In this section, the different extrication evolutions will be covered. The methods discussed are not all inclusive. They are, however, the most standard methods in which to gain entry into vehicles. It is important to understand that no two extrication scenes are the same, even though they may appear similar. Because of this, these standard techniques may need to be changed. Often times, a good deal of improvisation is necessary in order complete the task at hand. Techniques are often developed on the scene, some successful, some not so successful. Some extrications may take minutes, some may take hours. There may come the time where, because of the extent of damage to the vehicle, that the only option rescuers have is to cut the car away from the patient, piece by piece. These techniques provide a good base of knowledge for all rescuers to use and build upon. Only with the experience gained through years of service, will the fire fighter be able to build upon that base and become more proficient with extrication.

PURCHASE POINTS FOR OPENING AND REMOVING DOORS

There are multiple methods in creating a purchase point in a vehicle. In order to be the most effective, rescuers should be proficient in as many techniques as possible. Rescuers should utilize those techniques that don't require crews to hammer tools into vehicles or rock the vehicle back and forth. Hammering a door with a sledge may cause the side impact sensor to send a signal the airbag control module which in turn can deploy the side impact bag. Rocking a vehicle back and forth, trying to get a purchase point, can also have a negative effect. The gyroscopes, which sense a vehicle rolling over, can misinterpret this rocking and cause the head curtain airbag or roll bars on convertibles to deploy. Being able to choose the right operation for the right situation is crucial for extrication operations on today's vehicles.

Vertical Crush

One way to gain access to the door hinges is to open the spreader in the area between the bottom of the window frame and the roof. This can be done near the hinge or Nader pin side of all doors. Often times, the door can be completely removed in one motion, if the crush is attempted toward the Nader pin side. Care must be taken to ensure that the patient is protected in the event that the spreaders lose their bite and fall into the patient compartment space. The arrows show the area that the purchase points are created.

Towards Nader pin side

Passenger door towards hinge side

Door Pinch

Pinching any of the doors, with spreaders, at certain locations is very effective for creating good purchase points. The picture on the left shows the door being pinched in the middle in an attempt to create a purchase point at both the front and rear of the door. On the right the door is pinched at an angle towards the rear of the door to create a purchase point near the Nader pin area. The same method can be used on the hinged side of the door.

When attempting to pinch a door, the rescuer must understand that side impact airbags and/or the sensors for those airbags could be mounted in the doors of older vehicles. Care must be taken to protect the patient and rescuers working in and around the door, even if the battery has been disconnected.

Fender Pinch

In the method illustrated below, the rescuer creates a purchase point by pinching the front fender near the door hinge area. This creates enough of a space to place the tips of the spreader and begin working.

Pinch and Pull

Another way to gain access to the Nader pin or hinge is to pinch and peel any of the doors. First, if necessary, dent the rear fender with spreaders or with your set of irons, to create a void between the rear fender and the back door. This will allow your spreaders to grab the door and pull it back, creating a purchase point large enough for spreader tips.

Purchase Points with Manual Tools

Hand tools or Irons can be used very effectively. Creating a good purchase point only requires a Haligan tool, a flat head axe or sledge. The picture below shows the use of the sledge and the adze end of the Haligan to gain an entry point into door space. Once the bite on the door has been achieved, the rescuer pushes the fork end of the Haligan toward the ground followed by pulling the tool upward. Another method, the rescuer places the adze end of the Haligan in the door space and with an up and down rocking motion of the tool, simply "walks" the Haligan down the space between the two doors. In this method, the use of the sledge hammer or flat head axe is not required.

DOOR REMOVAL FROM HINGE SIDE

Step 1: Stabilize the vehicle to include primary and secondary stabilization (if needed) and protect the patient.

Step 2: Create a purchase point using any of the methods mentioned earlier.

Step 3: Insert the spreader slightly above the top hinge at a good angle to the vehicle to ensure that door is being pushed down and away from the vehicle. The area where the hinges are connected is usually reinforced in order to handle the weight and constant opening and closing of the door. For this reason, it is usually better to stay away from this area and attack above the hinges. If the rescuer chooses to attack the bottom hinge first, he or she must be aware that in doing so, the door will have tendency to be pushed inward toward the patient compartment. Care must be taken to protect the patient if this is the only option for door removal.

Step 2: Open the spreader using small movements until the spreader has a good bite. Once this occurs spread the door until the top hinge is broken.

Step 3: If the tool has a large enough spreading distance and is properly positioned, it may be possible to continue on and break the bottom hinge without repositioning. If this is not possible, reposition the tool and repeat the spreading process to break the bottom hinge. Take care to make sure the door does not fly off and strike someone as it is removed.

At this point, it may be possible to remove the door simply by using the door handle to open the door, if the area around the lock has not been damaged by our operations or by the accident,

In the picture above, a firefighter demonstrates proper technique when removing a door. A rope, rescue line or webbing should be used to secure the door.

*Process is the same for both the front and back door removal.

If the door is equipped with a side impact airbag, place the door at a safe distance away from the scene with the inside of the door facing up. There have been instances where door mounted side impact airbags have deployed after the door has been removed, launching the door into the air with enough force to cause injury to anybody in close vicinity.

DOOR REMOVAL FROM NADER PIN SIDE

Step 1: Stabilize the vehicle to include primary and secondary stabilization (if needed) and protect the patient.

Step 2: Create a purchase point using any of the methods mentioned earlier.

Step 3: Insert the tips of the spreader slightly above the door lock, at a downward angle. This is usually where the Nader pin is and is the best place to attack the door. Choosing a good angle of attack, place the tips in such a position that they push the door outward and toward the ground. If you are unable to achieve a good bite in your purchase point, consider a different angle of attack. Positioning the spreader in a more vertical angle and placing the tips between the window frame and the rear post (B or C post depending on the door being forced) may be more effective. As the door opening gets bigger, move the tips closer to the door lock and continue on.

Step 4: Using small movements at first, open the spreader until the door pops open. If the sheet metal around the door latch begins to tear, stop your operation immediately to avoid any further tearing. Reposition your spreaders to attack at a different angle and retry.

*Process is the same for both the front and back door removal.

ROOF FLAP/ROLL

Step 1: Stabilize the vehicle to include primary and secondary stabilization (if needed) and protect the patient.

Step 2: Remove door window glass using window punch or tools of choice. Remove the windshield with a reciprocating saw or axe. If a reciprocating saw is used, fire fighters must recognize that this tool tends to create fine glass particles which can cause respiratory problems in the patient and rescuers if inhaled. If the glass remains intact or in good condition with minor cracks, it may be advisable to leave the glass in place while flapping the roof.

Step 3: After exposing the plastic in the posts and the roof of the vehicle to ensure that there are no pressurized cylinders present, cut the A-posts on both the driver's and passenger's side.

Step 4: Make a relief cut, in front of the post where you intend to fold the roof back, on both sides of the vehicle.

Step 5: Creasing the roof at the relief cuts can facilitate the folding process. On the left, fire fighters are creasing the roof with a flat head axe. On the right, fire fighters lay a pike pole across the roof at the point where the relief cuts are made. Some times these methods may not be necessary as the roof may fold back easily.

Step 6: Fold the roof back, making sure that the patient remains protected and that the windshield, if not removed, does not fall onto the patient.

Step 7: Secure the flapped roof with a strap or rope to ensure that the roof will not be blown back onto rescuers or patients by a strong wind or even by a large passing vehicle, such as a tractor trailor.

ROOF REMOVAL

Step 1: After primary and secondary stabilization has been performed, remove all window and windshield glass (if necessary). Protect the patient as needed. Expose plastics and all posts to look for any air bag high pressure cylinders.

Here, a fire fighter is using a spring loaded window punch to break the door glass. Windows on newer vehicles are using laminated safety glass instead of tempered glass windows. Using a window punch will not be effective at breaking these windows. A saw such as a Glassmaster is extremely effective at removing these windows.

Step 2: Cut A and B posts on driver and passenger side of the vehicle, making sure to avoid any pressurized cylinders mounted in the posts.

Step 3: When making the final cuts on the C posts, make sure that there are enough crew memers assigned to support the roof and to keep it from falling into the patient compartment. Also, make sure that all seat belts have been cut before the roof is lifted off the vehicle. Finally lift the roof up and back out of the way of the vehicle.

ROOF REMOVAL
VEHICLE ON ITS TOP

Step 1: Begin with primary and secondary stabilization (if needed) of the the vehicle.

Step 2: Remove all glass necessary and protect the patient. Also expose all posts and the interior roof line to look for pressurized cylinders.

Step3: Cut all posts on one side of the vehicle then move to other side and do the same.

The picture above shows the fire fighter cutting the C-post.

Both of the pictures show B and A posts being cut.

Step 4: The roof can now be removed from either side or rear of vehicle. In some cases, it may be necessary to remove the doors and seats to gain better patient access by creating more working space.

ROOF FLAP
VEHICLE ON ITS SIDE

Step 1: Begin with primary and secondary stabilization of the the vehicle (Refer to Section __ on Vehicle Stabilization for more details),.

Step 2: Remove all glass necessary and protect the patient. Expose all posts and the interior roof line to look for pressurized cylinders.

Step 3: Cut A, B and C posts on exposed side of vehicle.

Step 4: Make relief cuts at the bottom of the roof near the A and C post. Shown below.

Step 5: Pull the roof down toward the ground. Another option is to lay cribbing or step chocks on the ground so that the flapped roof creates a platform, the picture on the right shows this option being utilized.

Laying the roof onto step chocks or cribbing creates a platform, strong enough to hold the weight of at least two to three fire fighters, that can be used as a suface for patient care or packaging. The picture below illustrates this well.

FLOOR FLAP

The floor flap is a useful technique in the event that a vehicle is on its side, there is no access to the patient from the roof or rear and the patient is still buckled in the seat. This can also be very useful if the vehicle, on its side, has impacted a tree, pole or other such object with the roof of the vehicle and is stuck in that position. When completed, a stable platform will be created that will make removal of the patient much easier.

Step 1: Begin with primary and secondary stabilization of the the vehicle. Remove all glass necessary and protect the patient as best as possible and pull all the plastics in all the posts.

ne part of Primary Stabilization shown above.

Above, fire fighters deemed that Primary Stabilization is not enough to secure the vehicle and are now performing Secondary Stabilization.

Step 2: Force entry into the door that the patient is seated in. Use any of the door removal techniques discussed earlier in the chapter. Remember, utilizing good angles with spreaders and cutters is crucial in the awkward position that the rescuer will be operating in.

Once the door has been forced, either secure the door open with a strap or rope, or completely remove the door.

Step 3: Make your first cut into the rocker panel, behind the A post.

Step 4: Make your next cut on the rocker panel just in front of the B post.

Step 5: Continue down the cuts with a Sawzall or other cutting tool, down to the transmition tunnel. Be careful not to cut the patient while cutting and ensure that you cut through the floor board of the patient compartment. Also, be aware of fuel lines that may run along the vehicles frame rails or unibody support channel. Repeat the process with the second cut.

Step 6: Once the cuts are completed, pull down on the cut portion to expose the seat. Stabilization struts can also be used to prop the flap and create a stable base for EMS operations.

SIDE-OUT ON A FOUR DOOR VEHICLE

The side out is a great evolution to use when a lot of clearance is needed to access and remove the patient. It provides a large open space and can be accomplished fairly quickly. The negative to this evolution is that rescuers will need to step over the side of the vehicle that has been laid down. This could be hazardous, especially in vehicles equipped with door mounted side impact airbags. If this is the case, using the Blow-out evolution may be more appropriate.

This evolution may be more difficult to perform on newer vehicles, due to the tougher and more stringent vehicle safety standards. These standards are requiring better patient protection in the front seats. Part of this better protection is accomplished by strengthening the B-posts. Also, seatbelt pretension devices are usually mounted at the lower portion of the B-posts, requiring reinforcement in the area where we would normally cut. This evolution is still useful, however, on older vehicles.

Step 1: Begin with primary and if needed, secondary stabilization of the the vehicle. Remove all glass necessary and protect the patient as best as possible and expose all posts and the roof line to check for pressurized gas cylinders.

Step 2: Force open the front door at the hinges and the rear door at the Nader pin. As the doors are being forced with the spreaders, a fire fighter can begin working on Step 3.

Step 3: Cut the B post as high as possible without cutting through any pressurized cylinders (if any). A relief cut at the bottom of the B post may be necessary to facilitate the pulling down process. Be careful while cutting low on the B post as this is a common mounting location for seat belt pre-tensioning systems.

Step 4: Pull down on the B post to lay the doors and post down as one large section. Make sure that all seat belts are cut away from the patient prior to laying the side down. Care must also be taken to ensure that all sharp edges on cut pieces of metal are covered. If extra leverage is needed, crews can clamp onto the top of the B post with the spreaders.

BLOW-OUT ON A FOUR DOOR VEHICLE

A Blow-Out on a vehicle accomplishes nearly the same desired effect as the Side-Out. The main difference between the two is that with a Blow-Out, the entire side of the vehicle is removed. This allows fire fighters the ability to access the patient without having to worry about any door mounted airbags or stepping onto the side of the vehicle that has been laid down.

Again, personnel should consider the mounting location for the seat belt pre-tensioning system prior to cutting into the B-post. It may be necessary to cut higher up on the bottom of the B-post to avoid the pre-tensioning system altogether.

Step 1: Begin with primary and if needed, secondary stabilization of the the vehicle (Refer to the section on vehicle stabilization for more details). Remove all glass necessary and protect the patient as best as possible and eexpose all posts and the roof line to check for pressurized gas cylinders.

Step 2: Force the rear door at the Nader pin.

Step 3: Cut the B post as high and as low as possible without cutting through any pressurized cylinders (if any). Be careful while cutting low on the B post as this is a common mounting location used for seat belt pre-tensioning systems. If the B post cannot be cut completely through, a relief cut should be adequate.

Step 4: Pull the cut section away from the vehicle. In the event that the B post was not completely cut through, insert the spreader tips between the bottom of the B post, just above the relief cut, and the seat mount bracket or some other hard point. Spread until the B post is torn away.

* The pictures below shows the spreader being placed into the relief cut at the bottom of the B post.

*Another option would be to completely remove the entire side by removing the front door at its hinges.

DASH LIFT

The dash roll is necessary when the patient is trapped by the steering wheel or dash board. This evolution can be used on both driver's and passenger's side. Some vehicles respond to the dash lift very well, providing very large clearance for patient removal. There are some vehicles, however, where the dash lift will be ineffective, due to the construction of the vehicle or the damage done to it in the crash. If the Dash Lift does not work, the next option would be the Dash Roll. The following are instructions for the Dash Lift.

Step 1: Begin with primary and if needed, secondary stabilization of the the vehicle (Refer to the section on vehicle stabilization for more details). Remove all glass necessary and protect the patient as best as possible and expose all posts and the roof line to check for pressurized gas cylinders. When placing the cribbing, make sure that it is placed underneath the A post to provide reinforcement for the spreaders to lift the dash. If cribbing is not placed here, the spreaders will cause the rocker panel will fail before the dash is lifted.

Step 2: Force the front door using either any of the methods described earlier.

Step 3: After the door has been forced, either remove the roof or flap the roof. If the roof has been removed, the support needed by the B post may be gone, flapping the roof may be more effective. The decision to either flap or remove the roof should be made depending on how much room is needed to remove the patient once the dash has been lifted. If the roof is to be flapped, be sure to secure the flapped portion of the roof with rope or straps. A strong wind or a large passing vehicle can blow the roof back onto rescuers or patients.

Step 4: Make a relief cut on the front fender. Make sure that the cut is deep enough to cut through the support rail of the front fender. This relief cut is crucial, the weight of the engine along with this cut, will cause the fender to buckle, assisting in the lifting of the dash board.

Step 5: Make relief cuts above and below the bottom hinge bracket on the A post. Make sure that the cuts are deep. Certain vehicles, such as Volvos, Mercedes or other high end cars have extra reinforcement in these areas, requiring deeper cuts into the A post. Once the relief cuts have been made, move the piece of metal out of the way by pinching it with the spreaders and pull it out of the way. This is optional but helpful.

Step 6: Insert the spreader at a 90 degree angle, to the car, into the gap created by the cuts and begin to spread. Placing the spreaders at 90 degrees keeps them clear of the work area. Make sure the lower arm of the spreader is placed above the cribbing for support. Continue to lift until the desired clearance is reached. The dash can usually lifted enough to tear apart the fire wall.

DASH ROLL

The Dash Roll is a useful technique to use when the Dash Lift does not work. The Dash Roll accomplishes the same desired effect as the Dash Lift, but has two drawbacks; 1. the ram does not always roll the dash as high as the spreaders would lift and, 2. when the evolution is complete, the ram needs to be kept in place and remains in the way throughout our operations. This operation does have its place and time and rescuers should be as proficient in this evolution as in any other.

Step 1: Begin with primary and if needed, secondary stabilization of the the vehicle (Refer to the section on vehicle stabilization for more details). Remove all glass necessary and protect the patient as best as possible and expose all posts and the roof line to check for pressurized gas cylinders.

Step 2: Force the front door using either any of the methods described earlier.

Step 3: After the door has been forced, either remove or flap the roof. If the roof has been removed, the support needed by the B post may be gone, flapping the roof may be more effective. The decision

to either flap or remove the roof should be made depending on how much room is needed to remove the patient once the dash has been lifted. If the roof is to be flapped, be sure to secure the flapped portion of the roof with rope or straps.

Step 4: Make a relief cut on the front fender. Make sure that the cut is deep enough to cut through the support rail of the front fender. This relief cut is crucial as this cut and the weight of the engine will cause the fender to buckle, assisting in the lifting of the dash board.

Step 5: Cut a relief cut on the A post close to the rocker panel. Make sure the cut is deep enough to achieve the clearance needed.

Step 6: Place the head of the ram into the A post and the base on the rocker panel at the B post. One option to use is to place a rocker panel brace, or similar device, onto the rocker panel to help strengthen the base for the ram. Another option is clamp the spreader onto the rocker panel and place the base of the ram against the spreader. One more option would be to hammer the pick of haligan bar into the rocker panel at a place that will brace the ram. Once the haligan is in place, rotate the fork end of the bar towards the rear of the vehicle and place the fork end onto the ground. As the base of the ram exerts force on the haligan, the fork end will dig into the ground, providing a solid base. All of these options provide a strong stable base for the base of the ram.

Step 7: Once the ram is secure in it's spot, begin extending the ram until the dash and/or steering wheel has been lifted enough to remove the patient. The fire fighter operating the ram must be careful to ensure that the ram does not slip from it's position during operations. Also, if a rocker panel brace is not available, the rocker panel may weaken before the dash is rolled, therefore, it may be necessary for emergency crews to brace the rocker panel under the area where the base of the ram is placed with cribbing or step chocks.

* the tool operator must be stay out of the recoil zone of the ram in case it loses it's bite on the vehicle.

Once the dash has been rolled, the ram can be left in place and the patient can be extricated as shown in the left picture. Another compination requires using a combination of cribbing and wedges placed into the relief cut; the ram can then be removed safely.

THIRD DOOR

The third door evolution was designed to create access to a patient in the rear seat of a vehicle without a door to that seat. This technique can be used on a 2 door sedan as well as on a van or a SUV where the patient is in a third row seat and there is no access from the rear. The following instructions are for a 2 door sedan but can easily be used on the other types of vehicles.

Step 1: Begin with primary and if needed, secondary stabilization of the the vehicle (Refer to the section on vehicle stabilization for more details). Remove all glass necessary and protect the patient as best as possible and expose all posts and the roof line to check for pressurized gas cylinders.

Step 2: Force the front door using either any of the methods described earlier.

Step 3: After all posts have been exposed, cut through the top of the B post and make a relief cut at the bottom, near the rocker panel.

Step 4: Make a relief cut to the rear portion of the rear window to weaken the body and facilitate spreading process. If needed, a second relief cut can be made coming up from the rear fender well towards the first relief cut.

Step 5: After ensuring that the seat belt is cut, place the tips of the spreader between the interior body of the car, just above the relief cut, and the front seat mounting bracket. Spread the body to create the third door. If this does not work, the spreaders can be place between the interior body of the car and the hump where the rear seat is mounted.

Step 6: Once the spreaders have reached full spread, rescuers can pull the third door open the rest of the way with their hands or pinch the door with the spreaders for leverage. The sharp edges of metal must be covered, to protect the patient and rescuers, prior to removal of the patient. A turnout coat, tarp, old hose or similar items can be used to accomplish this. The picture on the right shows one of the jagged pieces that should be covered.

Another option to this evolution is follow steps 1 to 4, but creating the door through a different manner. Instead of spreading the door at the bottom, the spreaders can be inserted through the window to spread the door down. Care must be taken to ensure that the spreaders don't slip into the patient compartment. The pictures below illustrate this option. The spreaders can then be used as a lever by pinching the middle of the third door and pulling the door down to the ground. The following pictures show this technique.

* The downside to pulling the door downward is that now rescuers have work over the third door

The pictures above are illustrating some more options to creating the third door. The picture on the left shows the third door opening being created by using a high lift jack. The third door on the right was created by using a recip saw, such as a Sawzall.

TUNNELING

Tunneling is a useful evolution when the only means to access a trapped patient is through the rear of the vehicle, such as an under ride type of crash. It is a fairly simple evolution; however, as the rescuer gets deeper into the vehicle, the area where he or she is operating may get more cramped. Using your typical ladder ape for this operation may not be the best choice.

Step 1: Begin with primary and if needed, secondary stabilization of the the vehicle (Refer to the section on vehicle stabilization for more details). Remember, if the vehicle is involved in an under ride crash with another vehicle, there will be two vehicles to stabilize. Remove all glass necessary and protect the patient as best as possible. If you are able to, expose as much of the plastics as possible.

Step 2: Force open the trunk and remove it by cutting the support arms.

Step 3: Cut away the trunk deck with either the cutters or a Sawzall. It may be necessary to cut through the deck from underneath, in the trunk compartment.

Step 4: Once the decking has been removed, cut through any bracing that may be present and then cut through the braces of the seat back to remove the seat back. Be very careful while cutting out the seat back to avoid cutting any patients that may be sitting in the back seat.

Step 5: Remove the seat back to gain access into the patient compartment.

* To gain access to patients in the front seat, lay the front seat back down. If you are unable to gain access to the controls for the seat back, cutting the back away from the seat bottom may be a more viable option. Once the seat has been laid back or cut away, slide a back board underneath the patient and pull the patient out.

AIRBAG OPERATIONS

Airbag lifting operations are similar to vehicle stabilization using struts in that there can really be no step by step instructions for every scenario in which they may be used. Attempting to cover every scenario would be impossible, so we will provide the operating guidelines and principles for lifting airbags.

Airbags are extremely versatile because they can be used in a number of different situations ranging from vehicle extrication to lifting heavy machinery. They are capable of lifting an extraordinary load, (some airbags can lift as much as 40 tons). All in all, no matter which airbags are used, they all operate in the same manner, using the same principles.

First and foremost, every airbag must be operated within their limits. If crews operate beyond these limitations, anybody operating around them can fatally injured. Every type of airbag, whether they be high or low pressure, has manufacturer's recommendations that must be adhered to.

Second, always crib your load as you lift. This is extremely important. As loads are lifted, they can shift and collapse no matter what type of bag you are using; cribbing your load will prevent this from happening. Cribbing can be stacked either using the box or platform method, depending on the weight of the load being lifted. One thing that remains true for nearly all crews is that we carry a limited amount of cribbing on our trucks, so if the evolution seems is going to be technical at all, we need to consider having at least one more truck company on scene.

Cribbing is most effective when it is stacked on either side of the airbags. This can not always happen due to the nature of the accident, but we should attempt to do this as much as possible. The reason being is that the load can shift in either direction, so having protection on both sides would provide the maximum safety.

The picture on the left shows crews placing the cribbing under the hood, just in front of the A post on both sides. This accomplishes the objective of providing a good stabile base in case the load were to shift.

These next picture shows a good combination of cribbing and airbags.

Below, crews are confronted with a heavier, more unstable load. As you can see, instead of relying on the stack of cribbing as the safety backup, the crews used two stacks of cribbing placed on each side of the bottom vehicle and laid a couple of long 4 X 4 beams from one stack of cribbing to another for support. If crews choose to use this method, they must ensure to use enough beams to support the weight of the bus if the load shifts.

Third, no matter what is being lifted, always move in small increments. Airbags can be very unstable when they are inflated, operating them too fast can cause the load to shift and become even more unstable. This precaution should also be taken when deflating the airbags as this can also make the load unstable. The load can be more easily controlled when the airbags are operated in smaller, smoother movements.

Again, regardless of which type of airbag you are using, the same safety measures should always in place. Crews should never exceed the maximum safety ratings and limitations set forth by the airbag manufacturer. Always use cribbing when lifting your load and make sure that the cribbing is set in place as your load is being lifted. And finally, operate the airbags in small in movements to ensure that the load is controlled to the maximum. Following these guidelines should make operations run smoother and safer for both rescuer and patient.

BUS EXTRICATION

Bus extrication can present rescuers with difficult rescue operations because of the busses construction and also because of the infrequent number of incidents involving busses. Another stress factor involving these incidents is the fact that there is a strong possibility of encountering a large number of children that are seriously injured. These operations can, and will be extremely challenging both mentally and physically to all emergency crews involved.

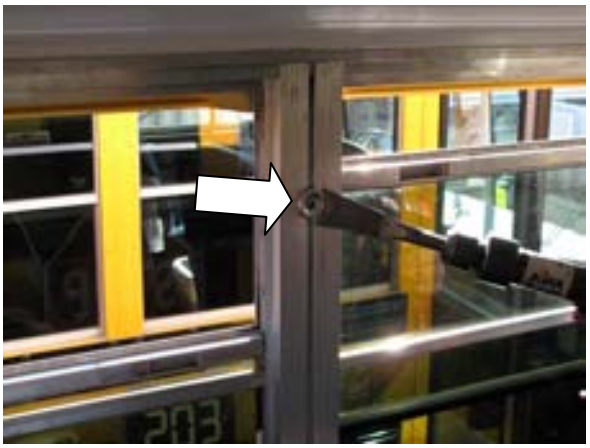
In this section, we will cover the basic construction of a school bus, the different types of busses, their emergency exits, extrication techniques, hybrid school busses along with their associated hazards and ways to mitigate them.

Construction

Public school busses are designed and built to protect the passengers in the event of a crash. A heavy duty frame with ribbed construction surrounds the busses occupants. Attached to the frame is light gauged sheet metal on both the interior and exterior of the frame with foam insulation in between. The sheet metal is connected to the frame work using rivets. The window openings are usually framed with aluminum frames that are secured from the inside with bolts that can be removed to create an exit. The seats are attached to the floor and sidewall and can be easily removed with cutters and spreaders. The pictures below show the framework of the common school bus.

Busses are designed with rigid structures that collapse in the weakest areas, which are the window areas. The picture shows a school bus that left the road and struck a tree. The bus collapsed like an accordion in the window areas.

Below are pictures of window frames. The arrow in the picture on the left shows one of the bolts that secure the window frame in place.



The picture below shows the seat and its floor mounting method.

Types of School Buses

There are three basic types of school busses, the rear mount engine, front mount engine and handicapped bus. The pictures below illustrate the differences in the three. The location of the engine does not really change the tactics or techniques used to extricate.

Rear mount engine

Front mount engine

Handicapped bus

Emergency Exits

A school bus is usually equipped with one emergency exit to be used along with the main exit in the event the bus has been involved in a crash. These exits can be toward the rear of the bus, on the roof, windows or on the side of the bus. These exits provide a very good means of ingress, for fire fighters and tools, as well as egress for patient removal. The pictures below show these exits.

Rear door and window

Roof Exit

Side Door interior

Side Door exterior

Handicapped rear side

Extrication Techniques

Stabilization

Buses are usually fairly stable no matter how it lays on the road. This stability can be contributed to the flat surfaces on all sides. However, if the bus is upright or on top of another vehicle, extra cribbing is usually needed due to the height off of the roadway.

Establish a Rescue Corridor

When beginning extrication operations, creating two openings in the bus can be extremely helpful. One opening should be used for emergency crews and equipment to enter the bus, the other opening can be used to remove patients. Remember there is limited room, especially with numerous patients so limiting the number of rescuers inside the bus is critical for smooth operations.

Seat Removal

Rescuers should understand the most entanglements usually involve the seats, unless patient limbs are trapped outside of the bus. In the event that the seat or seats must be removed, emergency personnel can use hydraulic cutters or a Sawzsall to cut the seat uprights. If seat is attached to the sidewall, the spreaders can be used to remove the seat from the lip it is attached to. The picture below shows the seat legs being cut.

Window Removal

Window frames are attached from the inside. Removing a window requires using an Ajax tool to remove the bolts heads that hold the window into the frame.

***To create a 48” x 24” opening remove two windows and the post between.

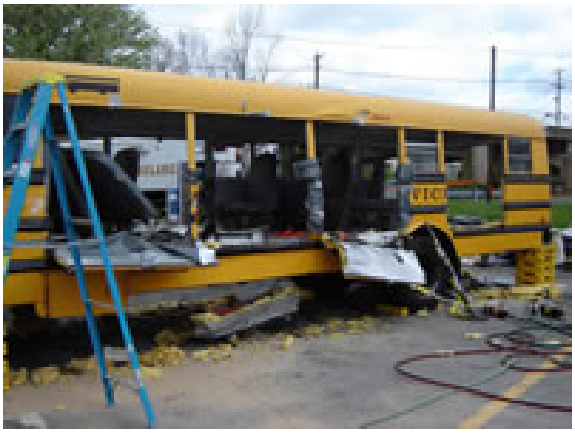
Sidewall Access

When attempting to gain access through the side wall of the bus, there are a few tell tale markers that provide emergency personnel good visual indicators on where to start their operations. The ribbed construction and use of rivets easily shows the placement of the main support frame of the bus and where the access points are. The black stripes on the side of the bus will help to gauge the location of the seat bottom and floor. The bottom black line is the height of the floor and the middle strip is the seat bottom height

Step 1: After ensuring primary and secondary stabilization (if needed) has been accomplished, remove the windows using the technique shown before.

Step 2: Begin opening up the side wall by cutting on the inside of the support frame. Remember, use the rivet line as an outline of the frame work. Hydraulic cutters, Sawzalls, Ajax tools or Cut off saws can be used to open up the side.

Create as big an opening as needed by removing the desired amount of side panels.

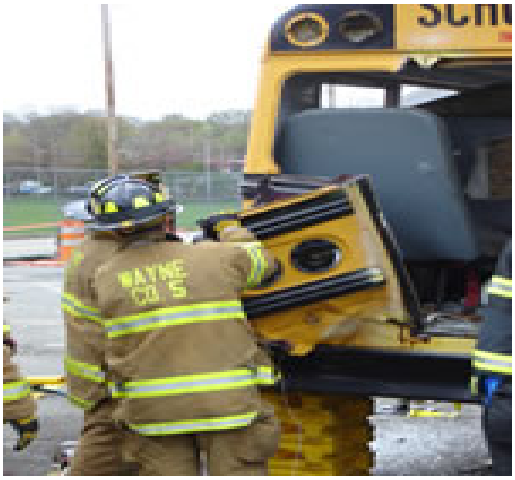


Tail Light Panel Removal

Step 1: After ensuring that primary and secondary stabilization has been accomplished, begin by removing the rear door and windows

Step 2: Cut frames high and near the floor

Step 3: Once the door frame has been cut the panel can either be flapped open or completely removed.



Roof Access

Because of rib construction and use of rivets you can see where you need to make entry this works extremely well when the bus is on its side. To create an opening a reciprocating, circular or cutoff saw, as well as an Ajax Tool can be used. Cutting the ribs out of the opening can create a bigger opening.

Handicapped Buses

A handicapped bus is similar in construction as a regular school bus. The main differences, aside from the physical or mental handicap of the occupants, are that these busses can be equipped wheelchair lifts, which operated by a handheld controller. Also, these buses usually have seatbelts that are attached to the floor and are used to secure wheelchairs. Emergency personnel should also be aware of the fact that oxygen cylinders may be present.

Actual extrication operations should be carried out in the same manner as with a non-handicapped bus.

Wheel chair lift

Handheld controller mounted on the door

Floor mounted seatbelts

Pictures showing handicapped markings and an oxygen cylinder holder.

HYBRID SCHOOL BUSES

Hybrid school buses are fairly new to the market but the construction and framework is the same as a regular school bus. Below are a few points to take into consideration when attacking a hybrid school bus.

Batteries and Weight Distribution

- Contains a battery bank of 28 12-volt lithium ion batteries connected in series
- Batteries are located on drivers side just front of center
- Protected by framework of heavy steel
- Weight is 1680 pounds
- Counter weight on right side weighing 1680 pounds
- When you factor in the electric motor (600 pounds) and a control electronics device (140 pounds) there is a total additional weight to the bus of 4100 pounds (2 TONS). This can cause issues if the bus is on its side or top

Hazards

- Batteries (like a cell phone, fluid is absorbed)
  - If breached they can release vapors (use SCBA)
  - Wired in series producing 336 volts
  - Avoid the Orange cables

Safetying the system

- Turn off the ignition and remove the key
- Turn off the hybrid system switch on the dash (usually left of the steering wheel)
- Turn off the service disconnect on the front of the battery bank (signage reads 'Emergency High-Voltage Shutoff Switch)

Warning – In cases of extensive damage it cannot be guaranteed that the disconnect switch will dissipate all high voltage in the system.

Hybrid information from Fire Engineering and Enova Systems (manufacturer) for further see www.enovasystems.com

Conclusion

As we have seen, vehicle extrication has changed drastically over the years. The auto industry is constantly improving their safety systems and emergency services are struggling to keep up. Every year there is the possibility that crews may encounter something that they have never seen. As stated before, some of the information provided in this chapter will be obsolete by the time this volume is put in circulation. In order to keep up with the auto industry, we need to make sure that we are constantly seeking to further our education. We can never learn too much about vehicles and their safety systems. As long as we maintain a positive attitude toward learning, we can stay abreast of all the changes and improvements.

Newer technologies are making the scene of an accident even more dangerous for emergency crews. No longer can we approach a vehicle and begin cutting into a car without first making sure the vehicle is properly stabilized. No longer can we assume that our tools will be able to cut, spread or push every vehicle. We can no longer assume that a vehicle does not have any airbags. We have to prepare ourselves for the possibility of encountering a vehicle with multiple airbags and pyrotechnic devices. Hybrid and alternative fuel vehicles must be identified early and all emergency personnel must be notified as soon as possible. Once these devices have been found and these specialty vehicles have been identified, we need to be able to mitigate the dangers that they present.

Hopefully, after reading through this chapter, crews will be able to incorporate some of this information into their training and operations. Again, it must be emphasized that the evolutions shown in this chapter represent only some of the possibilities available to crews. We need to be proficient in as many of these techniques as possible in order to be as effective as we can be. As long as we remained disciplined in our operations, use what we have learned and keep an open mind to new information and techniques, there will be nothing that extrication companies won’t be able to handle. And finally: TRAINING, TRAINING AND MORE TRAINING, that is the only way we will get better.