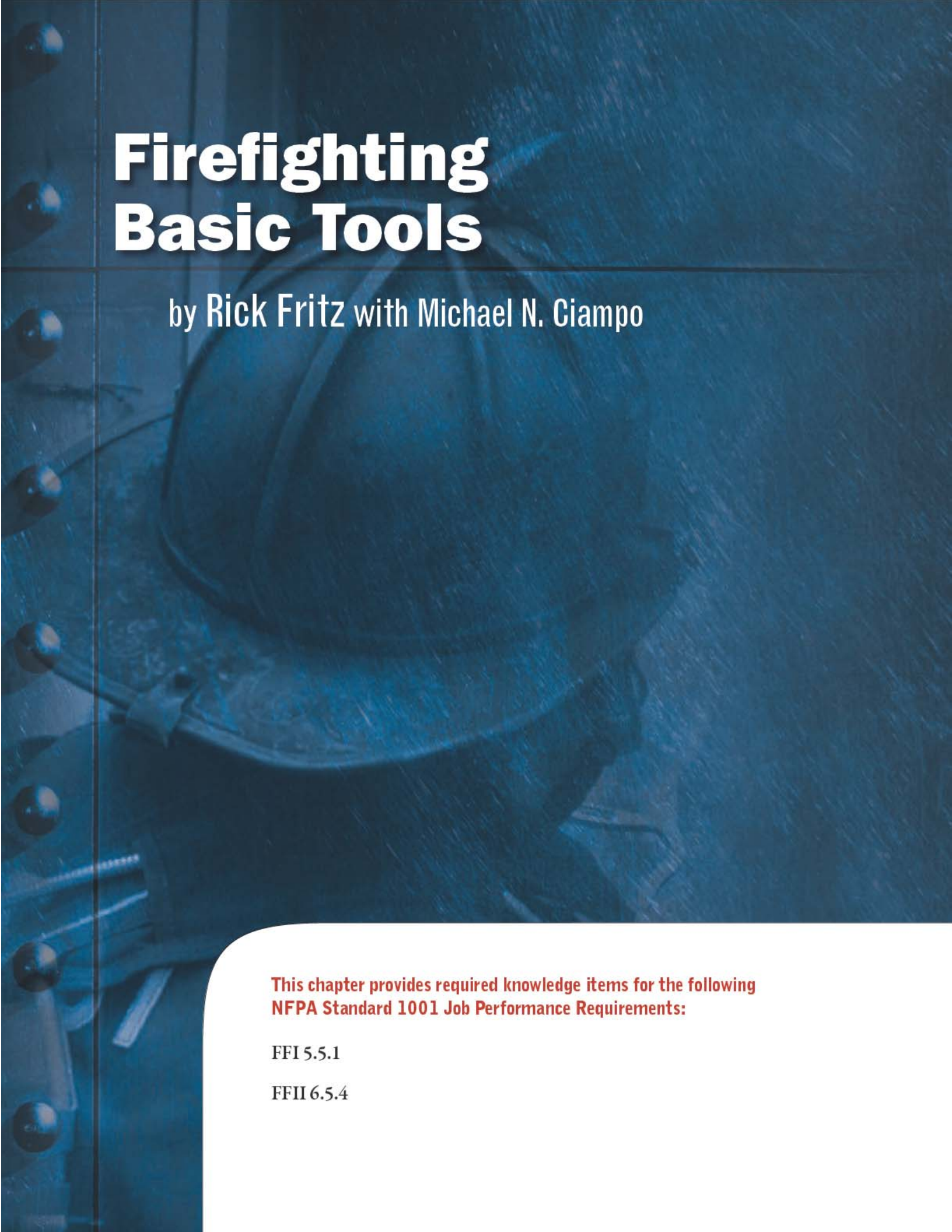

Firefighting Basic Tools

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This chapter provides required knowledge items for the following NFPA Standard 1001 Job Performance Requirements:

FFI 5.5.1

FFII 6.5.4

This chapter contains Skill Drills. When you see this icon, refer to your Skill Drill book for step-by-step instructions.

OBJECTIVES

Upon completion of this chapter, you should be able to do the following:

- List and describe general-purpose firefighting tools and equipment
- List and describe the safety considerations for each tool
- Identify tools used during forcible entry
- Identify tools used during overhaul
- Identify tools used for ventilation
- Identify tools used in fire attack
- Identify the different types of saws used in firefighting
- Describe the maintenance requirements for each type of tool and equipment
- Describe how to clean and inspect each tool prior to and after use

INTRODUCTION

As you can see from your work in the previous 10 chapters, firefighting is a labor-intensive, tool-dependant occupation. Firefighters who master the use of firefighting tools will do well in the profession. Tools accomplish various tasks on the fireground, including cutting, cutting and striking, striking, pushing, pulling, and prying. By effectively using tools as extensions of their bodies, firefighters may multiply the force or leverage applied in a given circumstance while quickly and safely accomplishing the task.

This chapter examines the uses of basic firefighting tools during fire responses. You might not use all the tools we describe during the same fire, but chances are good that you will use at least one or more before returning to the firehouse. Subsequent chapters in this book will cover the use of these tools in greater detail.

Basic firefighting tools are categorized by what they allow firefighters to do. The first group is hand tools that cut.

TYPES OF TOOLS

Cutting tools

SKILL DRILL

In the United States, engines and trucks carry two types of tools that strictly cut: one is a type of axe, the tool most recognized within the fire service, and the other is different-sized bolt cutters.

Pick-head axe. A **pick-head axe** (fig. 11–1) is a steel, single-bit axe, which means it has only one cutting blade. This blade should maintain a smooth cutting surface that is free of nicks and dings. On the opposite side of the blade is a pick. This triangular point can pierce materials such as roofing when it is necessary to create a starting point for cutting. It can also shatter materials such as glass, plastic, and fiberglass.

Fig. 11–1. Pick-head axe

FIREGROUND NOTE

These tools are as important to a firefighter as weaponry is to a soldier. Without them, the enemy is going to kill you.

An ideal axe head weighs 8 lb (3.6 kg). A heavier head will wear out the user before the task is accomplished, and a lighter head means the user must strike harder, which also will exhaust the user and make the axe hard to control.

Accuracy is the key to effectively using any axe. Swung properly, an axe will cut every time. If a user can't place an axe blade in the same place with each swing, he or she will never open a hole. If he or she continually misses the surface of the tool that needs to be driven into a door or wall, the user's firefighting effectiveness will be noticeably lessened.

To maximize your effectiveness, keep your eye on the area in which you want to drop the axe blade. Cutting with an axe is as much hand-eye coordination as strength. Before using any axe, clear the area around you. Axes can severely injure or kill anyone they hit.

To cut using a pick-head axe, grasp the handle firmly and find a stance that is comfortable and compatible with the surface on which you are working. Try to spread your feet and center your body weight. Flex your knees a little. Hold the axe handle where it feels comfortable, but not close to its head. Your stance should feel good and give you balance. You must be able to rock back and forth on your feet while swinging to maintain your balance. Gravity, the force of the wind, bad weather conditions, a burning structure, and the weight and restrictions of your turnout gear will all work against you. Your hands should go no higher than your shoulders on the upswing. Do not let the axe head go behind your head and shoulders. The axe's weight will pull itself from your hands and create a dangerous situation. Letting the axe drop into place will allow the weight of the axe to do the work. As you swing, slide one of your hands along the shaft of the handle to meet the other hand that is grasping the bottom. Don't try to push the tool or swing with one arm stiffened because you will tire quickly. An axe swung with too much force might slip from your hands and plunge into the hole endangering crews working below you, or you could miss your mark and hit another firefighter.

Concentrate on accuracy. Swing the axe so that the blade strikes the surface you want to cut at a slight angle. A dead-on strike might cause the axe to bounce back without cutting the material. If the blade sticks in the material, don't pull because you'll fall. Work the handle of the axe up and down a few times to release the blade. For pick-head axes that are deeply stuck, release the axe by gripping the handle with one hand and grasping the pick with the other. Work the axe head back and forth to release the blade. Place a Halligan bar or piece of debris under the axe handle near the head to create a fulcrum. (A Halligan bar works better.) Push the handle down to force out the axe head.

The pick side of the pick-head axe allows a user to make a purchase point, or starting hole, in materials that are too hard or that have too much spring to allow immediate cutting. To use the pick, flip the axe over and set your stance.

The axe will swing differently because the mass of the axe head will be at the top of the axe. As you swing as though you were using the blade side, maintain a firm grip on the handle to prevent the tool from rolling to the blade side. Keep your eye on the spot you want the pick to hit, and let the weight of the tool drive the pick.

Like the blade side, the pick might get stuck. To release the pick, don't pull. Push the handle forward a little, and then pull it back toward you. If the pick still won't release, lower the handle parallel to the surface you are cutting and rotate the handle 15 degrees in either direction. The pick is self-extracting and should enlarge the hole enough to release it.

Bolt cutters. **Bolt cutters** (fig. 11–2) are another cutting tool firefighters use. They provide a quick and relatively easy method of cutting through various materials. Other tools are available to firefighters for cutting materials such as chain, lock shackles, fencing, etc., but bolt cutters are inexpensive and, when used properly, they are also fast and efficient. Most important in using bolt cutters on the fireground is having the right set for the material to be cut. Some departments keep different types of cutters on the apparatus to cut materials of various strengths. The cutting surface of the cutter may not be suitable for case-hardened material such as some chains and lock shackles, but it's better at cutting fencing, light locks, and small cable.

Fig. 11–2. Bolt cutters

As a firefighter, be wary of dielectric bolt cutters and wire cutters. Firefighters don't cut energized electric lines of any type, ever. Bolt cutters should be made of high-quality carbon steel with long, powerful, preferably fiberglass handles with rubber grips. Handles should be long enough to make cutting easy. The shorter the handles, the less leverage for cutting.

When using bolt cutters, evaluate the material to be cut. Ensure that you have the proper bolt cutters that will bite into and cut completely through the material. Wear eye protection because bolt cutters can launch the cut-off end of chain, bolt head, or whatever you cut. Protect yourself from flying debris. Never intentionally cut a loose end. When cutting cable or some other material, make sure of the end result before you cut. Cutting cables or cords may release an object being held up or in a tension situation, such as a garage door spring.

When performing **forcible entry**, cut lock shackles high on the shackle. Cutting too close to the lock body might jam it if you don't cut all the way through or if the cutters twist. Cutting high on the shackle gives you another place to get a purchase if you can't get the leverage for the first cut. Bolt cutters are not designed to cut case-hardened material such as high-security padlocks and some security gates. Using a firefighter on each handle is dangerous. The bolt cutter blades might dimple or shatter, and the hinge mechanism of the bolt cutters might self-destruct under the tremendous pressure and force. If you encounter case-hardened materials, select another tool.

Bolt cutters can be used to remove wire lath or mesh during overhaul, and they can be used in conjunction with a hook. With the hook, knock the plaster loose. With the bolt cutters, cut the staple that holds the mesh to the wall. Peel back the loosened mesh with the hook.

Bolt cutters can also twist off, *not cut*, battery terminals on cars and trucks. Be extremely cautious working around the battery cells of hybrid cars. The voltage can be lethal.

Cutting and striking tools

SKILL DRILL

There are many cutting tools available to firefighters. Handsaws, power saws, chain saws, hydraulic cutters, and other rescue-type tools are covered in other chapters of this book. The next category of tools is a step up from single-use tools; these tools allow firefighters to cut and strike. These tools include the flat-head axe and splitting maul.

Flat-head axe. The **flat-head axe** (fig. 11–3) is a steel, single-bit axe. Its blade should also be maintained with a smooth cutting surface that is free of nicks and dings. Unlike the pick-head axe, the opposite side of the flat-head axe is a flat striking surface that can be used as a sledgehammer.

Fig. 11–3. Flat-head axe

To use the flat-head axe as a cutting tool, see the previous directions for the pick-head axe. A slight difference exists in the way the axe handles because of the absence of a pick. Otherwise, the axes are identical in use. When using the flat-head axe as a striking tool, allow the weight of the tool to do the work. It is not necessary to swing the tool in a full arc to get the benefit as a striker. Hold

the tool at waist level. Line up the flat striking surface against the tool or object you will strike. Instruct the firefighter holding the tool you will strike to stay still. Don't allow the tool being held to move. If you miss, you will certainly strike the firefighter holding the tool, and that will spoil his day.

Arrange your stance so you can effectively and strongly pivot your hips and hit your target. By putting your body weight behind the flat-head axe, you will strike and efficiently drive the tool into or through the target.

Eight-pound splitting maul. The **eight-pound splitting maul** (fig. 11–4) is another tool that will complement your cutting and striking capabilities on the fireground. The maul has a sledgehammer face on one side and a wedge-shaped splitter on the other side. The splitting maul can replace the flat-head axe in some forcible-entry situations. Its weight is effective, it provides cutting and striking surfaces, and it is inexpensive and readily available.

Fig. 11–4. Eight-pound splitting maul

The splitting maul is used primarily the same way as a flat-head axe. It is swung and used the same as a striking tool. The biggest difference is that the maul does not cut. It is designed to split wood, so it is a bit more brutal. The splitting maul makes short work of roof ventilation. Once the site for the vent hole has been selected, a firefighter can smash a hole through the roofing material, rather than cut it. The splitting maul easily splits oriented strand board (OSB) sheeting and even plywood. No shingles have to be pulled, and because of the shape of the head, a simple twist of the handle to the right or left will free the tool head.

Using this tool is much like using an axe; a proper stance must be taken to properly swing it. Hold the splitting maul as you would an axe. The head is a little more off-balance because the bulk of the weight is to the rear of the head.

When using the cutting edge, expect the tool's tendency to invert to the striking side. Hold the handle tightly and prevent it from flipping around in your hands when you swing and strike. Be prepared to shift your weight to accommodate the off-balance head.

As with every cutting or striking tool we have discussed, accuracy is key. Do not swing giant strokes. Slide one hand down the handle no more than shoulder high to meet the other hand that has a firm grip on the bottom of the handle. Allow the weight of the tool to do the work.

When the maul gets stuck, free it by twisting the handle to the right or left about 15 degrees. Pulling will cause you to lose your balance and fall. Remember, this tool is designed to split wood, not cut like an axe. A heavy, deep stroke might bury it into the material being cut and make for difficult removal.

When using the splitting maul or flat-head axe as a striking tool, allow the weight of the tool to do the work. It is not necessary to swing the tool in a full arc to get the benefit as a striker. Hold the tool at waist level. Line up the flat striking surface against the tool or object to be struck. Don't move the tool. Arrange your stance so you can effectively and strongly pivot your hips and hit the target.

Wall breaching and situations that require greater force than can be delivered with an 8-pound tool call for a sledgehammer.

Striking tools

SKILL DRILL

Types of striking tools. A **sledgehammer** (fig. 11–5) is used for one purpose: to strike an object or another tool. A sledgehammer has striking surfaces on both sides of the head. It is often mistakenly called a maul, which has a striking surface on just one side of the head; there is another tool on the opposite side. The splitting maul is a true maul. The sledgehammer is a big, heavy hammer.

Fig. 11–5. Sledgehammer

Only four firefighter tools are engineered to strike other tools: the back of the flat-head axe, the eight-pound splitting maul, the sledgehammer, and, in certain circumstances, the Halligan bar.

When you select a sledgehammer as a striking tool, the weight of the tool is important. To drive a stake into the ground, to hold a deluge gun, or to strike a Halligan bar in breaking a lock, you must determine how hard to swing. If you have to swing too hard, get a heavier hammer. Swinging hard does not mean swinging accurately.

Weight is the key. Sledgehammers should weigh 8, 10, 12, or 16 pounds (3.6, 4.5, 5.4, 7.3 kg). The mass of the tool determines how effective it is, as well as your ability to swing and strike effectively and accurately. Special care must be taken when you swing a sledgehammer, regardless of its weight. There is no need to swing a sledgehammer over your head and out of sight. Controlling the tool is paramount for your safety and the safety of others. If you find yourself swinging the tool into a position out of your peripheral vision, use a heavier sledgehammer.

Tool safety

SKILL DRILL

Swinging your tools. You should never lose sight of the tool during your swing. That means no over-the-head or way-around-sidearm, off-behind-you swinging. Keep the tool head in site and maintain good hand-eye coordination to deliver the maximum effective blows on target. Missed blows are just that many more strikes you'll have to make to accomplish the job, and too many missed blows can damage a tool.

Carrying your tools. Safety is a number-one priority at all times on the fireground. Axes, mauls, and sledgehammers are dangerous tools that can do great bodily harm if they are not handled carefully. The safest way to carry an axe, maul, or sledgehammer is to grasp the handle close to the head of the tool with the handle pointing away from you. You can use the handle to gently clear your path without hurting anyone with the steel tool head. You can also use the tool as a search tool when you carry it this way. The handle will act as a blind man's cane, allowing you to extend your reach safely during a search. An axe can be carried with the head of the tool tucked under your arm, blade facing backward, pick facing forward. Hold your hand over the pick. A flat-head axe may be carried under the arm with the blade facing backward, away from the body. If you carry either axe in a belt, always sheathe the axe. Never crawl with an axe in your belt. The weight of the axe head will cause it to slide out.

Prying tools

SKILL DRILL

Next to cutting tools for getting to a fire, the most important group of tools can pry or increase your leverage. They are pry bars, claw tools, and Halligan-type bars.

Pry bars. **Pry bars** are the ultimate in simplicity because they are basic, true levers. There are two types. **Pinch-point bars** (fig. 11–6) have only one beveled side. **Wedge-point bars** (fig. 11–7) have a bevel on both sides of the bar, forming a wedge point. Both bars are available in various sizes, dimensions, and weights. Both inexpensive pry bars are limited-use tools because many fire service tools work more efficiently. Nevertheless, these ultimate levers should not be removed from service. Learning how to use them will equip you to handle many situations. Their use in collapses, heavy rescues, and some confined-space, industrial rescues cannot be matched by any other tool.

Fig. 11–6. Pinch-point bars

Fig. 11–7. Wedge-point bars

A pinch bar and wedge bar are probably carried on at least one of your rigs. Neither will get much use, but when needed, one or the other will be the only tool that works. The pry bar can be used in conventional forcible entry to force open doors, windows, etc. These bars should not be the first choice for forcible entry. The wedge-point bar has a slight advantage over the pinch-point bar in conventional forcible entry. When combined with a striking tool, the wedge point of the bar can be driven into a door, window frame, etc. The wedge shape allows the tool to slip readily into recessed areas while spreading force is applied in both directions. Once the tool has been driven deeply into the door or window frame, force can be applied and the door or window will open.

A big advantage pry bars have over other tools is their length and narrow profile. These tools can be used with a proper fulcrum to raise collapsed material, machine parts, automobiles, trees, and other debris that has fallen or blocked a means of egress.

A firefighter may use a pry bar when stabilizing a car with cribbing by using the cribbing as a fulcrum. Firefighters can gently move or lift a vehicle by slipping cribbing materials under the frame.

During overhaul operations in plaster and lath fire buildings, firefighters can insert a pry bar into the bay of a wall and quickly open the walls. The entire length of the tool is then used, and there is no chance of snapping the tool as there is when performing the procedure with an axe handle.

Pinch-point bars are excellent tools for prying up wood floors. By inserting the tool bevel-side-up into the seam of a wood floor, a user can drive the tool in and lift the first piece of flooring. Then, using the tool as designed, the user can apply leverage and the flooring will come up. Two firefighters, each armed with a pry bar, can quickly remove many floor surfaces this way. Once the first piece is removed, the rest will follow easily.

Baseboards, moldings, and door and window frames are also easily removed with a pry bar, and, often, a firefighter will not need to bend to insert the tool. Allow the pry bar to slide along the face of the wall. Both wedge-point bars and pinch-point bars will almost always find the joint between a wall and a baseboard. Allow the weight of the tool to slide and force its way between the wall and baseboard. Pry outward, and the baseboard or molding will pop off.

Pry bars have a variety of uses, none of which has to do with using the tool as it was designed.

To make firefighting operations safer, you may use the tool as a securing post for ground monitors or deck guns. A pry bar can be driven into the ground like a fence post, and a monitor can be secured to it to prevent it from walking. The pry bar must be driven in deeply and could be difficult to remove following a fire, but it provides a secure post to which you may lash a gun.

Pry bars can also be used for securing ladders to windows. Place a long pry bar horizontally inside a window, and secure the ladder rung or beam to the pry bar. Apply sufficient pressure with the rope to pull the pry bar tightly against the interior window framing or walls. Ensure that the pry bar is substantially wider than the window.

Pry bars also make good handles for carrying basket stretchers or other heavy objects. Properly lashed, a bar provides handles for several firefighters to carry a stretcher or heavy object.

Claw tool. A **claw tool** (fig. 11–8) is a step up from a pry bar. It is a multipurpose prying tool, and although not extremely versatile, it can perform many tasks on the fireground when used correctly. Forcible-entry procedures can be performed easily with the claw tool.

Fig. 11–8. Claw tool

Its biggest disadvantage is the absence of an engineered striking surface on the hook end. When combined with a striking tool, a claw tool can be driven in and conventional, forcible-entry techniques can be used. The tool's length makes it a great lever, but at 42 in. (1,067 mm) long or more and with two sharp ends, it's a tight fit in narrow hallways and rooms. When using the fork, you must pay attention to the hook end. If the claw tool is not well set and it slips, the point of the hook end can rip skin and hook and tear face pieces.

The claw tool can also open windows. The fork can slide between the bottom rail of a window and its sill. Remember the principle of leverage and set the fork well. Once the fork is slid as far as possible, pry down on the bar. The screws holding the window lock should pull out.

The fork end can also shut off residential, light commercial, and industrial gas valves. The distance between the tines of the fork allows a good bite on gas valves.

Sliding both sides of the shackle into the fork and twisting or prying down with a sharp motion can twist off padlocks. Proper sizeup is key. If the hasp or other device to which a lock is attached is not of good, strong material, do not twist off the lock. The claw tool should be flipped over to use the hook end for easily breaking padlocks. The striking surface of the tool can be used, making this technique much safer than twisting.

The claw tool makes an excellent overhaul tool as well as a forcible-entry tool. Here, its length is an advantage because a firefighter doesn't have to bend so much when removing baseboards and flooring. The hook works well for prying up flooring and subflooring, and the curve of the hook acts as an effective fulcrum when rocking the tool back to apply force to the floorboards. The fork can also slide under floorboards to easily pull up flooring. The 42-in. (101-cm) or longer length is a mechanical advantage for heavy-duty work such as overhaul.

A firefighter wouldn't want to work with the claw tool over his or her head for long. The tool is best used at waist level or below. Fourteen pounds is a lot of weight to hold overhead when removing upper window casings and door trim.

The claw tool has some minor special uses, but they are limited. The hook end is an effective ripper for getting a firm bite into ductwork and other light-gauge, metal surfaces. You may use it to easily perforate and remove ductwork or metal. The curve of the hook end is a great handle when using the claw tool to open walls. Once a hole is created in a wall, slide the tool fork-end-down into the hole. Grasp the hook end and pull toward yourself.

The entire length of the tool will pull through the plaster and lath or wallboard, making opening much easier.

Halligan bar. If there has been one fire service-driven innovation that changed the way fire service operations are conducted, it was Chief Hugh Halligan's **Halligan bar** (fig. 11–9). Developed in the 1940s, this bar is now the preferred prying tool. It is the most efficient, effective tool available to any firefighter for tasks that require leverage (fig. 11–10).

Fig. 11–9. Halligan bar

Fig. 11–10. Halligan bars

The many functions of the Halligan bar depend on leverage. The tool's design allows for multiple functions with one tool, but leverage is the key. Halligans are available from 20-in. (508 mm) lengths to 42-in. (1,067 mm) lengths. The longer the bar, the greater the amount of leverage it is capable of producing. Its use will dictate what length you need. A 30-in. (762 mm) Halligan bar is the best bar for day-to-day, conventional forcible entry, ventilation, overhaul, and other standard fireground activities. Shorter and longer bars have their places, but you can optimize your tool selection with a 30-in. (762 mm) bar. Weight is also a consideration, and the 30-in. (762 mm) bar weighs only 9 lb (4.1 kg).

The Halligan bar is a single piece of forged steel. The adz end of the tool should gently curve and flare slightly from the tool's shaft to the end of the adz. The adz should be beveled, with the bevel on the topside of the adz. At a 90-degree angle to the adz is a hook point or pick. Wide at the base where it joins the tool, the pick should also taper and curve, ending in a sharp point. The adz portion of the Halligan tool has three areas designed as striking surfaces: the top of the tool, the side opposite the pick, and the side opposite the adz. These striking surfaces are designed to receive heavy blows from a striking tool, or to be used as striking tools themselves.

The shaft of the tool is usually at least $^{15}/_{16}$-in. hexagonal steel. The hexagonal shape adds strength and rigidity, and the many faces improve a firefighter's grip on the tool.

The fork is broad and tapered. It should be a minimum of 6 inches long and taper into two well-beveled tines. The bevels are located on top of the tines. The spacing between the tines allows gas valves, padlock hasps, and other objects to be inserted and levered by the tool. The bottom side of the fork is called the beveled side, and the topside of the fork, or "dished" side, is the concave side. There are no engineered striking surfaces on the fork. The tool may or may not have an attached ring just above the fork to which you may snap a utility rope for hoisting and lowering, attaching a carrying strap, or throwing the tool off a roof to ventilate upper-floor windows.

There are other versions and takeoffs of the Halligan bar. Two versions are the **San Francisco bar** and the **Chicago Patrol bar**. Although both are outstanding tools, the Halligan bar is more universally used by the fire service.

Push-pull tools

SKILL DRILL

Pike pole. The **pike pole** (fig. 11–11) is one of the oldest tools in our arsenal of weapons to combat fires and, next to the pick-head axe, is the most readily identified tool of our trade. Pike poles are used during most fire incidents to pull apart debris and burning materials, open walls and ceilings, remove trim, and allow engine companies to find and extinguish deep-seated fires.

Fig. 11–11. Pike pole

There is a variety of pike poles. Your department may or may not have a selection of pike poles for you to use. Pike poles come with different pike head styles to suit different materials, different handles that make them stronger and more durable, and different lengths to accommodate working overhead or below grade.

Pike pole handles come in three basic materials: wood, metal, and fiberglass. The shape of the pole can be round, oval, or I-beam. Wooden handles can be pine, hickory, or ash. Fiberglass handles can be solid round or oval, hollow core, or solid I-beam. Metal handles can be stainless steel, plain steel, or aircraft steel.

The biggest problem is the pole's diameter. Some fiberglass pike poles are 2 in. (52 mm) or more in diameter. They are extremely difficult to work with because they don't fit in your hand, they are slippery when wet, and they are difficult to stow on the apparatus.

Pike pole length is always a hot topic in firehouses. Many departments use short pike poles: 4 ft (1.2 m) long or shorter for working in tight areas. Many firefighters prefer this set-up. Tip: you'll be much more efficient if you use a Halligan bar in place of the short hook.

Pole length should depend on the type of structure for which you use it. Consider taking the standard 6-ft (2-m) pole as the minimum-length pole carried for standard firefighting operations. A 6-ft (2-m) pole will easily reach most parts of a residential structure that you will need to reach. It can be carried into and out of structures safely and can be maneuvered easily inside.

The 8-ft (2.4-m) pole should be the minimum-length pole taken into a commercial structure or light-industrial building.

The 10-ft (3-m) pole is not suitable for a typical residential home, or is it? Do you have any mansions in your jurisdiction? Large homes often have building features that require a 10-ft (3-m) pole. The pole is a bit cumbersome in single-family dwellings and sometimes won't fit. Have one available for overhauling large houses and commercial structures and for ventilation operations. The 10-ft (3-m) pole is the most useful pole in commercial buildings and light-industrial buildings.

Some poles become extremely flexible at 10 ft (3 m) or longer, especially oval fiberglass poles. It's like trying to use a fishing pole to pull ceilings: The head end bends and wobbles. Consider solid wood or fiberglass for long poles.

Pike poles come with various head styles. The most common is the standard pike pole. You will find many stored in compartments or on the side of the apparatus (figs. 11–12 and 11–13).

Fig. 11–12. Apparatus tool compartments

Fig. 11–13. Tools hung on the side of an apparatus

Other poles. Other styles of pike poles you might see in your department include the following (fig. 11–14 from left):

- The **Boston rake** is a great tool for older buildings with plaster and lath walls.
- The **Chicago pike pole** is a favorite tool of the CFD because the originals were made by the CFD shops.
- The **Providence hook**, a special hook with a cutting surface on the backside of the point (pike) and another on the top of the hook, pushes easily into gypsum and plaster, downside. The head is so thin that it doesn't pull a lot of material on the down stroke. It's great for light, tin ceilings.
- The **Halligan hook**, also known as the multipurpose hook, was invented by Hugh Halligan, inventor of the Halligan bar. With its engineered angles, this hook makes quick work of overhaul. Ceilings, moldings, baseboards, and other trim offer little or no resistance.

Fig. 11–14. Other pole styles

- The **San Francisco hook**, named because the city has many lath and plaster houses, quickly penetrates plaster and lath and pulls big holes in ceilings and walls during overhaul. The chisel point on the top of the pike allows for quick, efficient trim removal.
- The **Falcon hook**, a modified Halligan hook with broadened hooks and a curved cutting blade at the top, is a great hook for lightweight, metal buildings, tin ceilings, ductwork, and other hard-surface materials.
- The **New York hook** (fig. 11–15), official hook of the FDNY, is similar to the standard hook in configuration, but is beefier. A great hook for heavy-duty work. The head design allows more leniency when used as a prying tool.
- The **Gypsum board hook** (fig. 11–16) isn't really a hook at all, but a clawed rake that can chew and open up gypsum wallboard with little or no effort on your part. The angled jaw and cutting blade make pulling drywall easy. If you can get your hands on one of these during overhaul, it will become your favorite style of hook.
- The **L.A. trash hook** or **rubbish hook** (fig. 11–17) isn't really a hook, either; it is also a rake. Often referred to as an arson rake or trash hook, this tool is great for raking trash around in a burning dumpster to make sure you've gotten it all. It works as a tremendous lever in removing beadboard ceilings. Taken to the hook, the design of the tool head allows you to push down large sections of ceiling without getting tangled in the wiring.

Your department may or may not have any of these hooks in addition to a standard pike pole. Mutual aid departments might have them. The more you know about tools in the fire service, the better firefighter you will be.

Fig. 11–15. New York hook

Fig. 11–16. Gypsum board hook

Fig. 11–17. L.A. trash or rubbish hook

USED FOR WHAT?

We've looked at a lot of the basic tools you will use during most fires. When you get which tool and for what will depend on your department's operating procedures and

the wishes and tactics of your company officer. Basically, they are the following:

Cutting tools

1. Pick-head axe (fig. 11–1): forcible entry, overhaul, rescue, fire attack, ventilation.
2. Bolt cutters (fig. 11–2): forcible entry, rescue.

Cutting and striking tools

1. Flat-head axe: forcible entry, ventilation, fire attack, rescue, and overhaul. When married to a Halligan bar, the set of tools is known as a **set of irons**.

Prying tools

1. Pry bars (figs. 11–6 and 11–7): forcible entry, ventilation, fire attack, rescue, overhaul.
2. Claw tool (fig. 11–9): forcible entry, ventilation, fire attack, rescue, overhaul.

Striking tools

Four tools available to firefighters are engineered to strike other tools and are used for forcible entry, ventilation, fire attack, rescue, and overhaul:

1. Back of the flat-head axe (fig. 11–3)
2. Eight-pound splitting maul (fig. 11–4)
3. Sledgehammer (fig. 11–5)
4. Halligan bar (fig. 11–9 and 11–10), in certain circumstances

Push-pull tools

Pike poles (figs. 11–11, 11–14, 11–15, 11–16, 11–17) are primarily used for overhaul, although in some instances they are needed during fire attack and have been used in rescues.

TOOL MAINTENANCE

FFI 5.5.1 **FFII 6.5.4** Don't be too disappointed if the tools at your department could use a little work. Basic hand tools sometimes get overlooked for simple maintenance. Maintenance does not take long and is an outward sign of great company and departmental pride. You will also find that a little effort in the firehouse yields tremendous advantages on the fireground. Well-maintained tools look good, function well, and are safer than neglected tools.

Note: Do not perform any maintenance on your company's tools without authorization.

Cutting tools

SKILL DRILL

1. **Pick-head axe:** Remove all paint from the axe head. Sand or use a wire brush until the steel is clean and shiny. Use a mill bastard file to maintain the cutting edge of the axe. Do not over sharpen. Do not use a grinder. When finished, put a thin coating of light machine or motor oil on the tool head. Do not use any lubricant that contains 1,1,1-trichloroethane.

   Handles:

   a. Wood: Sand smooth. Inspect for splintering and cracks. Wipe with a tack cloth to remove dust. Coat handle with boiled linseed oil. Work well into wood.

   b. Plastic: Clean thoroughly with mild detergent and scrub brush. Dry thoroughly.

   c. Fiberglass: Inspect for splintering and cracks. Clean with soap and water. Dry thoroughly. If needed, rough spots can be sanded with fine-grit paper and wiped with a damp cloth. If fibers are showing or if cracks develop, replace handle.

2. **Bolt cutters:** Use a mill bastard file to maintain the cutting edge on the blades of the bolt cutter jaws. When finished, wipe entire tool with light oil. Do not get oil on rubber handles.

Cutting and striking tools

SKILL DRILL

1. **Flat-head axe:** Remove all paint from the axe head. Sand or use a wire brush until the steel is clean and shiny. Use a mill bastard file to maintain the cutting edge of the axe. Do not over sharpen. Do not use a grinder. When finished, put a thin coating of light machine or motor oil on the tool head. Do not use any lubricant that contains 1,1,1-trichloroethane.

   Handles:

   a. Wood: Sand smooth. Inspect for splintering and cracks. Wipe with a tack cloth to remove dust. Coat handle with boiled linseed oil. Work well into wood.

b. Plastic: Clean thoroughly with mild detergent and scrub brush. Dry thoroughly.

c. Fiberglass: Inspect for splintering and cracks. Clean with soap and water. Dry thoroughly. If needed, rough spots can be sanded with fine-grit paper and wiped with a damp cloth. If fibers are showing or if cracks develop, replace handle.

Prying tools

SKILL DRILL

1. **Pry bars:** Use a mill bastard file to maintain the bevels on the adz and forks. Sharpen the pick. Use fine-grit sandpaper or a wire brush to remove all rust and debris. Wipe entire tool with light motor oil.
2. **Claw tool:** Use a mill bastard file to maintain the bevels on the point and forks. Use fine-grit sandpaper or a wire brush to remove all rust and debris. Wipe entire tool with light motor oil.

Striking tools

SKILL DRILL

1. Remove all paint from the tool head. Sand or use a wire brush until the steel is clean and shiny. Use a mill bastard file to maintain the striking surface of the tool head. Do not remove too much metal or change the shape of the tool face. Do not use a grinder. When finished, prime and paint the tool head with a quick-drying, acrylic paint.

   Handles:

   a. Wood: Sand smooth. Inspect for splintering and cracks. Wipe with a tack cloth to remove dust. Coat handle with boiled linseed oil. Work well into wood.

   b. Plastic: Clean thoroughly with mild detergent and scrub brush. Dry thoroughly.

   c. Fiberglass: Inspect for splintering and cracks. Clean with soap and water. Dry thoroughly. If needed, rough spots can be sanded with fine-grit paper and wiped with a damp cloth. If fibers are showing or if cracks develop, replace handle.

Push-pull tools

SKILL DRILL

Use a mill bastard file to maintain all sharp surfaces on the tool head. Using fine-grit sandpaper, remove all dirt and rough metal from the tool head. Prime and paint.

Handles:

a. Wood: Sand smooth, inspect for splintering and cracks. Wipe with a tack cloth to remove dust. Coat handle with boiled linseed oil. Work well into wood.

b. Fiberglass: Inspect for splintering and cracks. Clean with soap and water. Dry thoroughly. If needed, rough spots can be sanded with fine-grit paper and wiped with a damp cloth. If fibers are showing or if cracks develop, replace handle.

POWER SAWS, CHAIN SAW, RECIPROCAL SAW

Rotary power saws

SKILL DRILL

Rotary power saws play a big part in firefighting tactics and procedures. These saws are commonly used to assist firefighters in performing forcible entry, ventilation, breaching, and demolition operations. The rotary power saw is commonly called a cut-off saw, demolition saw, or rescue saw (fig. 11–18). Some firefighters also associate a specific brand name or model number and often call the saw by that nomenclature.

Fig. 11–18. A rotary power saw

A rotary saw is a portable saw with a **two-cycle engine** that normally runs on a gas-and-oil fuel mixture. The engine's driveshaft powers a clutch assembly that operates a drive belt that is driven over two pulleys that spin the blade. As the blade spins, a specific material is cut. The speed of the saw is controlled by the firefighter as he or she applies pressure on a throttle lever in the saw handle. For the firefighter to control the saw during cutting, his

or her hand that is not controlling the saw's speed must hold onto the carrying handle.

The rotary saw can be equipped with a variety of blades to cut a range of materials. **Carbide-tip blades** are normally used for roof ventilation and cutting wood flooring (fig. 11–19). These blades cut through tar-covered roofs, Lexan®, acrylic glass panels, and light-gauge metal (i.e., "**Q-decking**," metal, aluminum, and vinyl siding). These blades should not be used to cut case-hardened locks, roll-down security gates, or structural steel components because the tips could snap off the blade causing a severe injury to a firefighter.

Fig. 11–19. Carbide tipped blades

For a rotary saw to cut heavy-gauge metals, it must be equipped with the proper blade (fig. 11–20). Rotary saws equipped with **aluminum oxide abrasive blades**, sometimes referred to as discs, will cut these metals (fig. 11–21). These blades are made up of metallic and composite materials held together by an organic bonding agent. These blades may also be reinforced with a fabric or fiber base that prevents the blade from breaking apart during cutting operations. The blades cut through material by friction and heat the metal being cut, disintegrating it into sparks, chips, fragments, and dust. The life span of these blades is relatively short if a large amount of metal material must be cut. The aluminum oxide blade can also cut through wood, although it's not the blade of choice. It actually burns through or grinds up the wood as it is cut.

A rotary saw with a **silicon carbide blade** or abrasive disc can cut through concrete, mortar, brick, block, tile, and stone. The blade closely resembles the aluminum oxide blade but is made of different composite materials that when applied to materials heats it through friction, causing the material to turn into chips and dust. To distinguish the two blades, some fire departments label or paint identification labels on them.

Another blade commonly used in the fire service is known as a multi-functional, multi-purpose blade or **diamond-cut grit blade** that will cut materials such as steel, concrete, and wood. These steel blades closely resemble carbide-tip blades. The major difference is that they are covered with industrial diamonds and grit held together by a bonding agent located toward the tips of the blade. These blades normally don't need lubricating fluids or water to assist the blade in its cutting efforts. The only minor downfalls are that these blades are expensive and once the diamonds become worn, a blade will not cut well.

Fig. 11–20. An irons saw

Fig. 11–21. The aluminum oxide and silicone carbide abrasive blades are similar in appearance, some departments paint the blade yellow to distinguish the two.

Saw safety. Firefighters must learn to operate a power saw under adverse fire conditions to reduce the risk of a severe injury or accident. Firefighters should follow the safety items listed to operate safely and efficiently with a running saw.

- Full personal protection equipment and eye protection must be worn when operating any saw.
- Prior to beginning a cutting operation, the operator should formulate a plan of action that includes the sequence of cuts, wind direction, and travel to a safe mean of egress.
- Firefighters should make all attempts to stand clear of debris thrown from the rear of the saw. Sparks, splinters, and chipped-off teeth can fly off the blade and injure an unassuming firefighter operating toward the rear of the saw.
- All firefighters should maintain at least 10 ft (3 m) from the saw during cutting operations. This circle of danger should encompass the saw and its operator.
- Once the saw is started, the operator should lift the carrying handle and push down with the hand holding the control handle. Following this procedure allows the saw blade to rise off the ground first.
- The operator should maintain constant contact with the saw using both hands when performing cutting operations. The saw can vibrate and move when cutting and easily slip or slide from an operator's hands if they aren't maintaining a grip on it. In addition, the saw can be awkward to operate and lift in overhead-cutting operations, so both hands should be used.
- When cutting, the operator should keep clear of the blade's path and discharging material thrown from the saw. When cutting metal overhead, the operator should hold the saw so that discharging sparks fly away from the operator and others.
- If manpower allows, a firefighter should be assigned to act as a guide person during cutting operations. This firefighter can monitor conditions around the saw operator and guide his or her movements when working in hazardous conditions and positions.
- Many times as a result of saw noise, communication between firefighters is not understandable or heard. To alleviate this, some fire departments rely on hand signals or taps/slaps on the operator's back to permit nonverbal communication. The following are the meanings of taps or slaps to the back:
  - One tap = stop cut
  - Two taps = cut
  - Three taps = shut down the saw
- Saw operations should be conducted in a well-ventilated area to prevent carbon monoxide buildup from the saw's exhaust.
- Saw should not be started or operated in suspected explosive atmospheres.
- Whenever a saw blade is removed from a cut, the operator should stop the blade on the material so it stops spinning. It's common for firefighters to mistakenly lift the saw and spin it to their side when they remove a saw blade from a cut, which could injure a nearby, unsuspecting firefighter.
- When cutting during dark hours, firefighters should provide adequate lighting to the scene.
- If manpower and conditions permit, a firefighter should be positioned away from the loud saw operations to monitor radio communications.
- If roofs covered with gravel must be cut, a path should be made in the gravel to decrease the chance of sending gravel flying like a projectile.

- When firefighters with a running saw must travel to a new location on a roof, they should stop the blade from spinning and roll the saw on its blade to the new location.
- A running saw should never be refilled with fuel. Firefighters must use caution when refueling a saw that has been running. The engine housing is hot, and any spillage of fuel mixture could ignite and cause an injury. Use a funnel in refueling operations.

Starting operations. Prior to starting any saw, a firefighter should ensure that the saw is in proper working order and equipped with the right blade for the task. There should also be sufficient room around the saw to ensure that the blade is able to rotate when started. Because most saws run on an oil-and-gasoline mixture, shaking a saw prior to starting it ensures the gas and oil in the fuel tank are properly mixed (fig. 11–22).

Fig. 11–22. Starting a cold engine

Starting a cold engine.

1. The firefighter checks that the stop or kill switch is in the off position.
2. The firefighter engages or pulls the **choke lever**, switch, or handle.
3. The firefighter then engages the **throttle handle trigger** and **throttle lock**.
4. If the saw is equipped with a **decompression button**, the firefighter presses the button to reduce the pressure in the cylinder and make the saw easier to start.
5. The firefighter places either boot into the saw handle while bending over to grab the control handle with the left hand. With the right hand, her or she grips the starter cord handle.
6. The firefighter then slowly pulls the **starter cord** until he or she feels resistance. Then, he or she pulls quickly upward with the right arm.

Note: *Do not attempt to pull the starter cord completely out of the saw or too forcefully because the chord could snap or damage the internal coil spring. Damage could also happen if a firefighter were to let the extended starter cord snap back into the starter mechanism.*

7. Once the saw starts, the firefighter applies full throttle to disengage the throttle lock. This stops the saw from running at its full **revolutions per minute (RPM)**.
8. If the saw starts and putters or runs for a few seconds, the firefighter may attempt to push in the choke lever to keep it running. Often, this doesn't happen and the saw stalls. Prior to restarting the saw, the firefighter pushes in or shuts off the choke lever. Many times, there is sufficient gas-and-oil mixture in the **carburetor** chamber to permit starting on the next pull.
9. Now that the saw is running, the firefighter ensures that the blade has stopped rotating and lifts the saw upward toward the cutting task.

For the firefighter to stop the saw, he or she must use a finger to engage the stop button, lever, or switch.

Starting a warm engine. When a saw has been running, the starting sequence may differ from starting a cold saw. Usually, there is no need to choke the saw again. The saw's engine is warm, and sufficient fuel is in the fuel lines and carburetor chamber. Firefighters should follow the same sequence as above other than choking the saw. If after two pulls the saw shows no signs of starting, then it may have to be choked.

Simple saw starting. A simple procedure to assist firefighters in saw starting was developed by Lieutenant Michael Ciampo of the Fire Department of the City of New York. All the previously mentioned mechanical procedures are followed in reference to the saw's physical positions for starting the saw. The change is in

the firefighter's body position. The firefighter positions himself or herself behind the saw in a balanced squatting position resembling a catcher's stance. The right knee exerts downward pressure onto the saw's air cleaner or upper housing (fig. 11–23). The firefighter extends the right arm forward and holds onto the control handle of the saw, keeping it balanced. The left arm pulls up on the starter cord to start the saw.

This method of saw starting has a few advantages:

- It puts the firefighter's hands closer to the choke and throttle levers once the saw is started.
- It shortens the pulling distance of the starter cord, which reduces the chances of damaging it or the saw's **recoil spring**.
- It allows the firefighter to lift the saw upward using leg and back muscles together, reducing the chances of an injury.
- It can be used on different types of saws.

Fig. 11–23. An alternative method for starting an engine

Traveling with a live saw

SKILL DRILL

When a saw is running, it is commonly referred to as a *live saw*. Firefighters must ensure that whenever changing locations or positions, the saw blade has stopped rotating. A rotating blade can injure an unsuspecting firefighter. To combat this problem, firefighters learn to roll a live saw on its blade when traveling. Rolling a saw to its next location decreases the chances of a rotating blade injuring a firefighter (fig. 11–24). It also can assist firefighters working on a smoke-covered rooftop. Pushing a saw in front of them while moving can inform them of any holes in the roof, shafts, setbacks, or edges of the roof.

Fig. 11–24. Rolling a saw

Carrying a saw in a sling

Carrying a saw up a ladder in a sling enables a firefighter to maintain hand contact with the ladder (fig. 11–25). Most manufacturers have made renovations to their particular saws that enable **saw slings** to be attached. If a saw doesn't have specific brackets or attachment rings, the saw sling can still attached to it. Never carry a live saw up or down a ladder.

A **choker hitch** can be made around the control handle of a saw and then the other end looped around the blade and down onto the **arbor**. This permits a firefighter to place the sling around one shoulder and or over the head to carry the saw.

Fig. 11–25. Using a sling to carry a saw up a ladder

Operating with a saw

SKILL DRILL

The work area should be as stable as possible so a firefighter can work in a balanced position while operating with a saw. Obstructions should be removed and all hazards in the cutting area identified prior to cutting operations. The firefighter operating the saw should have a plan of action and relay it to anyone operating within the vicinity of the saw.

Because firefighting is dangerous and conditions can change in a moment, saw operations are often performed in a two-person team: the saw operator and a backup, safety, or guide firefighter. The operator is responsible for the safe operation of the saw while the safety firefighter is responsible for the movement of the pair, giving hand signals, and watching and monitoring conditions around them. This procedure is normally used when performing certain types of roof ventilation. For other simple situations, such as cutting a lock off of a gate, there may be no need for a backup firefighter.

When cutting a roof for ventilation, vinyl siding with wood sheathing, or wood flooring, the saw must be run in a specific manner. Carbide-tip blades or multipurpose blades should be brought up to full rpms prior to engaging the material to be cut. If the blade were not spinning at full rpms, the blade could stop or become wedged in the material being cut.

When the saw is parallel to the material being cut, the saw's **foot bracket** should rest on the material. This will act as a pivot point. Once the saw is brought up to full rpms, the throttle handle is lifted upward and the saw pivots on the foot, bringing the blade closer to the material being cut. The firefighter must maintain control and balance of the saw while operating the throttle with one arm and holding the control arm with the other (fig. 11–26).

Fig. 11–26. One firefighter cuts a padlock while another firefighter holds the padlock with a pair of channel locks.

Once the saw is cutting, the firefighter maintains full rpms while he or she drags, pulls, or walks the saw back toward himself or herself. The saw blade spins toward the firefighter and cuts in a backward direction. Firefighters must not pull too fast because this can cause the saw to stall. They must ensure that they are cutting the material during the first attempt and monitor the cut for material being thrown. Sawdust and tar chips are tell-tale signs that the roof covering and roof boards are being cut in one operation. To assist the saw during the cutting operation, some firefighters gently rock the saw up and down by first lifting on the control handle and pushing down on the throttle handle and vise versa. This often assists the saw in throwing debris out of the blade guard and also increases the depth and width of the cut line, commonly referred to as the **kerf** of the blade.

Note: *Once the saw is removed from the cut, the firefighter should release the throttle trigger and slowly place the blade into the material being cut. This stops the blade from spinning and decreases the chance of hitting anyone with the blade.*

When cutting metal with an aluminum oxide blade or brick with a silicone carbide blade, the initial cutting operation is a little different. When the blade first comes in contact with the material to be cut, it should rotate at a slow to moderate speed. This enables the blade to

start a groove in the material to be cut. Then the saw can be brought up to full rpms to complete the cut. This also works for multipurpose blades when cutting metal or concrete.

Often during firefighting operations, the saw must be operated in precarious positions and a firefighter finds it difficult to balance or operate the saw. It may be necessary for the saw to be supported in a few manners. The saw can be supported by a firefighter's boot when he or she may have to cut at a low level. The firefighter can also use the upper leg to support the saw when cuts need to be made below the waistline. If the cut is chest-level, sometimes a firefighter may be able to press his or her chest into the saw's housing to support the cut. Cutting overhead is the most difficult, and firefighters must use upper-body strength to support the saw during these cuts. When performing cuts in precarious positions, it may be necessary to move the saw's blade guard to protect the firefighter from flying debris from the cut.

Whenever cutting with any type of blade, firefighters must remember the following:

- Limit side pressure on the blade and try to cut in a straight line. Side pressure or twisting of the saw can bind the blade in the cut or damage the blade.
- Firefighters should cut only as deep as necessary through materials; cutting through structural members can weaken a structure. A firefighter must learn how to listen to the saw's cutting sound and how it feels cutting through materials.
- Firefighters should not play with the saw's throttle, commonly referred to as **gunning the saw**, while waiting to perform another cut. This can damage the saw or injure another firefighter.
- Firefighters should operate to side of the saw in a well-balanced **boxer's stance** while cutting on a flat surface. This helps keep the firefighter clear of the debris being thrown from the blade.
- When firefighters cut metal, they should stand out of the flying sparks at all times. These sparks and molten metal have burned or melted the rubber on SCBA facepieces.
- Do not start or use saw in the presence of flammable gases or vapors.

Refueling the saw

SKILL DRILL

If the saw needs to be refueled during cutting operations, it must be shut down and moved to a safe location. Extreme care must be taken because the saw's exhaust is extremely hot and any spillage of the gas and oil mixture could ignite if the two come in contact. A small funnel should be used for all power saw fueling operations to prevent spillage or injury (fig. 11–27). Ensure that you use the proper type of fuel mix based on engine type (two-stroke vs. four-stroke engine, for example).

Prior to taking off the fuel cap, ensure that it and its surrounding are clean of sawdust, dust, or debris. Debris that gets into the tank can harm the saw. Also, always open the fuel cap slowly to release any over pressure that exists in the tank. After fueling, always tighten the fuel cap carefully, ensuring that the threads line up and the cap and gasket fit tightly onto the saw housing.

Fig. 11–27. Be careful when refueling a saw.

Maintenance

SKILL DRILL

Saw maintenance is a large factor in determining the life expectancy of a saw. There are specific instructions set forth by the saw manufacturers for specific saws. Firefighters must read and be accustomed with their particular saw-maintenance procedures. Firefighters may perform some maintenance. Qualified technicians must perform other procedures. Firefighters must check the following items regularly and after each use:

- The saw and saw guard blade must be clean and free of debris that could affect proper operation.

- The saw's throttle components, choke, and shutoff must operate freely and correctly.
- The saw's starter cord and handle must be free from defects.
- The saw's air intake fins must be free of debris.
- All bolts and nuts must be tight and secure (fig. 11–28)
- The fuel tank must be full and the cap must be secured.
- The clutch assembly and belt must be adjusted properly.

Depending on use and maintenance requirements, saws also need firefighters to do the following:

1. Change the air filter(s).
2. Change the fuel filter.
3. Change or clean the **spark plug**.
4. Adjust the belts and clutch assembly.
5. Check all cables and electrical connections.
6. Fix any deficiency with the saw.
7. Clean the cooling fins from dust and debris.
8. Check that the muffler is securely attached.
9. Check that the carburetor functions properly.

Fig. 11–28. Make sure all nuts and bolts are secure.

Miscellaneous rotary saws

There are also many types of saws powered by hydraulic fluid, lithium batteries, electricity, and water in a rotary design (fig. 11–29). These are not commonly used in everyday firefighting operations, but firefighters use them during collapsed-building operations and vehicle extrications. The saws run on the same principle as regular power saws but are constructed for adverse conditions. Specialized training may be required.

Fig. 11–29. Various rotary saws

Chain saws

SKILL DRILL

Chain saws in the fire service are normally used for ventilation efforts at structure fires or for cutting trees to provide a fire break in wildland firefighting operations. They also assist in removing trees from structures and automobiles during weather-related emergencies. Some chain saws can cut through concrete, **reinforced concrete**, bricks, and cement block and are useful at building collapses and for breaching walls and floors (fig. 11–30).

Fig. 11–30. Different types of chain saws

A chain saw is a portable saw with a two-cycle engine that runs on a gas-and-oil fuel mixture. The engine's driveshaft powers a sprocket assembly that operates a chain that rotates over a metal alloy guide bar. As the blade rotates across the guide bar, its teeth chip and cut a specific material. A firefighter controls the saw's speed by applying pressure on a throttle lever in the handle. Some saws come equipped with a **safety brake handle** or lever that prevents the blade from rotating across the bar as

the throttle lever is engaged. It also allows the operator to apply the brake, which immediately stops the blade from rotating in an emergency. To control the saw during cutting, the hand not controlling the saw's speed must hold onto the carrying handle.

A chain saw's cutting chain resembles a bicycle chain. Individual links are riveted together, and teeth on the top cut and chip the material being cut. These teeth can be carbide-tipped and can cut a multitude of materials. Some specialty blades reduce the chances that the blade will hook into the material, protect the carbide, and actually file through a material instead of cutting it. A metal finger on the underside of the chain attaches to the link, enabling the chain to ride inside the **guide bar**, carry oil to lubricate the cut, and engage in the sprocket to allow chain rotation around the bar.

The life span of a blade depends on how well it is lubricated throughout the cut and how much material there is to cut. Chain saws are equipped with a reservoir that holds bar oil. A built-in pump disperses the oil across the bar and into the bar's channel, which lubricates the chain throughout the cut. For long operations, firefighters must ensure that the reservoir always has oil. A sharp chain throws shavings and chips and requires little force to cut. A dull chain throws dust and requires a lot of pressure applied to the saw to cut.

Numerous brands and types of chain saws are used throughout the fire service. Some of the most common saws have **chain guards** and cutting **depth gauges**. A gauge set to the depth of the cut helps prevent the blade's teeth from cutting through the roof joists (fig. 11–31). These saws are normally used for roof ventilation. Some chain saws with specially designed guide bars are shaped differently than most common guide bars. Firefighters must know their departments' specific saw specifications and operating procedures.

Fig. 11–31. A chain saw with a depth gauge

Chain saw safety. Many safety items mentioned in the rotary saw material apply to chain saws, with a few additions:

- Never lean over or straddle a moving chain saw blade.
- Position yourself left of the chain line, with the left hand on the control arm and right hand on the control handle.
- When performing prolonged saw operations, wear approved hearing protection.
- Find an alternative to cutting overhead with a chain saw.

Traveling and carrying a chain saw. A running saw is a "live saw." Firefighters must ensure that the chain has stopped rotating when changing locations or positions. A rotating chain can injure an unsuspecting firefighter. To combat this, firefighters should engage the **chain brake** (if the saw has one) before moving to a new location. Firefighters can also roll a live saw on the chain when traveling.

If the saw isn't running, firefighters should carry the saw with the chain facing the rear. If they were to trip or fall forward, they would not land on the blade. In addition, it would less likely strike another firefighter on the fireground.

Chain saws can also be carried using a saw sling. Most manufacturers have procedures for carrying saws. Firefighters must be accustomed to their departments' saw procedures.

Starting a chain saw. Rotary saw starting procedures apply to the chain saw with one additional safety factor: If the chain saw is equipped with a chain brake, it should be engaged before starting the saw. This eliminates the chance of the blade's rotating around the bar once the saw is started. If the saw does not have a chain brake, the firefighter must be aware that the blade will begin to rotate around the bar once the saw is started. Firefighters must remember that a rotating chain can injure. All safety procedures must be followed.

Operating with a chain saw: ventilation. The work area should be as stable as possible so a firefighter can work in a balanced position while operating a saw. Obstructions should be removed and all hazards in the cutting area identified before cutting begins. The firefighter operating the saw should relay his or her plan to anyone operating within the saw's vicinity.

Because firefighting is dangerous and conditions can change, saw operations are often performed in two-person teams: the saw operator and a backup, safety, or guide firefighter. The operator is responsible for the safe operation of the saw while the safety firefighter is responsible for the movement of the pair, giving hand signals, and watching and monitoring conditions around them. This procedure is normally used when performing certain types of roof ventilation.

Because many chain saws used for roof ventilation lack a safety guard, the safety or guide firefighter should place himself or herself slightly behind and to the opposite side of the saw when cutting is in progress. The possibility of the saw kicking back out of the cut line or the operator lifting it up could cause the saw to kick toward the rear and cause an injury. Some fire departments do not allow a guide or safety firefighter to be near a saw with no safety guard. Firefighters must understand their fire departments' standard operating guidelines (SOGs).

When cutting a roof for ventilation, vinyl siding with wood sheathing, or wood flooring, a firefighter must run the saw in a specific manner. Normally, only the tip of the saw and a few inches of the bar are used to cut through a material. Burying the whole saw's bar and blade into the roof could cause the saw to cut right through the structural joist and cause a collapse. Saws that have depth gauges and guards should be set to cut only through the roofing material. Firefighters can cut a small inspection hole, kerf cut, or cut line to verify roof thickness and then set the depth gauge before cutting operations begin.

When saw cutting begins, the chain must be plunged into the roofing material to start the cut line. The saw should be brought up to full rpms before engaging the material to be cut. If not, the chain could stop or become wedged into the material. If a chain saw has a depth gauge or safety guard, the underside of the guard at the tip can be placed onto the roofline to assist in making the initial cut. The saw can pivot on the guard as the firefighter brings the saw up to full rpms and then rotates the tip into the roofing. Once the saw plunges through the material, the saw cuts back toward the operator and should be held almost vertical and run at full speed during the entire cut. The operator should watch the debris being thrown to judge the cut's progression.

Note: *As the saw is pulled from the cut, the operator should engage the brake lock, which will stop the chain's rotation. This prevents injuring anyone when the saw is moved. If the saw does not have a brake, the blade should be kept near the cut until it stops rotating and then be moved to the next cut.*

Chain saws assist firefighters in ventilating hurricane windows (see chapter 12, Forcible Entry, for more information on these windows). Firefighters should be equipped with proper breathing protection during cutting operations. Before beginning the cut, ensure that a purchase point for the saw's chain exists. Cutting these windows can be dangerous and all safety procedures should be followed.

Operating with a chain saw: tree cutting. Cutting trees with a chain saw is different than cutting a ventilation hole in a roof. Different procedures must be followed. Normally when firefighters cut trees or limbs, their chain saws lack a safety bar or depth gauge. The entire bar and chain is exposed during cutting, which increases the risk of injury if safety is not practiced at all times.

Prior to cutting any trees, limbs, or branches, firefighters must perform a scene size-up to ensure they are not in any contact with electrical lines. The size-up should include the position in which the tree is resting or leaning. In instances such as a crushed automobile with a trapped victim, it may be necessary to lift the tree with firefighting equipment instead of cutting it. Another danger is when a tree is leaning on a structure and firefighters begin to cut. Once a few of the larger branches are removed, sometimes the trunk may actually spring up and back into position because the weight is released, or fall farther down into the structure. Firefighters must use caution when performing these tactics. If the situation has no immediate rescue or life hazard, the area should be secured or stabilized and left for the proper attending authorities.

To begin saw operations, firefighters place the saw against the tree with the **bumper spikes** in contact with the tree. The saw is held with the bottom of the chain just off the tree. Once the throttle is fully engaged, the saw can pivot on the spikes and the chain can cut into the tree. The saw must be run at full speed during the entire cut. Once the chain has cut through the material, the throttle releases. The chain saw should not be forced downward into the cut. The firefighter should allow the saw's chain to cut

the tree. The saw can be slowly rocked up and down to assist in the cut.

Firefighters must remember that any cutting with the tip of the bar and chain can cause the saw to kick back toward the operator. Using the tip is dangerous and should not be done.

There are numerous cutting variations and situations when cutting trees and dismantling limbs. Wedges and blocks assist firefighters in many of these procedures. Firefighters must follow manufacturers' guidelines when operating their departments' saws.

Maintenance. Chain saws require more labor-intensive maintenance than rotary saws because of all of its parts. Firefighters must know their departments' saws and follow specific manufacturers' procedures. The following are some of the most common post-cutting maintenance requirements for chain saws:

- Clean and inspect the guide bar for wear and damage. It is also recommended to run a narrow object around the entire channel in which the chain rides to remove debris.
- Maintain the saw with a sharp, properly adjusted chain.
- Ensure that the oil discharge ports are clear and oil flows freely through the bar.
- Ensure that the oil reservoir and fuel tanks are full.
- Clean and inspect the air intake and remove any dust or debris from the openings.
- Ensure the air cleaner is free of dust and debris.
- Clean and remove any sawdust or debris from around the sprocket and inside the saw's sprocket housing cover.
- Ensure that the depth gauge or chain guards are in good working order.
- Wipe off the saw housing and any areas that may have excess oil.
- Ensure that the chain is installed properly.

Periodic maintenance should also be conducted.

Reciprocating saw

SKILL DRILL

Reciprocating saws are commonly used for vehicle extrications, machinery extrications, and building collapses. These portable saws are lightweight, small, and easy to transport (fig. 11–32). They are capable of operating on battery power with no need for an electrical cord. Some reciprocating saws operate on air supply and normal, household electrical current. They are commonly called sabre saws or by the brand, Sawzall®.

Fig. 11–32. Reciprocating saw

The reciprocating saw uses an alternating-direction motor (reciprocating motion) to move a blade back and forth to cut through material. Many of these saws offer a variable speed control option that works in conjunction with the amount of pressure applied to the trigger switch by the firefighter. The saw can be equipped with a multitude of blades that can cut wood, metal, plastic, automobile windshields, and drywall (fig. 11–33). Many of these blades are capable of cutting a few types of material and may be labeled as **bi-metal**, meaning they can cut metal and wood products. The blades are inserted into a holder and kept in place by a set screw or a manual locking device. They also can be inserted with the teeth of the blade facing either up or down to offer a different angle or plane of cutting. Lubricating some of these blades while cutting may also increase the blade's life span.

Fig. 11–33. Reciprocating saw blades

Maintenance. After each use, the saw should be cleaned of dust, dirt, and debris, especially around the blade holder. If the saw is cordless, it needs its batteries recharged. A new blade should also be installed even though the blade may still have some life left in it. The fire service must keep its equipment fully ready for service at all times. The old blade can be used for drill periods.

Safety

- Prior to cutting, the firefighter should be wearing all personal protective equipment and safety glasses.
- Anything being cut that has a power supply should be shut down prior to cutting.
- The area or material being cut should be surveyed to ensure other or structural members aren't cut accidentally.
- Firefighters must wear gloves. Blades are hot after cutting and can burn.
- When necessary, clamp or secure the item being cut so it doesn't move during or after cutting.
- Maintain a well-balanced position while cutting, and don't overreach with the saw.

Cutting operations. The firefighter first ensures that the saw is equipped with the proper blade for the cutting operation. He or she holds the control handle in one hand with the index finger on the speed control trigger. The other hand holds the saw near the blade around the tool's shaft or grip handle. Now, the firefighter holds the blade slightly off the material with the safety shoe against the material and slowly engages the trigger to make a cut line in the material. Once the blade bites into the material, the firefighter either operates the saw at full speed or a slower speed depending on the cutting operation.

As the saw cuts, the firefighter should watch the dust and debris thrown by the saw and the depth of the cut. He or she also listens to the saw and blade cutting through the material. If the saw sounds like it is laboring, the firefighter is placing too much pressure on the material being cut, the saw needs to run at a higher speed, the speed of the cut must be slowed to enable the blade work, or the blade may need replacing. In some cutting operations, the saw can be pivoted on the safety shoe in an up-and-down motion to assist the blade in cutting the material.

LESSON FROM THE FIREGROUND

A tool's efficiency depends on you. Size-up is critical to tool selection, and it should be made long before you respond to an alarm. Knowing the types of building construction in your response area is an absolute must. Know your town's history. By studying the history of your community, you will learn what types of buildings you may encounter and what building techniques were used. It is very important. Germans built buildings differently from the Swedish, who built differently from the French, who built totally differently from the colonists. Our own fire service history has played an important role in the way buildings are constructed. Huge conflagrations and high death tolls brought about the enactment of building and fire codes. As a firefighter, you are responsible for every structure in your community, not just those under construction today, but every building ever built and still standing.

Become familiar with what types of security devices are being sold and used. A trip to the local home-improvement store will answer a lot of questions about what types of tools you will need to bring with you to the next fire. Do prefire inspections. Don't just look for code violations. Look at how the occupant secures the building at night. How do you get in? What tools do you need?

MY POINT

Standing in front of a locked door with the most sophisticated tools in the world won't open that door. Know the capabilities and limitations of the tools you are holding in your hand.

QUESTIONS

1. Name the tools identified in chapter 11 as roof ventilation tools.
2. What type of fuel is used with rotary and chain saws?
3. Describe the maintenance needs for fire service axe heads.
4. According to the text, what four tools are available to firefighters to strike other tools?
5. Carbide-tip blades on a rotary saw are used to cut what materials?
6. Describe the most common lengths for pike poles and their uses.
7. Describe the maintenance procedures a firefighter should carry out after using a chain saw.
8. Describe the parts of a Halligan tool.
9. Describe the primary disadvantages of fiberglass poles used on pike poles and other push-pull tools.
10. Which general variety of tools is used for overhaul?
11. Describe the necessary actions to start a cut in a roof with a chain saw.
12. Describe the signal system recommended in the text for physical communication between a saw's operator and her partner during roof operations.
13. What is the recommended minimum distance other firefighters should maintain from a firefighter operating a saw?
14. What is the proper method for starting a cold engine on a rotary saw?
15. What is the most important safety factor a saw operator must do after cutting?
16. How should a saw in use be refueled?
17. When using a saw to ventilate a roof, what is the recommended method for moving to start a new hole?
18. An ideal axe head should weigh how many pounds?
19. What is considered the ideal length of a Halligan bar?
20. When using a monitor nozzle or deck gun as a master stream device, what tool can be used to safely anchor the device?
21. Discuss the safety considerations firefighters employ when using an axe.