal airbag if the electrical system has not been shutdown. The critical deployment weight is _____.

- A) 10 pounds or more.
- B) 25 pounds or more.
- C) 40 pounds or more.
- D) 55 pounds or more.

Answer: C

Rationale: The critical weight of 40 pounds or more must be present at the moment of the collision to allow the crash signal to go to the passenger's frontal airbag. (Objective 3)

6. An airbag system that actually has two inflator modules connected to one airbag is referred to as a _____.
- A) two unit airbag
 - B) dual stage airbag.
 - C) dual inflator airbag
 - D) Multi threshold airbag.

Answer: B

Rationale: A dual-stage airbag actually has two inflator modules connected to one airbag. (Objective 1)

- 7) The importance of taking away a vehicle's electrical power should now be considered an essential action if medical or rescue work is to take place with any degree of safety. Taking away the power, _____.
- A) prevents airbags from deploying
 - B) causes loaded airbags to deploy
 - C) stores electrical energy within the airbag capacitor
 - D) begins the airbag capacitor draining process.

Answer: D

Rationale: Early in an incident, efforts to simply disconnect or double-cut the battery cables must be initiated. Taking away the power begins the airbag capacitor draining process. (Objective 1)

8. Researchers at USA TODAY report that hip injuries accounted for 48% of car-crash leg injuries in 1993-2001 vehicles. To address this injury concern and to help keep front seat occupants away from frontal airbag inflation zones, manufacturers have dramatically increased their use of _____.
- A) frontal airbags.
 - B) roof airbag systems.
 - C) knee airbag systems.
 - D) side-impact airbag systems.

Answer: C

Rationale: Researchers at USA TODAY** report that hip injuries accounted for 48% of car-crash leg injuries in 1993-2001 vehicles. To address this injury concern and to help keep front seat occupants away from frontal airbag inflation zones, manufacturers have dramatically increased their use of knee airbag systems. (Objective 1)

9. It is now common knowledge among rescue personnel that if a vehicle is equipped with a roof-mounted airbag system, somewhere on the vehicle there will also be _____.
- A) stored gas inflator modules present.
 - B) deployed roof airbags.
 - C) dual airbag 'brain' control modules.
 - D) knee airbags.

Answer: A

Rationale: It is now common knowledge among rescue personnel that if a vehicle is equipped with a roof-mounted airbag system, there will be stored gas inflator modules present somewhere on the vehicle. (Objective 9)

10) Pressurized vessels can be used to deploy passenger frontal airbags, door airbags, roof airbags, and _____.

- A) seat airbags
- B) a steering wheel airbag.
- C) a seatbelt pretensioner
- D) a driver's frontal airbag

Answer: A

Rationale: Pressurized vessels are used primarily to deploy roof-mounted airbags but can also be found connected to seat or door-mounted airbags as well as the passenger frontal airbag and knee bag systems. (Objective 2)
