Vehicle Stabilization

CHAPTER

8

NFPA 1006 Standard

Vehicle and Machinery Rescue

10.1.4 Stabilize a common passenger vehicle or small machine, given a vehicle and machinery tool kit and personal protective equipment, so that the vehicle or machinery is prevented from moving during the rescue operations; entry, exit, and tool placement points are not compromised; anticipated rescue activities will not compromise vehicle or machinery stability; selected stabilization points are structurally sound; stabilization equipment can be monitored; and the risk to rescuers is minimized. (pages 174–190)

(A) Requisite Knowledge. Types of stabilization devices, mechanism of common passenger vehicle and small machinery movement, types of stabilization points, types of stabilization surfaces, AHJ policies and procedures, and types of vehicle and machinery construction components as they apply to stabilization. (pages 174–190)

(B) Requisite Skills. The ability to apply and operate stabilization devices. (pages 174–190)

10.1.5 Isolate potentially harmful energy sources, given vehicle and machinery tool kit and personal protective equipment, so that all hazards are identified, systems are managed, beneficial system use is evaluated, and hazards to rescue personnel and victims are minimized. (pages 190–191)

(A) Requisite Knowledge. Types and uses of personal protective equipment, types of energy sources, system isolation methods, specialized system features, tools for disabling hazards, and policies and procedures of the AHJ. (pages 190–191)

(B) Requisite Skills. The ability to select and use task- and incident-specific personal protective equipment, identify hazards, operate beneficial systems in support of tactical objectives, and operate tools and devices for securing and disabling hazards. (pages 190–191)

Knowledge Objectives

After studying this chapter, you will be able to:

- Explain the basis for stabilizing a vehicle. (pages 174–175)
- Explain the five types of wood box cribbing configurations. (pages 175–176)
- Explain the five directional movements of a vehicle. (page 176)
- Describe how to stabilize a vehicle in its normal position. (pages 176–180)
- Describe the proper procedure for deflating tires. (pages 178–179)
- Describe how to stabilize a vehicle resting on its side. (pages 180–184)
- Describe how to stabilize a vehicle upside down or resting on its roof. (pages 184–186)
- Describe how to marry two vehicles or objects together. (pages 186–190)
- Describe ways to mitigate vehicle electrical hazards. (pages 190–191)

Skills Objectives

After completing this chapter, you will be able to perform the following skills:

- Demonstrate the proper procedure for stabilizing a vehicle in its normal position. (pages 179–180, Skill Drill 8-1)
- Demonstrate the proper procedure for stabilizing a vehicle resting on its side. (pages 182–183, Skill Drill 8-2)
- Demonstrate the proper procedure for stabilizing a vehicle resting on its roof. (pages 185–186, Skill Drill 8-3)
- Demonstrate the proper procedure for marrying two vehicles. (pages 188–189, Skill Drill 8-4)
- Demonstrate the procedure for mitigating vehicle electrical hazards at a motor vehicle collision. (page 191, Skill Drill 8-5)

You Are the Technical Rescuer

You are on the scene of an extrication incident with a car on its side and one victim trapped. The officer asks you and your partner to set up a triangle configuration utilizing a tension buttress system with a chain package. You and your partner have attempted this setup only one time on a training drill and do not feel confident performing this technique.

1. Do you advise the officer that you are not familiar with this technique and suggest another, simpler technique that is equally effective?
2. Which section of this vehicle will you crib first?

Introduction

"Few things are impossible to diligence and skill. Great works are performed not by strength, but perseverance."
—Samuel Johnson

Chapter 7, *Site Operations*, Chapter 8, *Vehicle Stabilization*, and Chapter 9, *Victim Access and Management*, outline a successive three-phase process that the technical rescuer should follow at every extrication incident Figure 8-1. This chapter will discuss the second step of this process, vehicle stabilization.

If not controlled, unstable vehicles are serious threats to rescuers and to those injured in a motor vehicle collision (MVC). The shape, size, and resting positions of vehicles after a collision can create many challenges for rescuers. Proper vehicle stabilization provides a solid foundation from which to work, ensuring safety for the emergency personnel as well as the victims Figure 8-2.

There are numerous methods for cribbing and stabilizing vehicles, such as box cribbing, struts, step chocks, wedges, shims, ratchet lever jacks, stabilizer jacks, rope, chain, cable, winches, ratchet straps, and tow trucks. This chapter will dis-

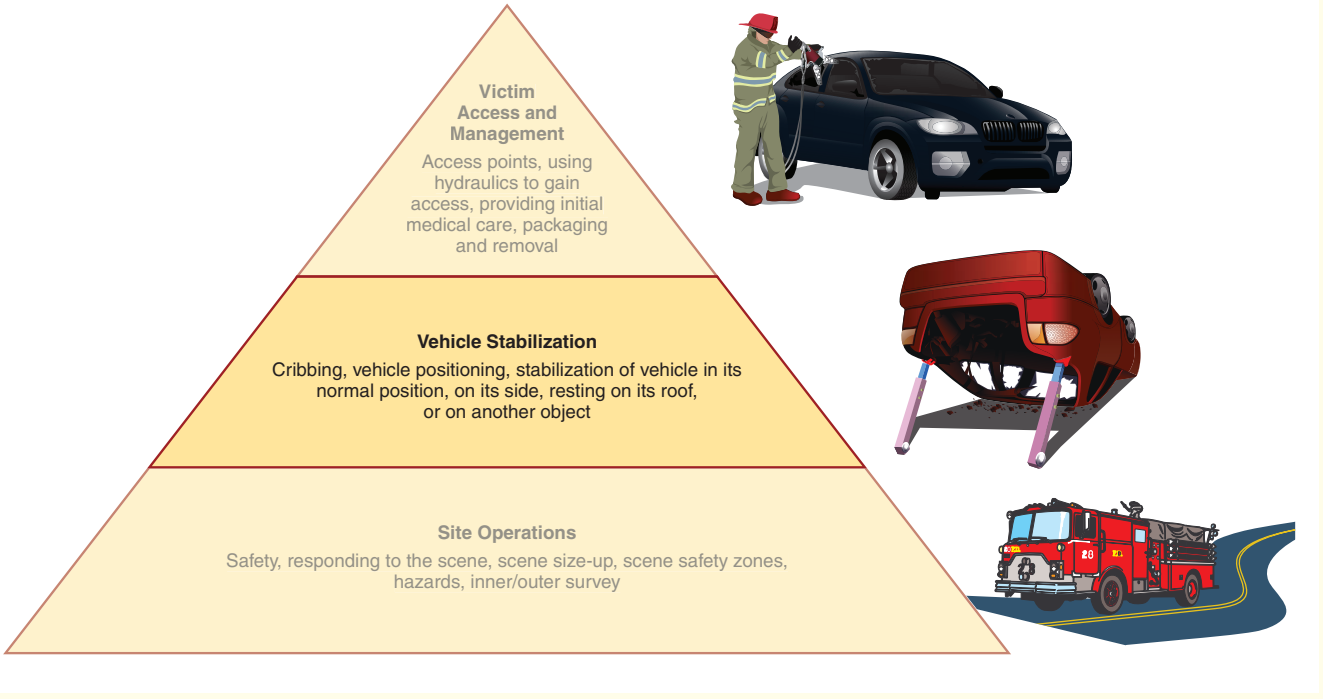


Figure 8-1 Vehicle extrication is a technical process that requires structured successive steps to produce favorable results. This chapter will discuss the second step of this process, vehicle stabilization.

Figure 8-2 Ensure vehicles are stabilized before performing any operational techniques on the vehicles.

cuss how to stabilize common passenger vehicles in multiple resting positions following a crash incident.

To facilitate the learning comprehension of this chapter, review Chapter 6, *Tools and Equipment*, for the various stabilization tools and cribbing configurations.

Rescue Tips

During stabilization, responders should always be aware of the potential for vehicles to shift.

Cribbing

As discussed in Chapter 6, *Tools and Equipment*, cribbing is the most basic physical tool used for vehicle stabilization. Cribbing is commonly available as wood or composite materials, with some products being made of steel. Several cribbing designs are utilized for extrication incidents, such as step chocks, wedges, shims, and the basic 4- by 4-inch (102- by-102 millimeter [mm]) sections of timber (commonly referred to simply as "four-by-fours") that are cut at various lengths, most commonly 18 to 20 inches (457 to 508 mm) and 3 to 6 feet (1.2 to 2.4 meter [m]) or longer.

Wood Characteristics

Understanding the basic characteristics of wood used for cribbing is essential to the technical rescuer, whether you are stabilizing a vehicle, shoring a structure, or supporting a load.

Wood is heterogeneous in nature, meaning that it is composed of a mixture of different materials or has a lack of uniformity. Wood is also considered anisotropic in that the properties of each wood species are different according to its growth ring placement and direction of the grain. These two facts are important because not all wood types are suitable for cribbing and/or shoring. As was stated in Chapter 6, *Tools and Equipment*, soft woods such as Southern Yellow Pine or Douglas Fir are commonly used for cribbing because they are well suited for compression-type loads. Hard wood, such as an oak species, is very strong but may split easily under certain stresses.

When considering wood species for cribbing, the primary concern is the measurement of applied stress (which is a unit of force), without failure, of that particular species of wood. The applied stress factors may be compression, tension, or shear. All of these stress factors, including the proportional strain of the wood, occur when a force is applied and a section of wood bends, which is considered the elastic performance of the wood.

Stress and strain are proportional, which means that any incremental increase in stress is proportional to an incremental increase of strain. The maximum stress and proportional strain on an object beyond its proportional limit will result in the failure of the material. Wood is considered elastic up to its proportional limit; beyond that limit, failure occurs.

The American Society for Testing and Materials (ASTM) has adopted standardized testing guidelines for measuring the relative stress resistance or strength values of particular species of wood. The maximum stress a board can be subjected to without exceeding the elastic range or proportional limit is known as its fiber stress at proportional limit (FSPL) rating.

When the downward force of an object rests or applies pressure on the surface of a section of wood and it is perpendicular to the grain, such as when a section of cribbing is set up in a crosstie or box crib configuration, the cribbing strength is determined using a formula. The dimension of the surface area at the **contact point**, or weight-bearing section of cribbing, is multiplied by the FSPL rating of that particular species of wood. For example, the FSPL rating of the Southern Yellow Pine or Douglas Fir is 500 pounds per square inch (psi) (3447 kilopascals [kPa]), meaning 500 psi (3447 kPa) is the load capability in pounds for each contact point. Now apply this formula to a 4- by 4-inch (102- by 102-mm) box crib. Multiply the surface area of contact of a 4- by 4-inch (102- by 102-mm) section, which is generally configured to be 3.5 by 3.5 inches (89 by 89 mm), or 12.25 square inches (7921 mm^2):

500 psi (3447 kPa) (FSPL rating) × 12.25 square inches (7921 mm^2) (surface area of contact) = 6125 pounds (3.0625 short tons) per area contact point

The load capacity is 6125 pounds (3.0625 short tons) per area contact point. If you have a simple box crib configuration with only four points of contact, then this setup will support a uniform load capacity of 24,500 pounds (12.25 short tons):

6125 pounds (3.0625 short tons) × 4 points of contact = 24,500 pounds (12.25 short tons)

Wood Box Cribbing

NFPA 1006, *Standard for Technical Rescuer Professional Qualifications*, discusses five types of wood box cribbing configurations that the technical rescuer needs to be familiar with:

- Two-piece layer crosstie Figure 8-3A ▸
- Three-piece layer crosstie Figure 8-3B ▸

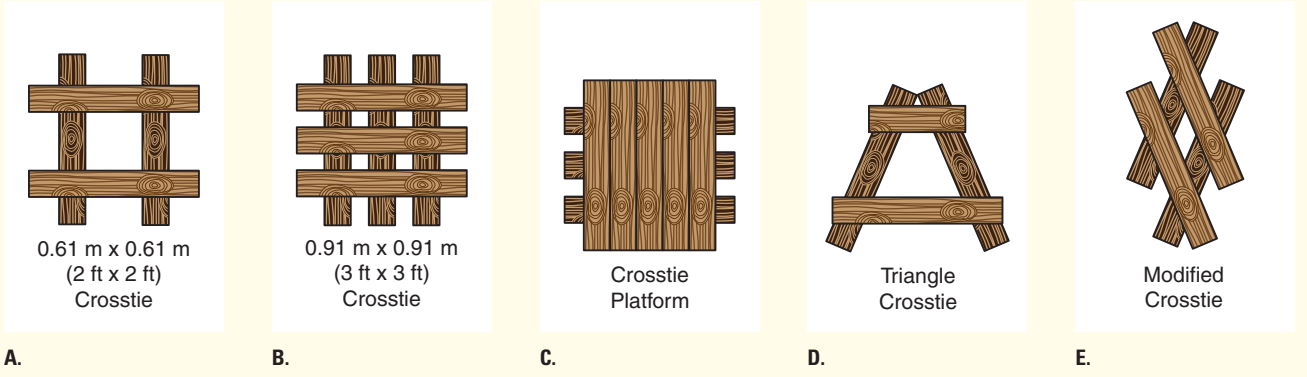


Figure 8-3 Five wood box cribbing configurations. **A.** Two-piece layer crosstie. **B.** Three-piece layer crosstie. **C.** Crosstie platform. **D.** Triangle crosstie. **E.** Modified crosstie.

- Crosstie platform Figure 8-3C
- Triangle crosstie Figure 8-3D
- Modified crosstie Figure 8-3E

The two-piece layer crosstie, the three-piece layer crosstie, and the crosstie platform are the most commonly utilized wood box crib configurations; these will be used to demonstrate a majority of the various cribbing scenarios discussed in this chapter. The triangle crosstie and modified crosstie are unique types of wood box crib configurations that are specific to the type of stabilization incident presented; they are generally utilized for tight or odd-shaped spaces.

When you are setting up a basic two- or three-piece crosstie crib configuration, make sure that all the individual sections are uniform, with one on top of the other, providing a 1- to 1½-inch (25- to 38-mm) gap from the ends. Most ends on a cut section of a four-by-four are cracked or splintered, creating a potential for failure. Always avoid placing the contact point, or the weight-bearing section of cribbing, at the ends; doing so will provide you with a safety margin if the load shifts and the crosstie moves Figure 8-4. Remember, when using a four-by-four, either Southern Yellow Pine or Douglas Fir, each contact point has an estimated weight or load-bearing capacity of 6000 pounds (3 short tons).

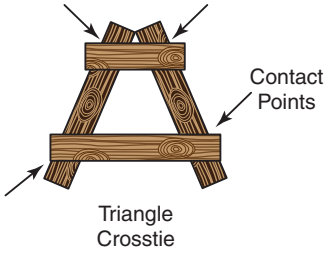


Figure 8-4 Each contact point has an estimated weight-bearing capacity of 6000 pounds (3 short tons).

Rescue Tips

Take the necessary steps to ensure that all cribbing configurations are structured and uniform, with one on top of the other.

Vehicle Positioning

There are five directional movements that the officer or technical rescuer in charge must consider during the process of vehicle stabilization:

1. **Horizontal movement**. Vehicle moves forward or rearward on its longitudinal axis or moves horizontally along its lateral axis Figure 8-5A.
2. **Vertical movement**. Vehicle moves up and down in relation to the ground while moving along its vertical axis Figure 8-5B.
3. **Roll movement**. Vehicle rocks side to side while rotating about on its longitudinal axis and remaining horizontal in orientation Figure 8-5C.
4. **Pitch movement**. Vehicle moves up and down about its lateral axis, causing the vehicle's front and rear portions to move left or right in relation to their original position Figure 8-5D.
5. **Yaw movement**. Vehicle twists or turns about its vertical axis, causing the vehicle's front and rear portions to move left or right in relation to their original position Figure 8-5E.

There are four common postcollision vehicle positions that can be encountered at an accident scene: The vehicle may be in a regular or normal upright position resting on all four tires, it may be resting on its side, it may be resting on its roof, or it may be on top of another vehicle or another object.

The Vehicle in Its Normal Position

Why do you stabilize a vehicle that is upright and resting on all four tires Figure 8-6? The first thought that probably comes

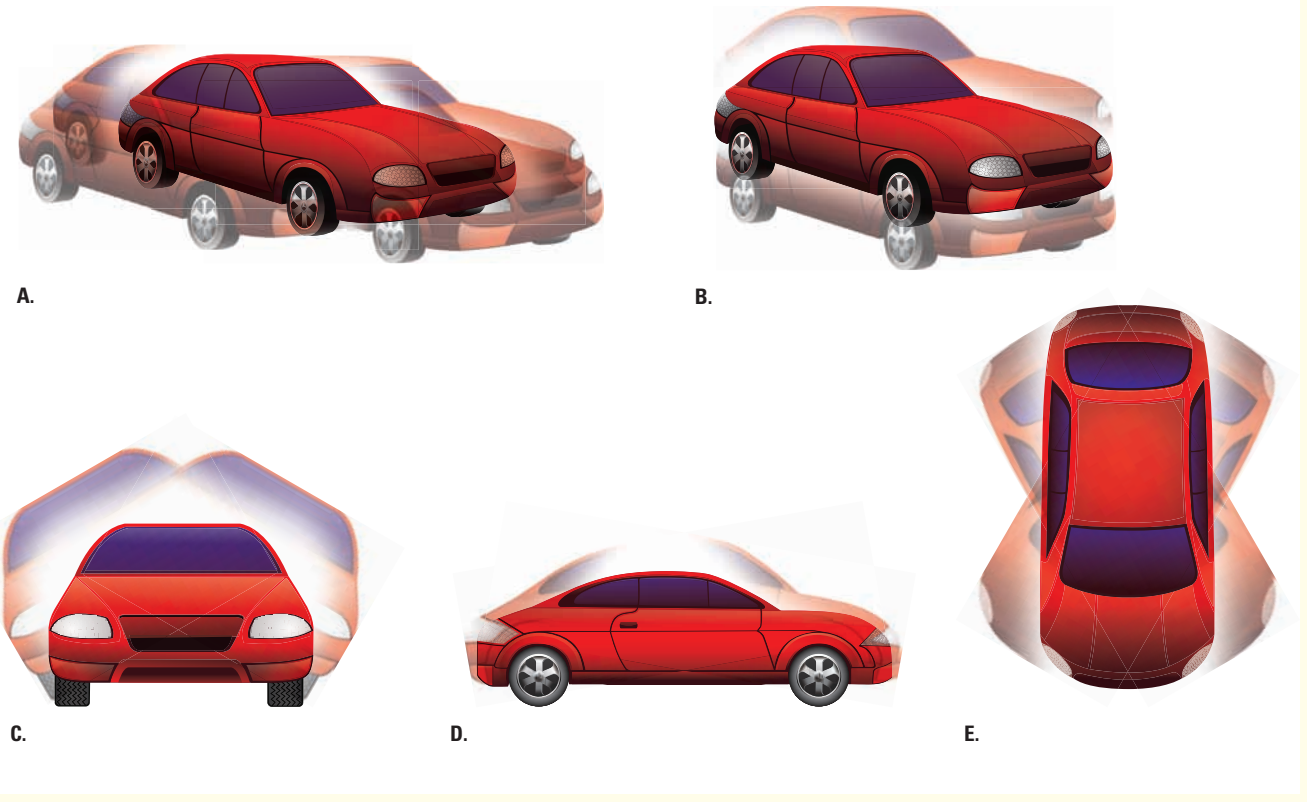


Figure 8-5 Five directional movements. **A.** Horizontal movement. **B.** Vertical movement. **C.** Roll movement. **D.** Pitch movement. **E.** Yaw movement.

Figure 8-6 A vehicle in its normal upright position.

to mind is that you do not want the vehicle to roll away. This is absolutely true, but the main reason we stabilize the upright vehicle is to gain control of all vehicle movement by minimizing the vehicle's suspension system and creating a solid and safe base to work from. A vehicle's suspension system can cause the body of the vehicle to move up and down, potentially causing further injury to a victim. A victim with a suspected spinal injury needs to be properly immobilized immediately; any vehicle movement can exacerbate a spinal injury, potentially causing paralysis of the victim. The goal is to create a balanced platform to work from and minimize the vehicle's suspension system.

To better illustrate how to create this balanced platform and minimize the vehicle suspension system with cribbing, look at the shape of the underside of a vehicle. If the vehicle's frame, undercarriage, underside, or platform is rectangular or square in design, and if all of the vehicle's upper body components are removed, including side panels, parts, and wheels, you will be left with a rectangular or square frame or platform. In order to balance out this object that is shaped like a rectangle or square, the best practice is to access four or more solid points or areas under the object and insert cribbing equally at these points to establish a balance, whether you build a wood box crib configuration or insert a step chock. In a perfect world you would always have access to all four sides of a vehicle, but the reality is that you may only have access to one or two sides of the vehicle. In such scenarios, use your best judgment and crib the sides that you have access to. Properly cribbing just one side of the vehicle will help to minimize movement of the vehicle. The overall objective for crib placement is to position cribbing in four or more solid areas spread out equally to create that balanced platform.

Also, one must consider placing cribbing at the front and rear tires to eliminate the potential for forward or backward movement of the vehicle. This is particularly a factor when the tires remain inflated. If the tires are deflated and the vehicle is resting firmly on cribbing, then the need for placing cribbing at the front and rear is not a high priority unless the vehicle is positioned on an elevation or decline. This decision to add additional cribbing is up to the technical rescuer in charge of the operation.

When placing the cribbing, the need to choose areas that are solid cannot be stressed enough. Areas such as the firewall/dash section or the area just in front of the rear tires are generally very solid points to work from. For example, if you were to change a flat tire, you would place the car jack under a solid area of the vehicle and avoid weaker areas such as the fender sections behind the rear tire; these weaker sections can fold or collapse under weight or pressure. Also, avoid areas that can potentially block the extrication process or impede the normal swing of a door.

To eliminate potential problems, always think ahead before placing any cribbing sections. Ask yourself, "If cribbing is placed in this area, will it block my door from coming off? Will it catch a section of metal that I am trying to remove?" When you are playing a game of billiards, each shot you take sets up your next series of actions; you strategize each shot and placement of the cue ball to set up each successive step in advance. This same strategy should be applied to cribbing placement—and to extrication as a whole. Each action the technical rescuer takes should set up the next step rather than impede it. Therefore, it is vital to know where to place cribbing.

Rescue Tips

The technical rescuer should always think several steps ahead.

Determining the height distance from the ground to the bottom frame area will vary, depending on the vehicle. For example, the amount of cribbing needed to stabilize a large sport utility vehicle (SUV) will be significantly more than that needed to stabilize a small sports car. Step chocks will remove a lot of the guesswork because of the increased height adjustment on each successive step. When using cribbing, whether it is a basic four-by-four or a step chock, the goal is to make the contact area from the ground to the undercarriage tight, filling up any void spaces Figure 8-7▼.

Figure 8-7 When using cribbing, whether it is a basic four-by-four or a step chock, the goal is to make the contact area from the ground to the undercarriage tight, filling up any void spaces.

Figure 8-8 If a void space still exists after inserting a step chock, a wedge can be added under the step chock to build up the height and increase the contact area between the vehicle and the cribbing.

If a void space still exists after inserting a step chock, a wedge or shim can be added under the step chock to build up the height and increase the contact area between the vehicle and the cribbing; tap the wedge section in position using the butt end of a four-by-four, or use a rubber mallet Figure 8-8▲. Also, if you are dealing with a vehicle that is high off the ground, such as an SUV, a crosstie platform crib configuration can be set up with a step chock placed on top of it and then set into position. There is also an adjustable step chock that is composed of steel, which has a built-in mechanism that allows the chock to be manually adjusted and locked to meet the various height differences that the rescuer will encounter.

One question that is continually asked is whether the vehicle's suspension can be lifted manually, just enough to insert the cribbing, and then let back down to rest on the cribbing that is now properly adjusted to the required height. This is a loaded question. If done correctly, then yes, this method can be attempted and is very effective. The proper technique includes positioning your back against the body of the vehicle near the front or rear wheel well, lifting with your legs and not your back, and lifting the suspension only and not the vehicle itself. The problem comes from a poor lifting posture, or from overexertion by an adrenalin-fueled rescuer who tries to lift the vehicle rather than just move the suspension; injuries will absolutely occur when the latter happens. The decision to use or recommend this technique rests solely upon the officer in charge of the operation, or should come from a directive outlined in a departmental policy or standard operating guideline (SOG), which should also include the approval of an agency's risk manager. Also to be considered when determining to attempt this technique are the position of the vehicle, approximate estimated weight of the vehicle, and, obviously, the physical condition of the rescuer or rescuers who will be performing the lift.

Tire Deflation

An often debated topic is whether the tires of the vehicle should be deflated after the cribbing has been inserted. One benefit for deflating the tires on a passenger vehicle is that it will force the vehicle to rest firmly on the cribbing, creating a solid base to work from. As sections of the vehicle are removed, such as the

doors or roof, the vehicle becomes lighter. With a vehicle's tires still inflated and the vehicle becoming lighter, the suspension system will cause the vehicle to rise and the cribbing to come loose. When the tires are deflated, the vehicle settles down onto the cribbing with the suspension system virtually eliminated.

One drawback of tire deflation is that the stability of the vehicle may shift. Or, if there is an object or another vehicle positioned on top of the vehicle, then that object or vehicle can also shift. Determining whether to deflate the tires is purely a judgment call by the officer in charge and can only be determined at the time of the incident and by the type of situation being presented.

Some agencies do not advocate deflating tires because doing so can interfere with law enforcement's investigation by eliminating a means of measuring tire pressure. If your agency does not support tire deflation, then an alternative would be to insert a wedge section of cribbing under the crib configuration and strike the end of it with a mallet or the butt end of a four-by-four until the desired height or stability is achieved.

There are several tools that can be used to deflate a tire. One of the easiest and safest ways is to remove the tire stem. The best overall tool to use for this job is a stem puller or a channel lock wrench Figure 8-9. When using a channel lock wrench, grab hold of the tire stem and rotate the tool so that the head of the wrench rests on the tire rim. Using the rim as a leverage point, move the tool downward, causing the stem to dislodge from its housing.

Rescue Tips

An initial surge of air pressure rapidly releases following tire deflation.

Another option for tire deflation is to use the forked end of a Halligan bar. This technique can only be applied to a rimmed wheel with a protruding stem valve, in addition to the hubcap being removed. Slide forward one side of the fork inside the tire rim just over the area where the stem protrudes from the wheel; the key is positioning the blade of the tool at the correct angle, which can take some practice to achieve. Sliding this flat section of the fork forward over that area will cut off the end of the rubber tire stem at the base where it protrudes from the rim Figure 8-10. Remember that this technique will only work on rimmed wheels; any hubcaps will need to be removed prior to attempting this technique. Also, never use the spiked end of a Halligan bar to puncture the tire. This is a very dangerous practice that can potentially cause injury when the tool rebounds violently off the tire. This approach is also very unprofessional; as technical rescuers we strive to demonstrate skill through control, not through force.

Figure 8-9 When pulling a tire stem, always use leverage to dislodge the stem from its housing. The best overall tool is a stem puller or a channel lock wrench.

Figure 8-10 Sliding the flat section of the fork of a Halligan bar forward over the area of the rubber tire stem will cut off the end of the tire stem at the base where it protrudes from the rim.

Lastly, in addition to inserting cribbing for stabilization, the technical rescuer must always consider the basic or simple internal forms of stabilizing a vehicle. These steps include placing the vehicle in park, turning off the engine, and applying the parking brake. These are steps that can easily be overlooked because the focus is to quickly put cribbing or step chocks into place; yet these basic steps require very little effort to accomplish.

To stabilize a common passenger vehicle in its normal upright position, follow the steps in Skill Drill 8-1:

1. Don PPE, including SCBA if needed.
2. Enter the secure work area safely.
3. Assess the scene for hazards and complete the inner and outer scene surveys.
4. Lay out a tarp at the edge of the secure work area for staging tools and equipment, if indicated.
5. Apply basic or simple internal forms of stabilization by placing the vehicle in park, turning off the engine, and/or applying the parking brake. (Step 1)
6. Insert a step chock or build a wood box crib/crosstie configuration under four or more solid points of the vehicle.
7. If your agency supports tire deflation, deflate the tires to force the vehicle to rest firmly on the cribbing by pulling

NFPA 1006, (10.1.4)

Skill Drill 8-1

Stabilizing a Common Passenger Vehicle in Its Normal Position

1 Don PPE. Enter the secure work area safely. Assess the scene for hazards and complete the inner and outer scene surveys. Lay out a tarp at the edge of the secure work area for staging tools and equipment, if indicated. Apply basic or simple internal forms of stabilization by placing the vehicle in park, turning off the engine, and/or applying the parking brake.

2 Insert a step chock or build a wood box crib/crosstie configuration under four solid points of the vehicle. If your agency supports tire deflation, deflate the tires by pulling or cutting the tire stem. If your agency does not advocate tire deflation, use wedges to force the vehicle to rest firmly on the cribbing and consider placing additional cribbing at the front and rear of the tires to prevent any unexpected forward or backward movement. Reassess to confirm stabilization. Perform all of these tasks in a safe manner. Notify command that the vehicle has been stabilized.

or cutting the tire stem. If your agency does not advocate tire deflation, use wedges to force the vehicle to rest firmly on the cribbing and consider placing additional cribbing at the front and rear of the tires to prevent any unexpected forward or backward movement.

8. Reassess all of the cribbing to confirm position and stabilization.
9. Perform all of these tasks in a safe manner.
10. Notify command that the vehicle has been stabilized. (Step 2)

The Vehicle Resting on Its Side

A vehicle resting on its side is a very dangerous scenario Figure 8-11 ▸. As with other scenarios, the vehicle needs to be properly stabilized before any operations can be conducted. This section will demonstrate a technique using cribbing and tensioned buttress struts. Struts are structural supports used as a "buttress" to stabilize and reinforce an object. Because a technical rescuer must always be cognizant of time, this basic technique is designed for a very rapid and simplistic setup. When done correctly, this technique, including the inner and

Figure 8-11 A vehicle resting on its side.

outer surveys, should take no longer than 5 minutes to complete. Keep the techniques basic unless you and your crew are well versed in multiple advanced stabilization scenarios; the time to attempt a new technique is not on the emergency scene. There are many ways to stabilize a vehicle resting on its side, and it is in the technical rescuer's best interest to research the various manufacturers of stabilization equipment in order to become familiar with the wide array of tools, to learn more about how to utilize the various stabilization equipment, and to determine which tools are best suited to meet the needs of a particular organization.

One of the greatest advances in the rescue industry, with the exception of hydraulic tools, was the introduction of buttress stabilization struts with a tensioning attachment Figure 8-12. These tools have simplified the stabilization process tremendously and make it much safer to conduct emergency operations on a vehicle.

Rescue Tips

Make sure your crew fully understands the stabilization technique before attempting it. Stabilization is a team effort and every member needs to be on the same page.

A vehicle resting on its side has a center of gravity that is very high and a comparatively narrow track or base, which will cause it to topple over very easily. The center of gravity is the area of the object upon which all of the weight is centered; in this case, the center of gravity is high because the vehicle is on its side. The goal is to lower the vehicle's center of gravity by expanding the vehicle's **footprint**, or the area of the vehicle in contact with the ground. This can be accomplished with strategically placed struts, cribbing, and ratchet strapping. Ratchet straps are designed for tie-down purposes only and not for lifting. The main objective is to position the struts to form an A-frame configuration. The A-frame configuration will stabilize the vehicle (just as the outriggers on an aerial apparatus are designed to work).

Figure 8-12 Buttress stabilization struts are structural supports that can be made of steel, aluminum, composite/Kevlar® wrap, and wood. They are used as a "buttress" to stabilize and reinforce an object, expanding a vehicle's base or footprint while also lowering its center of gravity.

Rescue Tips

All vehicles have different body designs to some degree; some may incorporate more rounded features, and some will incorporate square features. It is important to consider these differences when you are trying to locate an area to position the tips of the struts.

The first step that the technical rescuer will take is to examine whether the vehicle is leaning in a particular direction. If the vehicle is on its side on a level plane with all of its tires intact, then the tendency is for the vehicle to roll toward the roof side; the roof side is considered the most unstable and will need to be the first side that is stabilized. To accomplish the scenario of stabilizing a vehicle resting on its side, the crew members should have a full complement of cribbing sections and struts to work with, such as wedges, shims, four-by-fours, and step chocks.

After the inner and outer surveys are completed and all hazards are clear, the officer or technical rescuer in charge of the operation will place his or her hands on the front or rear section of the vehicle to feel for any shifting or movement of the vehicle as the other crew members begin cribbing. This safety technique allows the officer or rescuer in charge to warn crew members if the vehicle is going to roll. Crew members who are inserting the cribbing are generally unable to determine vehicle movement because their focus is at ground level where the cribbing is being placed. This safety technique gives the officer full control of the operation by providing visibility to both sides of the vehicle Figure 8-13. Also, when operating at ground level around an unstable vehicle, such as when inserting or positioning cribbing, the technical rescuer must always work from one knee, in a semi-kneeling stance. This provides better mobility for moving quickly to avert any unexpected events, as opposed to being planted with both knees on the ground. The scene safety officer or the technical rescuer in charge of the operation must keep a keen eye open for any improper techniques and remind personnel to always work safely.

Rescue Tips

When operating at ground level around an unstable vehicle, such as when inserting or positioning cribbing, the technical rescuer must always work from one knee in a semi-kneeling stance.

Figure 8-13 The position of the technical rescuer in charge of the operation should be at the front or rear of the vehicle; this provides full control of the operation by providing visibility to both sides of the vehicle.

To stabilize a vehicle resting on its side using buttress stabilization struts, follow the steps in **Skill Drill 8-2** ▸:

1. Don PPE, including SCBA if needed.
2. Enter the secure work area safely.
3. Assess the scene for hazards and complete the inner and outer scene surveys.
4. Lay out a tarp at the edge of the secure work area for staging tools and equipment, if indicated.
5. Position an officer at the front or rear section of the vehicle. The officer should place a free hand on the vehicle to feel for any shifting or movement of the vehicle as the other crew members begin cribbing on either side of the vehicle.
6. Build up cribbing under the hood section of the vehicle by placing a four-by-four parallel to the vehicle, close to the hood line.
7. Insert two wedges on top of the four-by-four and lightly strike them in place with the butt end of a four-by-four or using a rubber mallet. Do not strike them too hard because you will have to reset all of the cribbing once the struts are in place.
8. Move to the rear of the vehicle. Utilize a step chock or the four-by-four wedge combination to stabilize the rear of the vehicle. The step chock can be positioned either right side up or upside down to match the anatomical position of the vehicle. In this situation, step chocks generally work best upside down to match the anatomical position of the vehicle. A wedge or two may need to be inserted on top of the step chock to fill any void spaces and create a tight fit. (**Step 1**)
9. As the initial cribbing is conducted, another crew member should set up the tensioned buttress system on both sides of the front quarter of the vehicle. The first strut should be placed at a solid section of the undercarriage so that the tip of the strut can push off from it (push point). Adjust the strut height to maintain an angle of not less than 45 degrees to the vehicle, and then properly lock the height position of the strut in place. (**Step 2**)
10. Move to the opposite (hood) side of the vehicle. Mark a purchase point location in the hood by first extending the strut, measuring the height needed, and marking off the proper location where the strut will be placed. A **purchase point** is the location where access can best be gained. A purchase point is often needed to hold a strut in place.
11. Create the purchase point by placing the spike end of a Halligan bar on the designated mark and striking the back of the tool with a flat-head axe until the hood has been penetrated. If the hood of the vehicle is made of fiberglass or polycarbonate material, then make the purchase point at a higher location where the hood seam and the upper rail join together; the strut tip will grab hold and lock in place when pressure is applied. This purchase point can also be made by utilizing an air chisel or a cordless drill with a large #9 step bit for penetrating the sheet metal. Setup time must be considered when using one of these tools. Remember, time is always working against you.
12. With the spike of the Halligan bar buried in the hood, spin the tool 180 degrees clockwise or counterclockwise, positioning the fork end of the Halligan bar straight up and prying or pulling straight down on the bar, creating an outward lip on the top of the purchase point. (**Step 3**)
13. Place the tip of the strut into the purchase point and adjust the strut height to maintain an angle of not less than 45 degrees to the vehicle. Lock the height position of the strut into place.
14. Lay out a ratchet strap that comes with the strut kit. Connect both struts together by attaching the ratchet strap to the base of each strut. Make certain that the base plates are facing one another and are not turned outward. This would cause the struts to be pulled out of position and fall when the ratchet strap is tightened.
15. Once both struts are attached to one another, the officer or technical rescuer in charge of the operation (the person who has a hand placed on the front section of the vehicle) will have the two crew members double-check the placement of the struts, making sure they are in the proper position before they are tensioned and locked into place. One crew member will then take up all the webbing slack on the ratchet strap before ratcheting; this will ensure that there is no overspooling of the drum on the ratchet strap mechanism. With one hand on the webbing slack and the other hand on the ratchet lever, he or she will pull tight on the webbing slack, guiding it in the spool as the lever is ratcheted. This action will cause the tips of the struts to drive deep into a locking position, slightly lifting the vehicle and causing its footprint to expand outward onto the strut's ground pads.

NFPA 1006, (10.1.4)

Skill Drill 8-2

Stabilizing a Vehicle Resting On Its Side

1 Don PPE. Enter the secure work area safely. Assess the scene for hazards and complete the inner and outer scene surveys. Lay out a tarp at the edge of the secure work area for staging tools and equipment, if indicated. Position an officer at the front or rear of the vehicle. The officer should position a free hand on the vehicle to look and feel for movement or shifting of the vehicle. Build up cribbing under the hood and rear section of the vehicle using step chocks, wood cribbing, and wedges.

2 Place a tensioned buttress strut at a solid section of the undercarriage at the front of the vehicle. Adjust the strut height to maintain an angle of not less than 45 degrees to the vehicle and lock it into place.

3 Move to the opposite (hood) side of the vehicle. Measure and then mark a purchase point location in the hood. Create a purchase point in the hood by using the spike end of a Halligan bar and by rotating the tool 180 degrees and prying or pulling down on the bar to create a lip on the top of the purchase point.

4 Place the tip of the strut into the purchase point, adjust the strut height, and lock it into place. Attach the hooks of the ratchet strap to the base of each strut. Double-check the placement of the struts before ratcheting. Tighten the ratchet strap, locking the struts into place. Reseat all cribbing to be sure the vehicle is stabilized.

16. Once these steps have been completed, reseat all cribbing by striking each section firmly with the butt end of a four-by-four or rubber mallet. (Step 4)

Initial crib placement will focus on the most unstable area, which, in this particular scenario will be the front roof side of the vehicle. The objective here is to set up an A-frame configuration using a tension buttress system, thus building up cribbing under the hood and rear sections of the vehicle and leaving the roof area unobstructed and open to work on.

As an additional safety factor, another set of struts can be applied in the same manner to the rear section of the vehicle for extra stability, but generally one set of struts in the front section of the vehicle with the cribbing configurations at the rear is sufficient to accomplish the task. Also, if the grade level of

Near Miss REPORT

Report Number: 10-452
Report Date: 03/11/2010

Synopsis: The vehicle had been chocked, but no one had checked to see if it was in park or if the emergency brake was on.

Event Description: We responded to a motor vehicle accident with injury. The victim in the driver's seat was restrained. A small amount of extrication was required. The fire crew was already on the scene, stating they needed a medic in the vehicle. The vehicle was off the road on top of a hill with a pond on both sides of the hill. I arrived on the scene and got in the backseat to hold c-spine and do patient care during extrication.

The vehicle had been chocked, but no one had checked to see if it was in park or if the emergency brake was on. As the extrication started, the vehicle started moving down the hill toward the pond. The patient and I were in the vehicle. It stopped prior to making it down the hill and we finished the extrication and transported the patient to the hospital.

Lessons Learned:

- Scene safety—Always be aware of surroundings.
- Teamwork—Work together and remind each other of possible safety issues.
- Command—Just because scene is established and units are on scene does not mean all safety aspects have been taken care of.
- Training—Always chock vehicles and make sure they are in park with the emergency brake set.

the surface is sloping, depending on the position of the vehicle, additional cribbing or struts can be added to the front or rear to prevent any potential shifting. A basic operation should take the technical rescuer and crew no longer then 3 to 5 minutes to deploy and complete the stabilization of a vehicle resting on its side. The main advantage of utilizing an A-frame technique is that the roof area is free of any cribbing and an uncomplicated roof removal can be accomplished if called for by the officer in charge. Other techniques require cribbing to be inserted under the roof line in the area of the A, B, C, or greater posts and this can impede a roof removal operation.

The Vehicle Upside Down or Vehicle Resting on Its Roof

When a vehicle is involved in a roll-over, the roof posts can be compromised by the crash impact and subsequent weight of the vehicle now on the posts; this makes the vehicle unstable Figure 8-14 ▸. Roof posts that have been compromised from a roll-over impact are not guaranteed to support the weight of the vehicle; therefore, the roof needs a solid artificial support system before any operation can be conducted. Federal Motor Vehicle Safety Standard (FMVSS) 216, *Roof Crush Resistance*, establishes the strength requirements for the passenger compartment roof. Currently, the roof strength requirements for vehicles 6000 pounds (3 short tons) or less is equal to 1½ times the unloaded vehicle weight of the vehicle. This tells us that the strength of the roof under normal conditions will support 1½ times the vehicle's weight. New standards going into effect in 2012 increase the requirement for roof strength to 3 times the weight of a vehicle weighing 6000 pounds (3 short tons) or less. This is an incredible safety feature for the consumer, but rescuers must not get lulled into a false sense of security by thinking that compromised roof posts are secure. The FMVSS test was

Figure 8-14 A vehicle upside down or resting on its roof.

not designed for postcrash roof supports. Always take the extra safety precaution and properly support the roof structure with struts and cribbing.

Stabilizing a vehicle on its roof involves using struts and applying cribbing, at a minimum, in a four-point configuration. Looking at the vehicle's position, the weight of the engine will normally drive the hood or front area of the vehicle lower to the ground, with the trunk area presenting much higher. This scenario is based on the standard American automobile with a front-end engine compartment, where the roof area has not been completely flattened. With unobstructed access, there are usually three points of entry: the driver's side, the passenger's side, and the trunk area. Stabilization should always be set up to keep these potential entry points open and unobstructed.

Initial crib placement should focus on the most unstable area. In this particular scenario, the unstable area is the trunk side of the vehicle. The objective is to set up an A-frame configuration at the rear of the vehicle using struts, building up cribbing under the rear roof section and hood/dash areas of the vehicle. It is also possible to use crosstie box cribbing configurations that are stacked on top of one another and placed under the trunk area on both sides. The rule of thumb is to never stack box cribbing any higher than two times its width. For example, a 20-inch (508-mm) wide box crib formation should not exceed 40 inches (1016 mm) in height (roughly 3.5 feet [1.1 m]). Understand that by placing box cribbing under the trunk, you eliminate any possible trunk entry utilizing a tunneling option. **Tunneling** is the process of gaining entry through the rear trunk area of a vehicle; this technique is more commonly used for a vehicle resting on its roof. Remember that it is always important to keep all options open to quickly compensate and change directions for any unexpected events.

To stabilize a vehicle resting on its roof, the crew members should have a full complement of cribbing sections and struts to work with such as, wedges, shims, four-by-fours, and step chocks.

To stabilize a vehicle resting on its roof, follow the steps in Skill Drill 8-3:

1. Don PPE, including SCBA if needed.
2. Enter the secure work area safely.
3. Assess the scene for hazards and complete the inner and outer scene surveys.
4. Lay out a tarp at the edge of the secure work area for staging tools and equipment, if indicated.
5. Place step chocks in the two void spaces between the ground and rear section of the roof just before the trunk area on the roof rail. Always place the step chock on the roof rail where it is stronger and avoid the center of the roof, which is weaker and has a tendency to fold or crease. You will need to determine the position in which the step chock

NFPA 1006, (10.1.4)

Skill Drill 8-3

Stabilizing a Vehicle Resting on Its Roof

1 Don PPE. Enter the secure work area safely. Assess the scene for hazards and complete the inner and outer scene surveys. Lay out a tarp at the edge of the secure work area for staging tools and equipment, if indicated. Build up cribbing under the hood and rear section of the vehicle using step chocks, wood cribbing, and wedges. Set up buttress struts on both sides of the rear quarter-panel/trunk area to form an A-frame configuration.

2 Measure and then mark two purchase points in the rear quarter-panel/trunk area, or place the struts in the corner of the rear window and trunk area, avoiding the trunk seam (which keeps the option of tunneling through the trunk available, if needed). Connect both struts together by attaching the ratchet strap to the base of each strut. Pull up all of the slack in the ratchet strap and make snug before ratcheting. Once completed, the remaining cribbing needs to be firmly reseated with the butt end of a four-by-four or rubber mallet.

fits best, either right side up or upside down, to best match the anatomical position of the vehicle. In addition, you may have to insert several wedges on top or bottom of the step chock to fill any void spaces and create a tight fit. The same step chock configuration can be inserted directly across on the opposite roof rail to balance it out. Placing cribbing in this area is not done to hold up the vehicle, even though it will add some support; the main purpose is to eliminate the potential for any rocking.

6. Place cribbing around the front sides of the vehicle under the dash/hood area and the front bumper area.
7. Set up buttress struts on both sides of the trunk area to form an A-frame configuration. (Step 1)
8. Option 1: Mark and create a purchase point on both sides of the rear quarter-panel/trunk area with the Halligan tool. The purchase point will hold the strut in place. Option 2: Place the struts in the corner of the rear window and trunk area, avoiding the trunk seam and thereby keeping the option of tunneling through the trunk available, if needed.
9. Connect both struts together by attaching the ratchet strap to the base of each strut.
10. Pull up all of the slack in the ratchet strap and make snug before ratcheting. Watch the strut base on both sides to ensure that the struts are not twisting out of position when the ratchet straps are tightened (if this occurs, reposition the struts).
11. Once ratcheting is completed, the remaining cribbing needs to be firmly reseated with the butt end of a four-by-four or rubber mallet. (Step 2)

Rescue Tips

Federal Motor Vehicle Safety Standards (FMVSS) 216, *Roof Crush Resistance*, establishes a minimum requirement for roof strength. Under previous versions of the standard, roofs of vehicles weighing 6000 pounds (3 short tons) or less were required to withstand 1½ times the weight of the vehicle when it is sitting on its roof. The new standard going into effect in 2012 states that roofs of vehicles weighing 6000 pounds (3 short tons) or less are required to withstand 3 times the weight of the vehicle when it is sitting on its roof. Some manufacturers may impose an even higher standard. This is one example of how changes to the standard will affect our abilities during vehicle extrication.

Vehicle on Vehicle or an Object on Top of a Vehicle

When the technical rescuer encounters a vehicle on top of another vehicle or an object on top of a vehicle, such as a large pole or cement post, he or she may be presented with two objects that are independently unstable Figure 8-15 ▸. To stabilize both objects, they will need to be **married**, or joined together in their current position. Marrying vehicles will eliminate any independent movement of the two objects. For the purpose of this discussion, we will use the example of a vehicle on top of another vehicle. Joining the two vehicles together is best accomplished by utilizing industrial-grade ratchet strapping Figure 8-16 ▴.

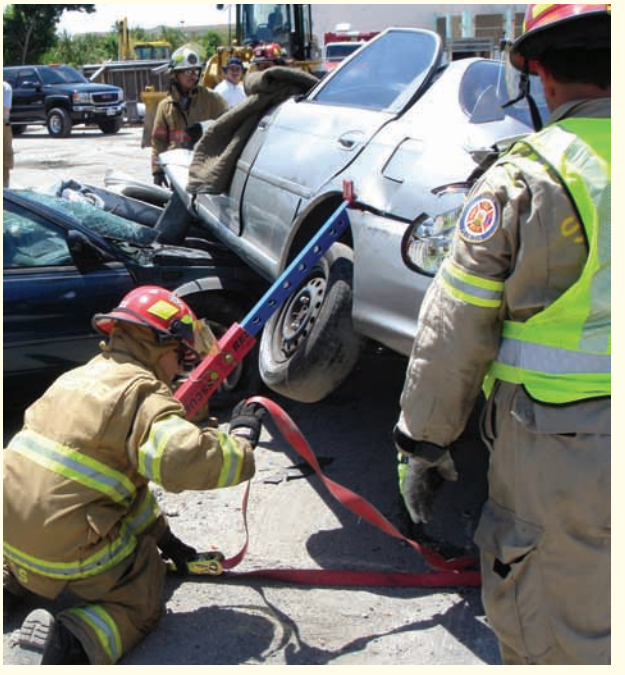


Figure 8-15 A vehicle on another vehicle.

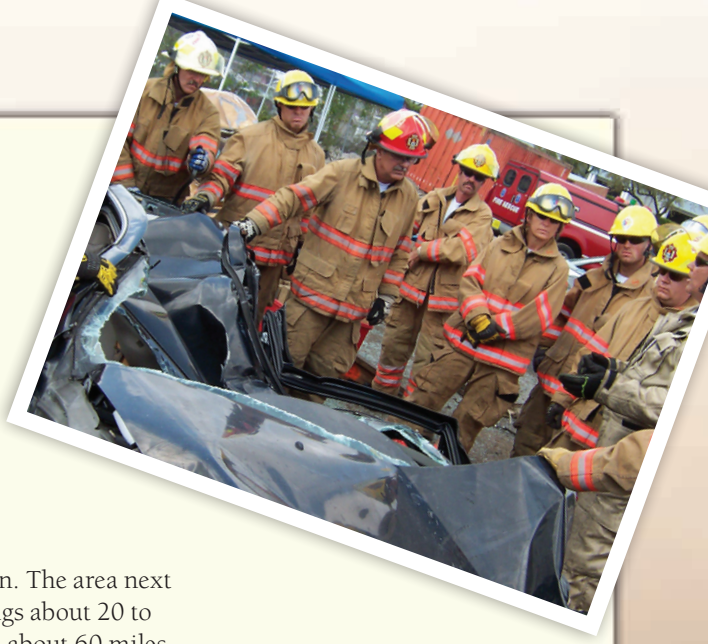
Figure 8-16 Industrial-grade ratchet strapping.

Because of the high degree of instability of this situation, it is extremely important to marry the two vehicles before operations are conducted. Stabilize the bottom vehicle first by inserting cribbing where there is access. Never crawl under the top vehicle, as you may become trapped by a sudden collapse; always work around the vehicle, remaining aware of and ready for any potential failure or collapse. If you need to pass a strap under a vehicle to the other side, hook the strap end to a long pike pole and safely pass it under the vehicle to the other side Figure 8-17 ▸.

Rescue Tips

Use a long pike pole to pass straps under the vehicle to the other side.

Voices of Experience



A sedan carrying an older couple left a divided highway one afternoon. The area next to the highway was a deep depression bordered by rock outcroppings about 20 to 30 feet (6 to 9 m) high. The car left the roadway at a high rate of speed—about 60 miles per hour (mph) (97 kilometers per hour [kph])—and nosed into the rock. The rear of the car came to rest on the upslope of the depression, causing the car to turn into a U-shape, with the dashboard firmly entrapping both occupants.

Because the ground was relatively soft, the front of the car was actually embedded in the ground, with the bumper resting on the ground. Stabilization looked like it would be a breeze. After all, the front of the car was rock stable, and the back of the car was on the ground as well. We placed elevated step chocks under the sides and felt pretty confident we had a stable work platform.

Due to the nature of the entrapment, we had to perform a dash-lift technique. With the front end on the ground, we had to do a modified raise, cutting the structural beam in the driver's side front quarter panel. We first addressed popping open the front doors … and found our first problem. We'd placed our cribbing on the sides of the car, effectively blocking the door from opening. The entire rescue came to a grinding halt while our stabilization was reevaluated, removed, replanned, and replaced. The outcome was 50-50: one dead, one critical but alive. We'll never know if the time lost in restabilizing the vehicle was a factor in our patient's death. By the time we were able to put a medic into the car, he was already dead.

> *"We'd placed our cribbing on the sides of the car, effectively blocking the door from opening."*

When you stabilize a vehicle for a rescue, keep your strategic and tactical goals in mind. Don't let your stabilization block access or disentanglement efforts. Time is life.

W. Buck Heath
Overland Park Fire Department
Overland Park, Kansas

Figure 8-17 If you must pass a strap under a vehicle to the other side, hook the strap end to a long pike pole and safely pass it under the vehicle to the other side.

Other guidelines to remember about marrying vehicles utilizing ratchet straps are:

- Always look at the top vehicle and determine where it wants to roll, shift, or move. Strap it in the opposite direction, pulling it in that opposite direction and locking it into place.
- Always ratchet toward yourself and not away, and try to wrap the ratchet strap around the object and hook it back into itself. If you must use the hook into the object, make certain that the object is strong material that will not tear and that the hook itself is the double-wire type.

Various factors will determine how the operation will be conducted. What are the positions of both vehicles? How is the top vehicle resting on the bottom vehicle? Is any section of the top vehicle touching the ground? Where are the victims in relation to the top vehicle? Are there any victims inside of either vehicle? Where are the entry or access points to both vehicles? Will strapping or marrying the vehicles together block any access points? These are just a few questions that need to be addressed before any operation can be conducted, but additional questions will probably come up. This section will review only one of the many possible vehicle-on-vehicle scenarios.

The objective is to stabilize the bottom vehicle and then marry the two vehicles together, eliminating any independent movement. To stabilize or marry a vehicle on top of another vehicle, follow the steps in Skill Drill 8-4 ▸:

1. Don PPE, including SCBA if needed.
2. Enter the secure work area safely.
3. Assess the scene for hazards and complete the inner and outer scene surveys.
4. Lay out a tarp at the edge of the secure work area for staging tools and equipment, if indicated.
5. Position an officer at the front or rear section of the vehicle. The officer should place a free hand on the vehicle to feel for any shifting or movement of the vehicle as the other crew members begin cribbing on either side of the vehicle. (Step 1)
6. Stabilize the bottom vehicle. Follow the procedures discussed in Skill Drill 8-1, *Stabilizing a Common Passenger Vehicle in Its Normal Position*. Do not deflate the tires of the bottom vehicle; doing so can cause a shifting of the top vehicle, which can cause a potential collapse. Once the top vehicle has been successfully married to the bottom vehicle, the decision to deflate the bottom vehicle's tires can be addressed, if needed.
7. Cover the victim in the bottom vehicle with a blanket and then remove glass from the window frames. Glass removal procedures are discussed in Chapter 9, *Victim Access and Management*.
8. Place cribbing between the top and bottom vehicles to fill all void spaces. (Step 2)
9. Anchor the ratcheting section of the ratchet strap to the lowest area of the passenger-side A-post of the bottom vehicle, and then loop the loose end of the ratchet strap through the B-post of the top vehicle and back through and secure it to itself. Make certain that the hook is facing up and outward, not downward, to avoid the potential of the hook dislodging when tension is applied. If the top vehicle is too high to reach, a pike pole can be used to pass the strap through. If possible, avoid the use of ratchet straps within close proximity of the victim.
10. Fill the void spaces where the rocker panel of the top vehicle meets the hood section of the bottom vehicle.
11. Tighten the ratchet strap, and lock or marry the top vehicle to the bottom vehicle. (Step 3)
12. Once the top vehicle is secured to the bottom vehicle, the remaining cribbing needs to be firmly reseated with the butt end of a four-by-four or rubber mallet.
13. Once the top vehicle is secured to the bottom vehicle, a rescuer can be placed inside the bottom vehicle to treat and package the victim.

This marrying configuration gives you access to the victim through the entire door and roof area Figure 8-18 ▾. Keep in mind that there are several additional cribbing options that can

Figure 8-18 Marrying two vehicles utilizing the technique in Skill Drill 8-4 gives you access to the victim through the entire door and roof area. Even if the A-post were cut for a roof removal, the lower area of that post is strong enough to remain a solid anchor point.

NFPA 1006, (10.1.4)

Skill Drill 8-4

Stabilizing/Marrying a Vehicle on Top of Another Vehicle

1 Don PPE. Enter the secure work area safely. Assess the scene for hazards. Complete the inner and outer scene surveys. Lay out a tarp at the edge of the secure work area for staging tools and equipment, if indicated. Position an officer at the front or rear of the vehicle to look and feel for movement or shifting of the vehicle.

2 Stabilize the bottom vehicle. Cover the victim in the bottom vehicle with a blanket and then remove glass from the window frames. Place cribbing between the top and bottom vehicle.

3 Anchor the ratcheting section of the ratchet strap to the lowest area of the passenger-side A-post of the bottom vehicle. Loop the loose end of the ratchet strap through the B-post of the top vehicle, and then loop the strap back through and secure it to itself. Fill the void spaces where the rocker panel of the top vehicle meets the hood section of the bottom vehicle. Tighten the ratchet strap, and lock or marry the top vehicle to the bottom vehicle.

4 Reseat all cribbing. Once the top vehicle is secured to the bottom vehicle, a rescuer can be placed inside the bottom vehicle to treat and package the victim.

Figure 8-19 There are several additional cribbing options that can be added to the side of the vehicle on top to prevent any potential sliding as the bottom vehicle is being stabilized.

be added to the side of the vehicle on top to prevent any potential sliding as the bottom vehicle is being stabilized Figure 8-19.

Hidden Dangers and Energy Sources

While vehicle fires and down power lines are visibly prominent and require immediate action and mitigation before the vehicle is stabilized, there are other potential hazards that may be hidden and cause havoc or injury to personnel on scene. For example, suppose you find a portable propane cylinder that someone was taking to get refilled in the vehicle's trunk or back passenger compartment, or suppose a short from a damaged electrical system starts a postcrash engine fire Figure 8-20.

Once the vehicle has been stabilized, the proactive technical rescuer can mitigate hidden potential hazards by, for example, removing the portable propane tank and disabling the energy system of the vehicle. Again, the best practice is to stabilize the vehicle and establish a solid base or platform for the rescuer to work from, in addition to minimizing vehicle movement, which can potentially exacerbate patient injuries. Unless there is an immediately dangerous to life and health

Figure 8-20 Hidden dangers such as this portable propane tank may be found in the trunk of a vehicle.

(IDLH) hazard that will affect the safety of the operation, stabilizing the vehicle should precede opening a hood of a vehicle to eliminate power. This practice is a guideline only that should be applied for conventional vehicles; alternative fueled, hybrid, and fuel cell vehicles require special procedures where disabling the electrical system is incorporated into stabilizing the vehicle and may have to be accomplished before cribbing is applied. The sequence of these actions is a judgment call that the officer in charge will have to make based on the type of incident presented.

Isolating or eliminating a vehicle's electrical system may be as simple as disabling the vehicle's 12-volt DC battery, removing fuses from the fuse box, and/or removing any smart keys out of the range area Figure 8-21. A smart key is an electronic key that allows the driver to remotely start the vehicle from a general range of 15 to 20 feet (4.6 to 6.1 m) away. Before the electri-

Figure 8-21 Isolating or eliminating a vehicle's electrical system may be as simple as disabling the vehicle's 12-volt DC battery, removing fuses from the fuse box, and/or removing any smart keys out of the range area.

cal system is disabled, make sure any electrically controlled devices defined by NFPA 1006, *Standard for Technical Rescuer Professional Qualifications*, as a beneficial system, such as vehicle seats, automatic steering wheel adjustments, or power windows, do not have to be utilized to gain access or create space for the victims. This needs to be coordinated between members of the rescue team and the incident commander.

Another issue that can be encountered in some conventional vehicles is the possibility of multiple batteries or batteries that may be located in places other than the front hood area, such as in the rear trunk, under the front or rear seat, or under the right or left wheel well. Vehicle manufacturers such as Buick, Mercedes, and BMW install 12-volt DC batteries in the trunk or under the rear seats. You must be aware of this possibility. Also be aware that some manufacturers have only provided access to the negative battery cable for purposes of disconnecting the electrical system. Another method to disconnect the energy system is to locate the fuse box and remove the fuses, which will isolate all of the electrical components and disable them. Although the 12-volt DC battery will remain live, this is the second best option. Supplemental restraint system (SRS) air bag control units come equipped with an energy capacitor that can store power, keeping the air bag system active and live even when the power has been disconnected for a varied amount of time, which differs among manufacturers. Supplemental restraint systems are discussed in detail in Chapter 5, *Supplemental Restraint Systems*.

To disable a conventional vehicle's electrical system and mitigate the potential electrical hazards at an MVC, follow the steps in Skill Drill 8-5:

1. Don PPE, including SCBA if needed.
2. Stabilize the scene by conducting the inner and outer scene surveys.
3. Stabilize the vehicle with the appropriate stabilization technique(s).
4. Check the vehicle for a smart key and move it out of range, approximately 15 to 20 feet (4.6 to 6.1 m) from the vehicle.
5. Open the vehicle's hood.
6. Locate the 12-volt DC battery system in order to eliminate the source of ignition.
7. Remove the negative terminal connection first and then the positive terminal. This can be accomplished by cutting a section out of the negative battery cable and a section out of the positive battery cable.
8. Fold back and tape the cut sections of cable to prevent the cables from touching the terminals. Always remember to remove the negative before the positive to avoid possible electrical shock or arching. (Step 1)

NFPA 1006, (10.1.5)

Skill Drill 8-5

Mitigating Vehicle Electrical Hazards at a Motor Vehicle Collision

1 Don PPE. Stabilize the scene and the vehicle. Check the vehicle for a smart key and move it out of range. Open the vehicle's hood. Locate the 12-volt DC battery system and eliminate sources of ignition. Remove the negative terminal connection first and then the positive terminal by cutting a section out of the negative battery cable and then a section out of the positive battery cable. Prevent the cables from touching the terminals.

Wrap-Up

Ready for Review

- Vehicle stabilization is a critical component of the extrication process.
- Proper vehicle stabilization provides a solid foundation to work from, which ensures safety for the emergency personnel as well as the victim and bystanders.
- Cribbing is the most basic physical tool used in vehicle stabilization.
- Soft woods are commonly used for cribbing because they are well suited for compression-type loads. Hard wood is very strong but may split easily under certain stresses.
- NFPA 1006 discusses five types of wood box cribbing configurations: two-piece layer crosstie, three-piece layer crosstie, platform crosstie, triangle crosstie, and the modified crosstie.
- There are five directional movements to consider during the process of vehicle stabilization: horizontal movement, vertical movement, roll movement, pitch movement, and yaw movement.
- There are four common postcollision vehicle positions that can be encountered at a collision scene: The vehicle may be in a regular or normal upright position resting on all four tires, it may be resting on its side, it may be resting on its roof, or it may be on top of another vehicle or an object may be on top of a vehicle.
- The basic or simple forms of internally stabilizing a vehicle include placing the vehicle in park, turning off the engine, and applying the parking brake.
- The main purpose for stabilizing a vehicle in its normal position is to gain control of all vehicle movement by minimizing the vehicle's suspension system and creating a solid and safer base to work from.
- When placing the cribbing, choose areas that are solid; areas such as the firewall/dash section or the area just in front of the rear tires are generally very solid points to work from.
- When using cribbing, the goal is to make the contact area from the ground to the undercarriage tight, filling up any void spaces.
- The purpose of deflating the tires is to have the frame of the vehicle settle down onto the cribbing, creating a balanced platform to work from and virtually eliminating the suspension system.
- The goal of stabilizing a vehicle on its side is to lower its center of gravity by expanding the vehicle's footprint.
- When a vehicle is involved in a roll-over, the roof posts will be compromised by the impact and weight of the vehicle, making the vehicle unstable. The objective is to set up an A-frame configuration at the rear of the vehicle using struts, building up cribbing under the rear roof section and hood/dash areas to maintain balance.
- When the technical rescuer encounters a vehicle on top of another vehicle or an object on top of a vehicle, he or she is presented with two objects that are independently unstable. These objects need to be joined together, or married, to eliminate any independent movement.
- Once the vehicle is stabilized, the technical rescuer should mitigate any potential postcrash vehicle electrical hazards that can occur, which may require disabling the vehicle's electrical system.

Hot Terms

Contact point When sections of cribbing are set on top of one another, the weight-bearing section of cribbing that crosses over the other. When using a 4- by 4-inch (102- by 102-mm) piece of timber, each contact point has an estimated weight-bearing capacity of 6000 pounds (3 short tons).

Footprint A generic term used to describe an object's balance in relation to its center of gravity, as determined by how much of the object's base touches the surface and how much of the object spans the surface.

Horizontal movement One of five directional movements; the vehicle moves forward or rearward on its longitudinal axis or moves horizontally along its lateral axis.

Marrying (vehicles) The process of joining vehicles together to eliminate any independent movement.

Pitch movement One of five directional movements; the vehicle moves up and down about its lateral axis, causing the vehicle's front and rear portions to move left or right in relation to their original position.

Purchase point The location where access can best be gained.

Roll movement One of five directional movements; the vehicle rocks side to side while rotating about on its longitudinal axis and remaining horizontal in orientation.

Tunneling The process of gaining entry through the rear trunk area of a vehicle, a process more commonly used for a postcrash vehicle resting on its roof.

Vertical movement One of five directional movements; the vehicle moves up and down in relation to the ground while moving along its vertical axis.

Yaw movement One of five directional movements; the vehicle twists or turns about its vertical axis, causing the vehicle's front and rear portions to move left or right in relation to their original position.

Technical Rescuer *in Action*

Your unit responds to a report of a MVC. Upon your arrival, you discover that multiple cars are involved. The incident commander assigns you the task of performing stabilization on vehicle number two.

As you perform your size-up of the vehicle, you note a late-model SUV that has come to rest on its roof. The vehicle has suffered major damage from an apparent roll-over accident. There are parties trapped inside the vehicle who will require emergency medical care. You have access from all sides of the vehicle, and you do not see any secondary hazards such as power lines or leaking fuel as you and your crew complete the inner and outer surveys.

1. Stabilizing the vehicle will provide:
   - **A.** tasks to keep the fire fighters occupied.
   - **B.** time for other resources to arrive.
   - **C.** a stable foundation to work from.
   - **D.** an alternative to rolling a vehicle back onto its wheels.
2. The most basic physical tool in vehicle stabilization is cribbing.
   - **A.** True
   - **B.** False
3. A vehicle resting on its side on level ground with all four wheels intact tends to roll towards its:
   - **A.** trunk side.
   - **B.** roof side.
   - **C.** undercarriage side.
   - **D.** The vehicle will not roll.
4. A vehicle that has been in a roll-over and comes to rest on its roof is compromised because of the:
   - **A.** engine block altering the center of gravity.
   - **B.** potential for leaking fluids.
   - **C.** potential for victims being underneath the vehicle.
   - **D.** potential crash impact that compromised the integrity of the roof posts.
5. In this situation, struts and cribbing should be placed at a minimum of:
   - **A.** one point.
   - **B.** two points.
   - **C.** three points.
   - **D.** four points.
6. A vehicle that has come to rest on its roof provides a number of unique complications.
   - **A.** True
   - **B.** False
7. If no other routes of entry into the vehicle are available, such as if the sides are blocked, the victim can be reached through the rear via a method called:
   - **A.** burrowing.
   - **B.** tunneling.
   - **C.** worm-holing.
   - **D.** belly crawling.
8. To stabilize the vehicle resting on its roof, the technical rescuer would likely use in addition to cribbing:
   - **A.** electric winches.
   - **B.** struts.
   - **C.** chain hoists.
   - **D.** come alongs.
9. The goal of the rescuer should be to create a strut configuration that is a(n):
   - **A.** A-frame.
   - **B.** lean-to.
   - **C.** V-point.
   - **D.** pivotless point.
10. Stabilization of a vehicle resting on its side should be focused on lowering the vehicle's:
    - **A.** position.
    - **B.** height.
    - **C.** weight.
    - **D.** center of gravity.