Supplementary Restraint System Guidance - SRS

What is an airbag:

An airbag is a vehicle safety device. It is an occupant restraint system consisting of a flexible fabric envelope or cushion designed to inflate rapidly during an automobile collision. Its purpose is to cushion occupants during a crash and provide protection to their bodies when they strike interior objects such as the steering wheel or a window. Modern vehicles may contain multiple airbag modules in various side and frontal locations of the passenger seating positions, and sensors may deploy one or more airbags in an impact zone at variable rates based on the type, angle and severity of impact; the airbag is designed to only inflate in moderate to severe frontal crashes. Airbags are normally designed with the intention of supplementing the protection of an occupant who is correctly restrained with a seatbelt. Most designs are inflated through pyrotechnic means and can only be operated once. Newer side-impact airbag modules consist of compressed air cylinders that are triggered in the event of a side impact vehicle impact.

http://en.wikipedia.org/wiki/Airbag

Vehicle airbags come under the heading supplementary restraint systems because they are designed to work in conjunction with the seatbelt, without each other the level of protection afforded by just one device is greatly reduced.

It has become very apparent through experience and incident history that some rescuers are unsure of what direction to take when faced with a vehicle containing a vast amount of safety systems, even to the degree that we are taking short cuts by taking the casualty out through the side of the vehicle to avoid cutting near the SRS systems.

This may not sound such a great deal, or is it? with a casualty centered rescue these short cuts should not be happening with the knowledge and training that is available today.

How many airbags can we expect to find in a standard shop configuration?

Mercedes-Benz 2010 E-Class has 11 airbags fitted as standard

The Scion IQ Toyota's smallest car has 11 airbags fitted as standard

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These are just two examples, there will be many more out there. For the rescuer the main point to digest is the basic principles we can take to make the job of an extrication a lot safer for the rescuer and casualty/s.

We are not going to look at how they work etc this information is available all over the internet by simply searching about vehicle airbags.

Our initial actions:

After we have assessed the situation (360) and have ascertained there are undeployed or indeed deployed SRS systems, some decisions need to be made.

- Is the battery accessible
- Do we need to use the vehicles electrical functions (seat recline, windows)?
- Can we disconnect the battery now?
- What are the capacitor drain times - do not let this delay rescue?

Lets have a look at some solutions, these are not definitive, just a guide.

- **Is the battery accessible?**

  If the battery is accessible we will need to decide when to disconnect it, this can only be made by the experience and knowledge of the OIC (officer in charge) or indeed with the help of his crew who may have a better knowledge.

- **Do we need to use the vehicle electrical systems?**

  This will be answered by the above, if we have access to the battery we will at some stage need to think about its disconnection, firstly is there a need to utilise the vehicles systems, such as winding down the windows, reclining a seat at the latter stage or assisting with removing a convertible roof and so on.

  If we do disconnect the battery it may need to be done in such a way that it can be reconnected later on in the rescue to recline a seat or similar. So think twice before cutting the cable! With all this going on the decision may be made to leave the battery live during the rescue and put into place alternative safety measures. These will be covered later on.

- **Can we disconnect the battery now?**

  Yes the battery can be disconnected as soon as possible as long as the above has been thought about thoroughly, with a good scene assessment and plan of action confirmed. Do not make the mistake of needing the vehicles systems at a later stage and find you have no power, past examples are, electric seat recliner located 1 hour into the incident, battery in the boot disconnected only to find its needed and the boot mechanism works of the vehicles power, these two examples are not the end but created unnecessary tasks which increased the rescue time, these could both have been avoided.

- **What are the capacitor drain times?**

  These can vary greatly from a few seconds to 1 hour, this information can be found on ERG's or electronic systems such as Moditech's CRS software. Some vehicles can also have super capacitors which hold a lot of residual power and take a while to drain, there are also modifications that people make such as adding extra capacitors and systems to power high end stereo systems and other luxuries.

  Do we wait for these systems to drain? No! We must make sure we do not let these issues delay rescue times, casualties can not afford this extra time, with the correct safety measures put in place this should not be an issue that needs rescuers to hold back. This may sound like a caution-less statement but through sound research we can avoid these issues with a better understanding of what we are dealing with.

To conclude this first part:

The rescue must happen and tasks need to be completed with a systematic approach. There is no need to delay rescue times due to SRS concerns. The following information will hopefully give you a better understanding of what can be done.

Frontal Airbags:

Frontal airbags come in many different sizes and shapes, these are ever changing due to new technology and vehicle crash testing, however for the rescuer this poses a headache or does it?

Once the frontal airbags have deployed are they safe? There are multi stage smart bags in many new vehicles which will deploy one or more charges depending on the persons seat position, size and weight, in older vehicles there is the risk of a second deployment if both didn't actuate the first time. In newer vehicles this has been developed so that even if both stages are not needed it will still burn off the inflation charges to prevent a second actuation. Good for us, however how will we know if this has happened or what device this vehicle has. CRS software is a good start, but we don't all have it. What if we get the make/model of car wrong?

To plan for this we should still fit a safety device if we carry them, a minimal control measure, these have been known to fail due to steering wheels now being softer in design to prevent further injury. Vehicle manufacturers do not even recommend them because SRS devices are not designed to be restrained. A contradiction from the point of this article. However if we have them it is still a control measure that should be used.

If they are used, everyone must still maintain the safety distances recommended for SRS systems, so that should one of these devices fail we are not in the deployment area and avoid serious injury.

Deployment safety distances for frontal airbags should be a minimum of 10” drivers side and 20” for the passenger side, the more distance the better, frontal airbags are getting bigger and so will the deployment zones.

If the casualty is able and the medics are happy, move the casualties seat further away from the deployment path, if there is an entrapment and this is not do-able we need to put into place control measures befitting the situation, a casualty centered rescue still needs to happen.

Turning the ignition off is the first action, this will shut down SRS systems, next we can manage the battery, if we can not do this, make sure everyone is aware that they are working with live systems, steering wheel protection must also be fitted, these become the initial minimum control measures. Do not use tools between the casualty and un-deployed airbags.

The majority of PAD's (Post accident deployments) are caused from cutting spreading and ramming too close to SRS actuators, so the highest level of control, awareness and communication needs to be when these actions are being carried out.

What can set off PAD:

- Cutting through an airbag actuator
- Static electricity
- Short circuit
- Hitting an SRS controller
- Potential for system back-feed
- Submersion in water for the electrics

The list above has been researched and there has been reports from around the globe of these actions causing PAD's following a vehicle crash.

Side Systems:

Side airbags will in most cases only deploy from side impacts, however with new vehicles and SMART systems analyzing the crash data it may now be found that these systems may also actuate in a frontal collision, don't forget there may be other forces such as rotational force from rebounds etc.

These airbags will only deploy once, after that they are safe, they do however deploy a lot faster that frontal systems due to the closeness to the vehicle body and the person in the vehicle.

They are usually deployed from a cylinder in one of the side posts or in some cases areas of the roof, so we must always peel and reveal all areas we are going to cut, spread or ram.

These can deploy to a depth of 12-18” depending on the type fitted, usually in a downward direction.

With side airbags, once they have deployed there is no further risk from cutting through the deployed cylinder, you must however make sure that it is the cylinder that has activated, some vehicles will have two cylinders in different locations for twin side SIPS airbags, it is best said not to get in the habit of cutting through these cylinders even if they have deployed to avoid any problems in the heat of the moment, cutting through the wrong one.

A simple guide to pealing and revealing; if a rapid extrication is needed it is permissible to either miss this all together and use other control measures such as safety distances, a call that only the OIC can make in liaison with the medics.

The other option when time is limited is only expose one side of the vehicle to save time, the only risk with this is that vehicles that have been customized, in other words had additional SRS systems fitted may not mirror the other side, ERG’s and other software will not show the optional extras that can be fitted for extra safety. So some SRS devices may be missed, the situation will have to dictate what you do, **but some control measures must be put into place.** In an ideal situation all areas that cutting, spreading and ramming is going to take place need to be inspected, not just for SRS devices but also to avoid additional strengthening in the area we want to relocate.

Pelvic and Torso/chest Airbags:

This type of airbag is also a one time activation, once deployed they are safe to work around, these can either be deployed form the B-post, seat or fitted into the door, so a thorough scan for these airbags needs to be carried out.

If working on a seat we need to expose the inner seat to see exactly where the airbag unit is, a very simple task. With these airbags we need to maintain safety distances of around 6” cushion depth (the distance it will come out from the door, post or seat) and 12-18” in a upward direction. Some types will also deploy as an “L” shape to give protection to the torso/chest and pelvis at the same time so we need to be aware of deployment paths forward of the seat-back.

If the wires which in most cases are **yellow** can be revealed, they can be cut with insulated wire cutters to prevent a short circuit from setting off the airbag, the ends then need to be secured to prevent them coming in-touch with each other or any metal parts of the vehicle.

SRS wiring is Yellow in most cases, sometimes covered in a black sheath with a bunch of other wires. Cutting this bunch with hydraulics is common practice, but runs the risk of causing a short through static build up and such, ideally we should be using insulated wire cutters, this risk is very low, with a well drilled rescue team these wires should be cut in preparation prior to cutting with hydraulics.

Where the battery cannot be disconnected, rescuers are going to have to work alongside live systems. As the motor industry as a whole has failed to address the issue of 'Rescue with compromised or live systems', rescuers have to make their own judgement calls and initiate suitable option measures – These measures include:-

Precautionary measures:

Avoidance – Instructions (DO NOT cut or crush or place hard protection between bag deployment path and the casualty).

Warnings – Safety calls (Stand clear SRS/SIPS/IC or HPS and ROPS deployment paths). Maintain the 150, 250 and 500mm (6,10 and 20") rule.

Protection – Dust masks and hard protection

Disconnection – SIPS connector plug and module disconnection

Isolate/Cut– Use wire cutters to cut SRS wiring and a strategic safety cut to isolate pyrotechnic lines.

Safety cuts - Cuts to air curtains and HP bolsters

Extrication options – Various evolution strategies to reduce possible hazardous outcomes.

(Resqmed-pry before you cut-PDF)

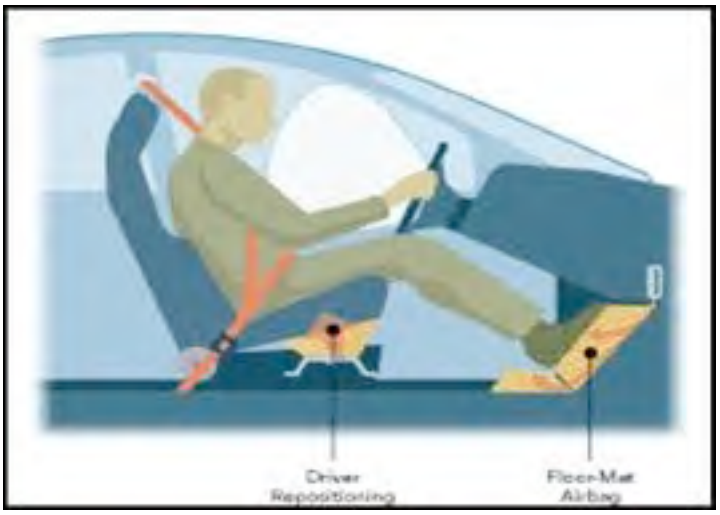
Middle seat Airbag:

Middle seat airbags are now present in vehicles, these prevent the passengers from colliding with each other in side impacts or impacts with severe rotational forces. Once deployed they are then safe and will not deploy again. The main concern here is to make sure we have assessed the seats before we do any cutting work on them, this includes the rear passenger seats as they are now being fitted in the middle of the rear seats on some vehicles. If possible expose the wiring and disconnect/cut in a controlled way.

Knee Airbags:

Yet another area we now find airbags. Again these only deploy once, usually using seat sensors, which sense if the seat is occupied and deploying the airbag thats needed. These may cause issues when carrying out dash relocations, so again we must make a thorough assessment to see what is present and put into place some control measures. Such as seat relocation, verbal warnings etc With lower limb entrapment and frontal impact there will be a high chance that this airbag will have activated, the only time it will be a problem is when dash work is needed and it hasn't deployed due to the parameters of the sensors with a casualty in the deployment path.

Under seat Airbags:



These are designed to prevent submarining of the knees under the dash by lifting the front of the seat. These are either under the seat as seen here or build into the lower seat frame. We need to be aware of these if we are relocating the seat or cutting/ramming in these areas.

Also seen here is the foot airbags which are in the pedal area to prevent the feet from submarining under the pedals, this again is only an issue if we have to work in that area, also with dash relocations. In most cases these airbags will have activated, if we find they haven't we need to put into place some kind of control measures as already discussed.

Rear mounted airbags:

These are found on the Scion IQ as the vehicle is very short and the occupants are very close to the rear window, this airbag works to prevent injury from rear impacts. Normal control measures can be used here, we must as always carry out a thorough scan of the vehicle and expose areas we are working.

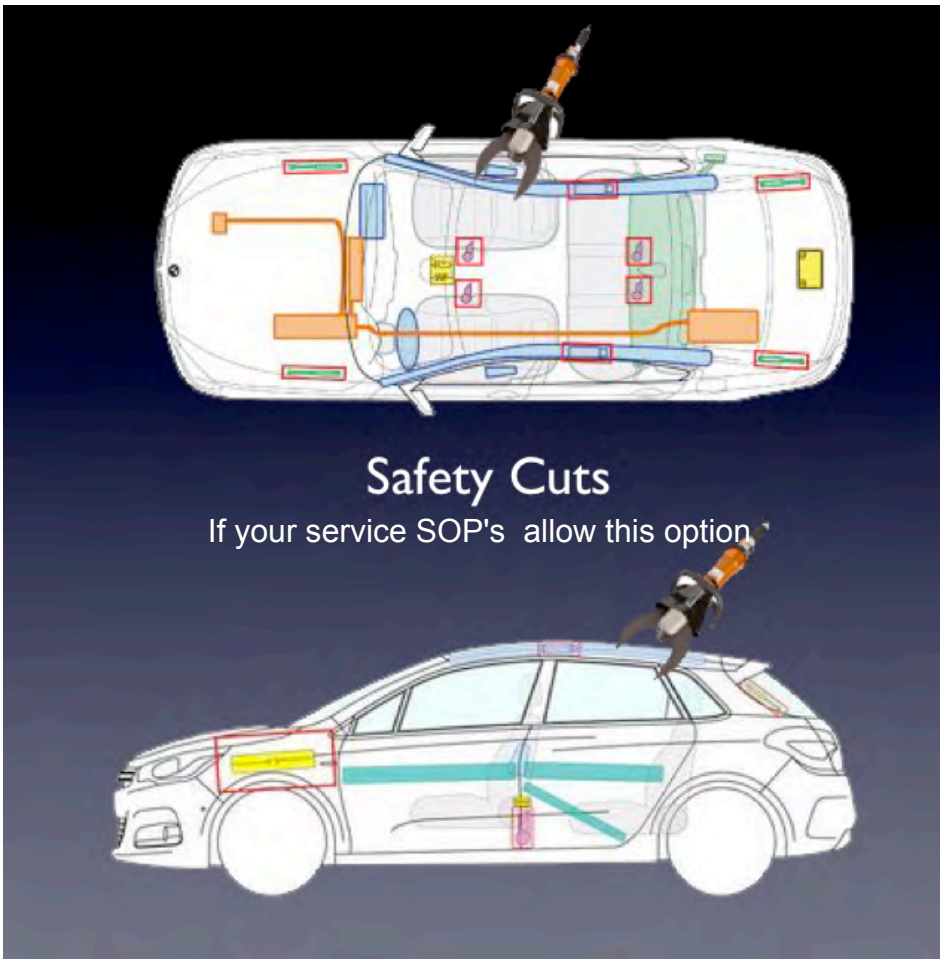
Roof mounted airbag:

Dubbed the “bag in roof” airbag system, it works by deploying a single airbag large enough to protect both the driver and front seat passenger. Advantages of the roof mounted design over more conventional dash-mounted designs include both space savings and lower production costs for dashboards. TRW’s Dirk Schulz, engineering director for their Inflatable Restraint Systems division, explained their reasoning behind the new design by saying, “Occupant safety systems are becoming increasingly versatile. With the increasing focus on reducing road fatalities, we need to develop new ways to enhance the protection of occupants – one area of focus is the redesign and configuration in airbags.

The main issues here will be if it hasn't deployed due to frontal collision, in cases where the vehicle has had a slight under-ride this may be enough to prevent the bag from deploying as it can be just outside the sensors deployment configuration. We must put into place control measures such as safety cuts in the bag to prevent full inflation should it deploy through extrication evolutions.

Nearly all airbags are designed to automatically deploy in the event of a vehicle fire when temperatures reach 150–200 °C (300–400 °F). This safety feature, often termed auto-ignition, helps to ensure that such temperatures do not cause an explosion of the entire airbag module.

Safety Cuts:



Safety cuts can be carried out as a control measure for side airbag curtain/tube systems when time permits. All that needs to be done is expose the rolled up bag in the side header rail and put a controlled cut through the bag, its paramount we cut the bag only not too close to the activation cylinder. One easy method is to cut through it with hydraulic cutters. Once we have made a safety cut as seen above this will prevent the airbag from inflating should an accidental activation occur during rescue. This is a recognized method, not always carried out due to lack of understanding and confidence in its use.

Bonet Airbag:

This type of protection developed by Volvo isn't far from hitting the roads. At this time we need to be aware of its presence especially during a vehicle fire as a projectile hazard, or during forced battery access.

Safety distances:

Due to the ongoing developments in airbag size and shape, the distances - 5, 10, 15, 20 are no longer a reliable guide, use them for reference if needed. These have been replaced with the control of "AVOID DEPLOYMENT PATHS"

Summary:

Airbags have been around for many years and will continue to be present until the end of my time.

There are many mixed feelings around the safety of the rescuer in regard to airbag deployment, some say it's not an issue because its never happened in their Fire Service. Some say they are very dangerous and take every measure to avoid them. So what is the answer; well through my experience, its how we decipher this information and how we perform as rescuers to achieve the ultimate goal, "a casualty centered rescue where no injuries are aggravated and no rescuers are injured" is this achievable? it should be! As rescuers we sign up to take that small risk to save a life. That said, we can, through good training and knowledge greatly reduce the risks of something going wrong.

Although there are many different views, evidence has proven that injury and fatalities have occurred from post accident deployment of airbags. No matter what we may or may not think it has happened and will continue to happen, even if it is a very small percentage of incidents. **We do not want to be the next statistic**.

Safety procedures performed can quickly reduce the risk:

- Switch off the ignition and remove the key
- Isolate the battery if accessible by unbolting the Negative terminal first, be aware some vehicles have more than one battery, both need to be disconnected.
- Verbal control measures - warnings
- Avoid Deployment Paths
- Expose and reveal
- Safety cuts if your SOP's allow
- Disconnect the connector plugs or cut the SRS wiring with insulated tools

Airbag systems are very safe and reports of accidental activation are small, we must not get overly worried about vehicle airbag systems, they must not prevent a casualty centered rescue or force us to take short cuts, we can still create maximum space even with a multitude of safety systems around us, all it needs is confidence and understanding of what you need to achieve along with the experience to carry it out.

Crash tests and the associated information in ERG's do not hold any resemblance to real life crashes and the anomalies that go with them, we will never know what safety systems have or have not activated correctly or if indeed anything in the vehicle is safe. But as a rescuer we know what needs to be carried out and what our control measures are, these are more than adequate to carry out the extrication safely.

Do Not become complacent through lack of Knowledge and understanding of this subject.

Post incident deployment of airbags have and will continue to happen all be it rarely, and many of these PAD's go unreported. Train regularly with these safety systems in mind and do not take short cuts at incidents, or others may suffer.

I would be happy to receive any feedback on your thoughts

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