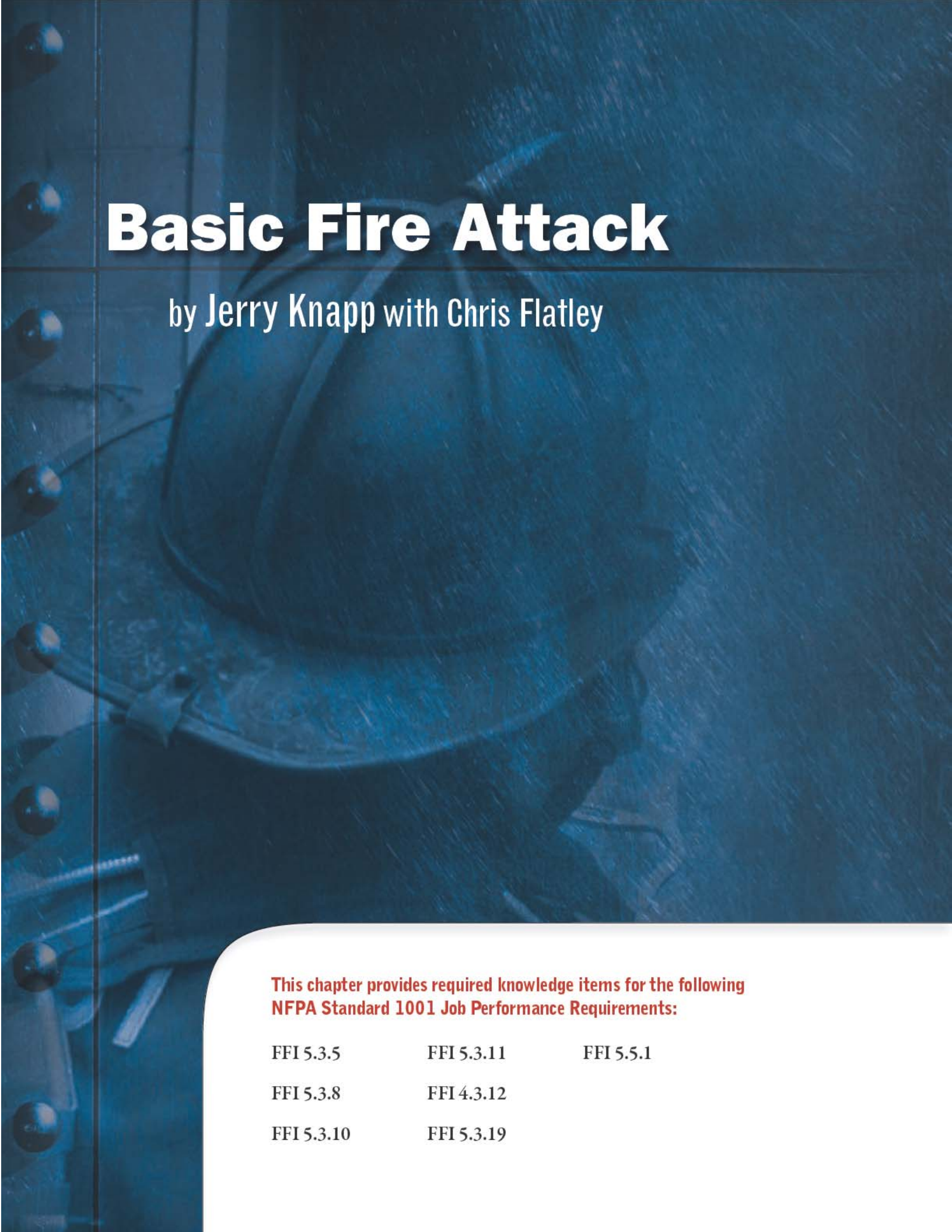

Basic Fire Attack

by Jerry Knapp with Chris Flatley

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

FFI 5.3.5	FFI 5.3.11	FFI 5.5.1
FFI 5.3.8	FFI 4.3.12	
FFI 5.3.10	FFI 5.3.19	

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

SKILL DRILL

OBJECTIVES

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

- Define *strategy, tactics,* and *size-up* as they apply to firefighting
- Describe the 10 steps for a successful fire attack
- Describe offensive and defensive strategies use at a fire incident
- Describe the importance of command control and communications at a fire incident
- List the common responsibilities of engine company personnel at a fire incident
- List the common responsibilities of truck company personnel at a fire incident
- Describe the key considerations for hoselines, water supply, forcible entry, ladders, ventilation, and search at a fire incident
- Describe the importance of an after action review of a fire incident

Fig. 20–1. Aggressive interior firefighting saves lives and property and is at the heart of what we do best. (Courtesy of Tom Bierds)

INTRODUCTION

This chapter brings together all the knowledge, skills, and abilities you have gained in previous chapters. It will provide you with a basic overview of what is required for a successful fire attack operation at a structure fire. As a Firefighter I, you will be given specific tasks to perform by your company officer or a senior firefighter. You will execute your assignment as part of a team, your fire company. It is the coordinated efforts of multiple fire companies working together that result in a successful fire attack (see fig. 20–1).

You might be part of an engine company, delivering water, deploying hoselines, or executing other tactics to extinguish fires. Or maybe you are a truck company member, assigned to place ladders; perform search and rescue, ventilation, or forcible-entry operations; secure utilities;and perform salvage or overhaul.

While you are performing your particular duties, it is important to understand the overall "big picture." Your understanding of how all the pieces of fire attack fit together will help you see the importance of your role. While not every task may be as dramatic as rescuing a child or being on a nozzle and knocking down a rapidly spreading fire, every task at a fire is critical to overall success. Your proficiency in carrying out your assigned tasks will directly affect the outcome of the fire attack.

It is important that you understand two important terms: strategy and tactics. While used interchangeably by civilians, they mean two different things. **Strategy** is the development and implementation of a plan, incorporating specific goals, to bring a fire under control. **Tactics**, on the other hand, are specific actions taken to accomplish the goals identified in an overall strategy.

Take a fully-involved car repair shop, for example. The strategy may be to take a defensive stance and protect exposures with the specific goal of preventing fire from spreading to an adjacent exposure. Tactics would involve placing a hoseline between the fire building and the exposure flowing water directly on to the exposed structure.

In order to understand all the elements of a basic fire attack, we will use a series of scenarios to illustrate the important details. The first scenario will be relatively simple. After you gain an understanding of the basics, we will advance into other, more complex, scenarios.

It is important to note that this chapter will cover only the basics of a fire attack operation, from pulling up on the scene to returning back to quarters after your job is done. The first scenario will be an uncomplicated fire but will require techniques, skills, tactics, and strategies covered in almost every other chapter.

At the end of this chapter the firefighter trainee will understand the following concepts and, more importantly, how they fit together for a successful fire attack operation:

- Strategy: An overall plan, including goals, of a basic structural fire attack
- Tactics: The specific firefighting procedures performed by company officers and firefighters to meet the overall strategic goals
- Size-up: An evaluation of what is happening
- Doctrine for an aggressive interior fire attack: Critical steps used across the country for structural fire attack
- Type of fire attack operations: Offensive, defensive, defensive/offensive, offensive/defensive (and the conditions that cause the transition from one to the other)
- Command, control, and communication: On the fire scene and why they are important
- Fire-extinguishment methods: Direct, indirect, and combination methods of fire extinguishment
- Coordination of engine and truck company functions

This scenario is based on a house fire because house fires often require all of our knowledge, skills, and abilities to be successful and safe. The house fire is also a good example because it is the most dangerous and deadly type of fire for both civilians and firefighters (fig. 20–2).

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Fig. 20–2. NFPA Fire Data Block

Communication

FFI 5.3.5 There are a few basic levels of communication that will occur at a house fire. Communication is the lifeblood of any emergency operation. Without effective communication, the operation is doomed to failure.

First, the dispatcher will provide information about the location, type of alarm (automatic, telephone, witness, etc.), the alarm location, and other important information the dispatcher may have (fig. 20–3).

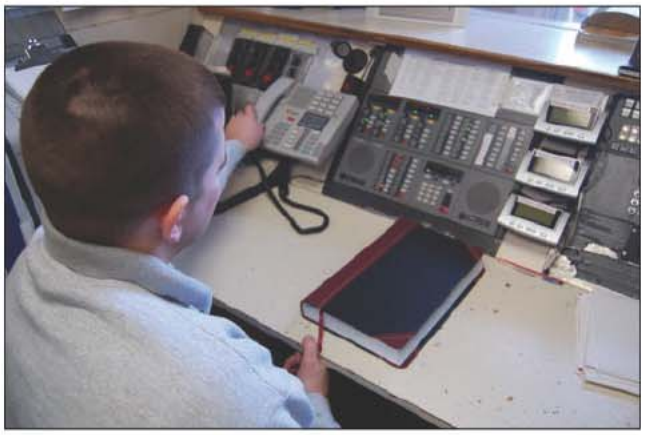

Fig. 20–3. A dispatcher

Messages received from dispatchers often hold clues to the fire condition. Words like "across from" or "next to" will indicate that the fire may not have been reported by someone inside the structure but by a passerby.

Generally, chief officers will arrive before the apparatus (though not always) and give a quick "on-scene report" confirming the address, providing a brief description of the fire, and giving orders for the responding units (fig. 20–4).

Fig. 20–4. Chief officer giving orders

Let's take a look at a typical communication from a first arriving chief at a house fire. A typical initial fire report would be: "Battalion 23 on scene, 20 Main Street, a 20×40, 1½ story single-family home fire showing on A and B side, report of victims trapped." This report provides valuable information to responding firefighters and confirms the correct address and gives dispatch an initial report.

Important points you should gain from the initial report:

1. Confirmed address—you are going to the correct place.
2. Type of occupancy—residential (general knowledge of the typical hazards).
3. Size and height—type of ground or aerial ladders needed.
4. Location of fire in building and severity (may determine tactics).
5. Report of victims reportedly trapped (clearly this is the priority). When a life hazard exists, all on-scene operation support the search and rescue operations.

The on-scene report paints the picture for incoming units so you can begin to consider what priorities, actions, and tools will be necessary at this call.

Command will communicate with engine and truck officers to give assignments, direct search and rescue, coordinate ventilation and fire attack operation, monitor progress of assigned crews, and ensure the safety of all firefighters on the scene.

Unit leaders (engine and truck officers) will report back to command via radio on the progress of their assigned tasks and other valuable information such as fire location, the location and status of victims, and other safety considerations.

Interpersonal communication among the company members and with the company officer is critical for success and safety. The company officer will give initial orders, for example, "stretch the 1¾-in. attack line to the front door," or "we have a report of persons trapped on the second floor." Company members will have to coordinate actions to ensure that the orders and tactical assignments are executed properly. The nozzle operator may ask the backup position to flake out the line or ask for more effort to pick up the nozzle reaction. Firefighters will use their portable radios to communicate with one another during the entire fire attack operation.

COMMON TERMINOLOGY

Firefighters use common terminology to describe different areas of the fire building. This allows firefighters to communicate quickly about strategy and tactics and to give orders. On larger fires it is a way to divide up areas of responsibility. For example, a chief officer may assign a subordinate officer to be responsible for a particular side of the building. That officer will coordinate all actions necessary for the operation on that side or area and report to and work for the incident commander (IC).

FFI5.3.10 It is important to clarify the location terminology here. In National Incident Management System terminology, we would use the terms *Division A, Division B, Division C,* and *Division D* (fig. 20–5). These are essentially geographic areas or parts of the entire fire area. The division chief (in the past, this position was termed the "sector" chief") is responsible for all activities in that area and how those activities impact all other **sectors**. These latter designations also help orient all on-scene firefighters to particular locations in a building where things may be happening: spreading fire, a trapped victim, or a localized collapse, for example. Exposures are designated by letters corresponding to the side of the fire building they face: exposure D is the building that faces the D side of the fire building. Exposure D1 is the next furthest exposure on the D side of the fire building (fig. 20–6).

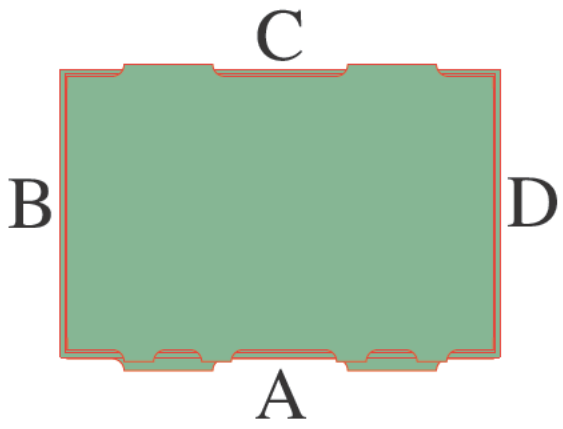

Fig. 20–5. Building sectors

The A side of the structure is usually the side of the building with the main entrance that faces a street, although not always. Sides B, C, and D are the other three sides assigned clockwise around the structure. Divisions can also refer to floors, such as floor 2, division 2. It is up to the incident commander to make the division designations.

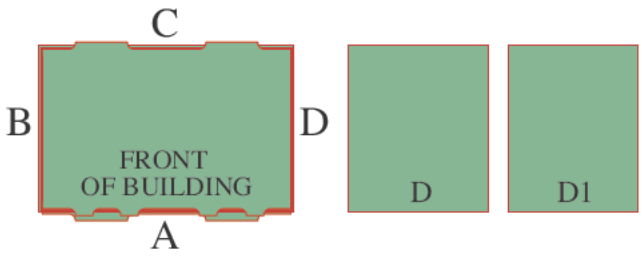

Fig. 20–6. Sector view with exposure designations

STEPS TO A SUCCESSFUL FIRE ATTACK

1. Size-up: the ongoing process of evaluating the situation before arrival, upon arrival, an during the incident
2. Develop a strategic plan (the incident commander's job)
3. Establish a reliable water supply
4. Force entry or exit into or out of the structure
5. Conduct search and rescue operations
6. Stretch and operate a hoseline; confine and extinguish the fire
7. Ventilate the fire building
8. Protect exposures
9. Fire control and overhaul
10. Pick up and return

YOU ARE HERE

1. Size-up
2. Strategic plan
3. Establish water supply
4. Force entry/exit
5. Search and rescue
6. Fire attack
7. Ventilate
8. Protect exposures
9. Fire control and overhaul
10. Pick up and return

Size-up

SKILL DRILL

Step 1 in any emergency situation, size-up is critical for gaining awareness to develop an action plan. The ISFSI's 2013 *Position Statement on Fire Dynamics Research* states "Size-up must occur at every fire. . . A tactical plan for that fire must be developed, communicated, and implemented." Size-up is the ongoing evaluation of what has happened, what is likely to happen, and the available resources (in what priority order) needed to resolve the situation. Everyone on the fireground does an initial size-up and a continuing size-up as the situation changes.

Therefore, you must conduct your own size-up: evaluating the situation, determining what you know and what you don't know, and formulating what you think the situation really is, despite several unknown factors. As a Firefighter I, you will be given specific orders. However, you must continually conduct your own size-up of the situation to ensure your safety, to be sure you are performing the correct tactics, and to ensure the operation is having the desired result.

Dispatch time. Here is an example of how to use size-up and existing information. Assume that your dispatch time is early in the morning. Would you expect to find people sleeping? Where would these people be? In this case they are likely to be in the bedrooms in the rear of the house. Consider also that the victims may have attempted to escape and have collapsed by windows or on usual exit paths within the house.

You might think that the time of day of this call makes it unlikely that anyone is awake. Consider that people may work nights and be coming home or just going to work. Was someone cooking, and was this the cause of the fire? Don't discount any bit of information; you may not initially see how it fits in the overall understanding of the situation.

On-scene information. Bystanders, civilians, and police officers may have valuable information about the fire or occupants. A neighbor may report that the family is all away on vacation, or report that one person was home alone. Not all civilian reports are reliable. No bad intentions intended, but they may be swept up in the excitement of the moment and provide bad information. Conversely, police officers may have good information. They may have been on the scene before the fire department and have had a few minutes to gather and possibly verify that information.

Location of fire building. From the dispatch information you know that you are not responding to the industrial side of town. The fire alarm was in a new development. Developments are usually built with the same or similar style. This fact may help you understand the floor plan of the house, even if you have never been in it.

Floor plan. Have you been in the houses before? Did you inspect them when they were being built, or does your neighbor live in one just like it? Knowing the layout of the fire building is one of the most important factors in a successful operation. For example, you can move quickly through the structure toward the sleeping areas when you know where to go.

If this were a two-story home, what rooms may you expect to find on the first floor? Kitchen, living room, dining rooms, and maybe a utility room if there is no basement. What does that tell you bout what type of fire you may be encountering? What and where are the utilities? Electric, natural gas, or is it bottled gas or propane? Will that affect operations?

Construction hazards. If the housing development where the fire is located were described as new; how new? The words "new construction" now almost always means "lightweight" construction. Lightweight construction has been around long enough to almost not be considered new. If this home is built with trusses, laminated beams, or other composite materials, those factors will hasten fire spread and early collapse.

Lightweight construction is now very prevalent in our country. It is critical to understand that lightweight construction (trusses, laminated beams, metal studs, etc.) often has little or no fire resistance. Expect early and catastrophic structural failures that will cause floors to collapse, sending firefighters into the burning basement; second and third floors to drop firefighters a floor or more, trapping those below; and roofs to collapse, trapping firefighters in burning rooms on upper

floors. Prefire intelligence and planning are your best survival tools.

Resources available. You also know what other resources are responding with you. You know that another engine, a truck, and chief are on the way. Is this the typical response to a fire that is reported by telephone? Based on the report of a confirmed fire, the dispatcher may have dispatched additional units. The police department, whose unit may be on the scene before you, may also provide valuable information either directly or through dispatch.

You know what the staffing is on your engine; do you know what your assignment will be when you pull up? The ride to the scene is a time to make those assignments if they are not dictated by department policy.

Weather may also play an important part in your size-up. Will very high or low ambient temperatures limit the time firefighters can work? Will the doors and windows be closed or locked, delaying entry, confining the fire? Is there a high-wind condition that could drive fire quickly or unnaturally through the building immediately after the ventilation is completed?

The dispatch information reported a fire on the first floor. Did the caller give the address or say "next to" or "across from"? This may indicate that the call was made by someone not in the house but a person passing by or nearby. Could this indicate the possibility of an advanced fire on arrival? Are you receiving several calls reporting the same fire? Does this indicate that the fire is large enough to be seen by others? Or does it confirm a working structural fire?

At this point in your career many of these strategic decisions are not made by you. They are offered to give insight into what you will come to understand later in your career. You will do well if you control your anxiety and follow orders. When you put on your facepiece, try to control your breathing and keep your head.

Size-up upon arrival. The following are seven specific size-up points that must be considered to complete your size-up upon arrival:

1. Location of the fire and type of construction
2. Life hazard
3. Fire control
4. Forcing entry
5. Ventilation
6. Stretching considerations
7. Water supply

Size-up begins with receipt of the alarm and is a continuing process until you leave the scene. Everyone on the scene must conduct a size-up of the initial situation and a continual size-up of the fire scene. Everyone on the scene must conduct individual size-ups of the initial situation and continue to conduct size-ups, since incidents change rapidly.

YOU ARE HERE

1. Size-up
2. **Strategic plan**
3. Establish water supply
4. Force entry/exit
5. Search and rescue
6. Fire attack
7. Ventilate
8. Protect exposures
9. Fire control and overhaul
10. Pick up and return

Developing a strategic plan

Although it is the chief or first-in officer who will determine the overall strategy based on his or her size-up, it is important to understand the four basic fire attack strategies.

Strategy is the overall rescue and fire attack game plan for this call. Strategy is determined by command level officers. One possibility is to conduct a rapid search and rescue operation, supported by forcible entry and ventilation, then rapid deployment of the initial hoseline to protect the rescue crews and to attempt to control and or extinguish the fire.

Tactics, on the other hand, are the supporting tasks necessary to accomplish the overall strategy. It will be up to the company officer (or, in some cases, a senior Firefighter II) who has to make some tactical decisions (what room to hit with the line during the advance, where to cut the roof, etc.). It will be the firefighter who will execute the tactical decisions made by the company officers.

Offensive strategy. Offensive strategy is used when an aggressive interior search or attack can save lives or property, and some or all of the following factors are present:

- Lives can be saved by rapid interior search and fire attack operations.
- The building has a limited amount of fire and has areas that are salvageable.
- The building is safe for firefighters to operate in for a short period of time or until complete extinguishment (fig. 20–7).

Fig. 20–7. Size-up of this fire reveals that the fire appears to be contained to one or two rooms on the second floor. An offensive attack could result in saving the building and contents with a reasonable risk to firefighters. However, if this building was built with lightweight construction materials, it could be a deathtrap for firefighters. Incident commanders must realize these dangers to firefighters. (Courtesy of Brian Duddy)

Defensive strategy. Defensive strategy is employed when it is determined that some or all of the following factors are present (fig. 20–8):

- There is no saveable human life present; it is not worth risking firefighters' lives for a futile rescue attempt.
- The building is so heavily involved in fire that it is not salvageable (there is nothing left to save, neither contents nor the building itself).
- The building is unsafe due to heavy fire involvement.
- The building is unsafe due to a fire load on the lightweight construction components.

Fig. 20–8. This fire calls for a defensive strategy. There is no salvageable human life inside and no saveable property, therefore no need to risk firefighters' lives.

LESSON LEARNED

Rock Hill Missouri Fire Chief John Kriska had preplanned all commercial structures in his first due area. Heavy fire greeted the engine company. The Engine captain, following the preplan, established a defensive attack. Moments later, the metal bar joist (lightweight construction) failed under the fire load, sending roof HVAC units crashing to the floor, exactly where the engine company would have been if an offensive attack would have been chosen.

Defensive/offensive strategy is used when the firefighter cannot immediately enter the building because of an extremely heavy fire involvement or other hazards prevent you from getting close enough for an offensive attack. Defensive/offensive operations are employed when some or all of the following factors are present:

- Heavy fire upon arrival
- Hazards that must be controlled before firefighters can gain entry
- When the fire is knocked down quickly, allowing the IC to consider changing to an offensive operation

A common method to employ this strategy is to use the **blitz attack**. The blitz tactic uses heavy streams from a safe distance until the fire is controlled enough to safely approach for complete extinguishment (see fig. 20–9).

Fig. 20–9. Here, downed electrical wires prevented firefighters from making an offensive attack.

Offensive/defensive. When possible, we try to mount an offensive strategy to make an aggressive interior fire attack in an attempt to save trapped occupants or the building or contents. Sometimes we must fall back to a defensive strategy, giving up the interior fire attack for the following reasons:

- This could have been the intention of the incident commander: Mount an interior attack until a search can be completed, then back out due to the severe risks to firefighters.
- No headway has been made on the fire (fire not darkening down), and extinguishments with interior line will not be possible (fig. 20–10).
- If the fire is progressing faster than our ability to put water on it, we may need to shift to a defensive position (proper use of a limited water supply).

Fig. 20–10. a) This fire started out as an offensive attack. b) Heavy fire conditions inside combined with a large amount of accumulated materials inside the house prevented the interior attack lines from advancing and thus forced firefighters to change from an offensive operation to a defensive attack. c) The fire was contained with no injuries to firefighters.

YOU ARE HERE

1. Size-up
2. Strategic plan
3. **Establish water supply**
4. Force entry/exit
5. Search and rescue
6. Fire attack
7. Ventilate
8. Protect exposures
9. Fire control and overhaul
10. Pick up and return

Establish a reliable water supply

There is one inescapable truth in the fire service. To extinguish the fire, you must apply more gallons per minute to overcome the total heat the fire is producing to ensure extinguishment. To accomplish this, one of the first priorities is to establish a reliable water supply (figs. 20–11 and 20–12). The first-in engine company usually has two main options to establish a reliable water supply: forward lay from a hydrant or reverse lay to a hydrant. Fires in a rural setting will require drafting from static source such as a swimming pool or lake or using water from tenders. Tender shuttles may be required for large fires in a rural location. (See chapter 15, Water Supply for details.)

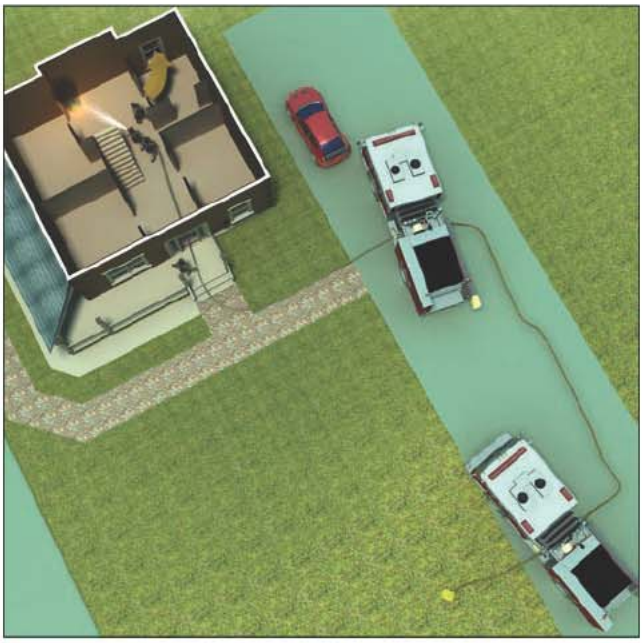

Fig. 20–11. Establishing a reliable water supply

Fig. 20–12. Establishing a reliable water supply is a critical step in the extinguishment process. (Courtesy of Brian Duddy)

YOU ARE HERE

1. Size-up
2. Strategic plan
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Forcible entry

Firefighters conducting forcible entry are usually the first team to the building because they have only hand tools (Halligan, axe, hydraulic door opener, etc.) with them, as opposed to the engine company, which is slowed by stretching the hoseline.

Common tools carried by the forcible-entry team include the flat-head axe, Halligan, and/or a hydraulic door opener. The flat-head axe is often replaced with a maul or sledgehammer as a tool to drive the Halligan tool. However, the occupancy and characteristics of the response area will dictate other appropriate tools. For example, if the area has a lot of industrial occupancies tools selected, maybe a rotary saw and even a hydraulic spreader could be used on bars or reinforced metal doors with multiple locks. Metal foldout gates or roll-down security shutters also require a rotary saw for rapid forcible entry.

The forcible-entry team will make their size-up of the building and choose the most appropriate place to enter. At house fires, this is usually the front door (fig. 20–13). Choosing where to enter the building is an important tactical decision. In this chapter we will discuss residential fires, and in *Firefighter II* we will discuss other types of occupancies. It is important to note that where you enter the building may have significant consequences in terms of your effectiveness and safety. This is significant for several important tactical reasons:

- The front door is generally the fastest and most used way into and out of the home.
- Victims may be found near the door if they were overcome and unable to escape.
- Opening the door may allow victims to escape.
- Opening the door will allow the engine company members to move quickly to the seat of the fire.

Fig. 20–13. Firefighters from the truck company force the front door. Note that the officer is holding a piece of webbing on the door handle to control the door once it is forced open. (Courtesy of Jerry Knapp)

There are two important safety factors to consider when conducting forcible-entry operations. First, consider forcible exit, that is, how are you going to get out of the area you just got into if conditions suddenly worsen? Is there a window you can get out of? Is there a ladder at that window, or are there bars on the window? In a home or apartment, can you breach the gypsum board wall in time to save yourself and crew? If you are operating in a multistory apartment building and plan on using your bailout system, find your anchor point as soon as you enter the area. Trying to find it while the place is lighting up around you will be too late!

Second, when forcing the door to the fire area, always be able to control that door with a rope, piece of webbing, or tool. The sudden inrush of air could cause the fire to flashover or backdraft, trapping firefighters above the floor the door is on or in the public hallway.

YOU ARE HERE

1. Size-up
2. Strategic plan
3. Establish water supply
4. Force entry/exit
5. **Search and rescue**
6. Fire attack
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Conduct search and rescue operations

There is no more important operation on the fireground than search and rescue. Saving the occupants of the building is always our first priority. We must remember that when we enter the building, we are equally valuable occupants. When a search and rescue operation is in progress at a scene, all operations must support the search and rescue. For example, the first hoseline must protect the means of egress for search team members. If the fire can be extinguished by this line, that's fine, but the primary purpose of the line is to protect the means of egress and the crew.

We must remember that search and rescue are two separate events. Entering the structure and searching for victims (and the location of the fire) is a dangerous task. When an entry team finds the fire, that information must be communicated to command and the engine, so they can bring the line to that location and extinguish the fire. When the team finds a victim, that ends the search and begins the rescue operation for that victim. This does not mean the search is over; other victims may still be in the structure.

When the victim is found, that information must also be communicated to the IC. Command will then be sure that medical treatment is available as soon as the victim has been removed from the structure. The egress route the team will be taking should also be communicated to other members operating in the area so they can clear the path to the exit.

This also allows the other fireground activities that are occurring simultaneously to support the rescue effort. When the rescue status is known, it greatly reduces the chances that the fire will be pushed on the search team by an advancing line or inappropriate ventilation. Ventilation will be performed to lift the heat and smoke and increase visibility. Forcible entry will be performed to remove obstacles and clear the path to the exit.

Search and rescue tools. It is important to select the proper tools to take with you for a search and rescue mission. Obviously, full personal protective equipment (PPE), including self-contained breathing apparatus (SCBA), are required. If you are going inside to work at any structure fire, a portable radio and handlight are also critically important. A thermal imaging camera will make your search much more rapid, effective, and—when used properly—safer for you and your crew.

Hand tools should be selected based on your department's SOPs. If the responsibility of the search and rescue crew is also forcible entry, then the Halligan tool and an axe are good choices. Your partner will have a 6-ft hook and possibly a water extinguisher, which are good complements to your search and rescue tools. Situations dictate specific actions, but this combination of tools provides a variety of options and good use of these tools to complement your search effort.

The Halligan and flat-head axe can be used in combination to force doors to gain entrance to the building. (See chapter 12 on forcible entry). The axe can be used to chock a door open after you force it. The Halligan can be used to sweep the floor as an extension of your arm to increase the efficiency of searching larger open areas (fig. 20–14).

The 6-ft (2-m) hook can be used also as a search tool. It can be used to take windows, if necessary (fig. 20–15). The power extinguisher can be used to hold a fire or extinguish a smaller fire found during the search.

When selecting tools, consider the number of personnel available and what specific task you will be accomplishing with that tool. Be wary of "do everything" tools because they may not function in any purpose with the effectiveness you expected. Also be suspicious of hooks shorter than 6 ft (2 m). Although seemingly a great idea, you selected a hook to provide an extended reach, and 3 ft (1 m) is not much of an extended reach. The standard time-tested tools described above have been successful in the fire service for many years. Learn to use these basic hand tools effectively and with mental agility, and they will assist you in the search and rescue mission.

Fig. 20–14. Sweeping with a tool

Fig. 20–15. Using a 6-ft (1.8-m) hook to open a window panel

LESSON LEARNED

We pulled up at about 0530 hours one morning, and the police officer met us as we stepped off the rig. He said there was a victim in the back bedroom, just below the window. When I asked him how he knew that, he said he saw him standing there, then collapse due to the smoke. Lesson learned: The police department maybe on the scene before you in enough time to collect valuable information about the status of victims or not inside the house.

The search and rescue plan. A standard search and rescue plan for single family dwellings uses the two-team approach (fig. 20–16). The two-team search plan at this fire will include one team entering the front door and the second team attempting to enter nearest to likely victim location. In two-story homes this will be the second floor for nighttime fires. The outside team does not necessarily have to enter through the second floor. One team forces the door at the most common entrance to the home, and the one most likely used by the occupants (usually the front door). This opens a door the escaping occupants might be using. The second team makes their way from the outside to rooms or areas where people are most likely be found. They may make use of portable ladders or porch roofs. You can see where knowledge of the layout of the house would be a huge benefit in this case.

Fig. 20–16. Two-team search plan. The second team can either enter above a porch or through a second story window.

The preferred means of removal (as taught by the New York City Fire Department [FDNY]) is to remove victims by interior stairs first, then through some horizontal exit or possibly an adjoining building, then fire escapes, then ladders (with an aerial being preferred to a portable ladder), and last being by a life-saving rope. All of these may not be an option in a private dwelling. Use the most practical method based on the situation and the best method to do no further harm to the victim.

LESSON LEARNED

I had the nozzle at a working house fire one night, and we were stopped at the locked front door. For some reason the truck company was delayed, so I decided to conduct the forcible entry operation with my foot. I leaned back and planted my size 10 boot on the door, missing the frame of the door and hitting a center wood panel. My foot went right through, and there I was with a charged line, fire blowing out, with my foot stuck in the door! Heavy fire or a large dog behind the door could have made this a painful lesson. Lesson learned: Use the forcible entry tools; the door provides protection from fire and other hazards if you control it!

The condition of the victims will have a great deal to do with how they are removed. With unconscious individuals, you may have limited options. Victims with burns and severe injuries may have to be moved as quickly as possible, risking other injuries to provide the best chance of survival.

Persons with lesser injuries may be "sheltered in place" until conditions improve to move them out of the building. A rescue should not place an individual at a greater risk than the current conditions.

An engine company with a charged hoseline can do more to effect the rescue of trapped or injured persons than any other small group of firefighters.

It is important to note that there are a variety of effective ways to protect lives of both civilians and firefighters. What does not change is that saving and protecting lives is always our first priority. Four of the most common ways lives can be protected are the following:

1. Immediate removal
2. Placement of hoselines to protect means of egress
3. Protection in place in areas of refuge
4. Fire extinguishment (if it can be achieved very quickly)

When a search and rescue operation is required at a fire, all other operations (fire attack, ventilation, forcible entry, and overhaul) must support the rescue operation. Putting the fire out and removing the bodies later is not a successful outcome. Hoselines can push fire onto victims or search crews. Inappropriate ventilation tactics can cause the fire to light up and trap and burn firefighters. It is up to the IC and the IC's division officers to ensure that these inappropriate and dangerous acts do not happen. All fireground actions must support the search and rescue.

Size-up is an important part of the search and rescue plan and operation. Evaluation of what you see during your size-up for your search operation will provide you with many clues that will help make your operation effective and safer for firefighters. It is important to note that these are only clues, not definitive answers. For example, does five days' worth of newspapers on the front porch mean that no one is home? Of course not; maybe the occupant is sick or simply has not picked them up. Here are few other considerations in your size-up for search and rescue:

- Does the house look occupied?
- Are there multiple mailboxes, utility meters, and so forth, indicating a multiple dwelling?
- Are there bikes or kids' toys outside the house?
- Are there cars in the driveway?
- Are TVs, air conditioners, or heaters running?
- Are there ramps that might indicate the presence of disabled people in wheelchairs?

Don't base your entire search and rescue strategy on one bit of information.

LESSON LEARNED

Peck street: Upon arrival, civilians told us that a person was trapped in this house. Firefighters entered the building and left the front door open, thus allowing the fire unlimited oxygen, which caused it to go to flashover very quickly, nearly killing three of the search and rescue crew. The victim was at a local bar. Lesson learned: Information from civilians at the scene may or may not be correct. Always ask, "Is everyone out?" But carefully evaluate the answer! Ask, ask again, and look for inconsistencies. Evaluate the answer, interrogate if you must, and remember that you are placing the lives of your firefighters on the line based on what people tell you!

YOU ARE HERE

1. Size-up
2. Strategic plan
3. Establish water supply
4. Force entry/exit
5. Search and rescue
6. **Fire attack**
7. Ventilate
8. Protect exposures
9. Fire control and overhaul
10. Pick up and return

Fire attack

SKILL DRILL

This is the heart of what we do. Decisions will have to be made as to the size of the hoseline used in the attack, the positioning of the hoseline(s), and coordinating the hoseline attack with ventilation operations. It is not your responsibility to make these decsions—these decisions will be made by officers. You will, however, be expected to carry out the tasks dictated by these decisions (fig. 20–17).

Fig. 20–17. As the search and rescue team enters a structure, the open door provides the fire with needed air that allows the fire to continue in the free-burning phase.

A chief officer will coordinate the ventilation and fire attack operations. When the hoseline is in place, he will direct the ventilation team to break out or **take the windows** ahead of the hoseline, then direct the hose team to advance to the seat of the fire. These operations are important for the following reasons: Brother and sister firefighters have entered this building to conduct a primary search and rescue operation. The fire now can grow unrestricted until the engine company gets water on the fire. Controlling the fire minimizes all other problems and most other hazards on the fireground. Fire growth in compartment fires (inside a building) is often determined by the amount of oxygen available. The open door we enter provides an excellent source of the oxygen required to light up the building or room we are in.

Ventilation, entry, and search make up the fire service doctrine in North America. Although this doctrine provides the greatest opportunity for firefighters to make a successful rescue, it is very dangerous for firefighters. Rapid and effective engine company (fire attack) operations greatly reduce these hazards to firefighters that we have intentionally put in harm's way. Rapid and effective fire attack operations are the responsibility and mission of the engine company. It can be argued that this operation is the most important of all we do in terms of firefighter safety.

Knowing where to stretch the line is as important as what line to stretch. There will be times in your career where you will pull up to a fire and need a larger line than the standard 1¾-in. or 1½-in. (45 mm or 38 mm) hand line.

Large-caliber streams are produced by deluge guns, either apparatus-mounted or ground-based, ground-based rapid attack monitors, or the use of a 2½-in. (65-mm) hand line with a large tip to generate flows of 250 gpm (946 L/min) or larger.

For large fires, the FDNY has developed the acronym **ADULTS**. This is easy to remember by the phrase "ADULTS use big hose."

The **A** in ADULTS is for a fire that is *advanced* on arrival. Any fire that has surpassed the extinguishing power of your standard (1¾-in. [45-mm]) attack line calls for a larger attack line. Two ineffective hand lines will not have the reach and penetration as one large-caliber line. If the water cannot reach the burning material, it will have no extinguishing power.

The **D** is for the *defensive* positions. This means any line stretched for outside exposure protection should be capable of a large-caliber stream. This will allow the water to be applied alternately between the fire building and the exposure, providing fire-killing stream reach and penetration and good reach to provide excellent exposure protection, thereby minimizing damage to both with one stream (fig. 20–18).

The **U** is for fires where you are *unable to determine* the size of the fire area. If you can't tell how much is burning or how large the space it is in, you should not be going in without the protection and capability of a large line. This is not the firefight to be caught short of water!

The **L** is for *large* and uncompartmentalized fires. For example, the sales floor of a department store is no place to be without a large volume of water. The fire spread in a situation like that could easily overwhelm a small hand line.

The **T** is for the times when you need a *ton* of water to cool large amounts of burning material (fig. 20–19). For example, a lumberyard fire or building that has a lot of combustible contents, such as furniture. Another possible scenario is a flammable gas tank with flame impingement. For larger tanks you need a "ton" (500 gpm [1,893 L/min] minimum) of water to prevent a boiling liquid expanding vapor explosion (BLEVE). The much longer reach of the larger line keeps you much further away from the tank if it does explode.

The S is for *standpipe* operations. The FDNY has a policy that all lines stretched from a standpipe will be 2½-in. (65-mm) hose with a 1⅛-in. (30-mm) tip on a smooth bore nozzle. Most standpipe systems were not designed to supply the high pressures (100 psi [700 kPa]) required by a combination fog or automatic nozzle. The smoothbore nozzle and large-diameter hose will deliver superior flow at low (design) pressure.

Fig. 20–18. This is a good example of a fire that needs large lines. There is a greatly advanced body of fire, necessitating a defensive operation, and at this point it is still undermined how much of this building the fire will involve. The high heat production will require tons of water to extinguish the fire. (Courtesy of Brian Duddy)

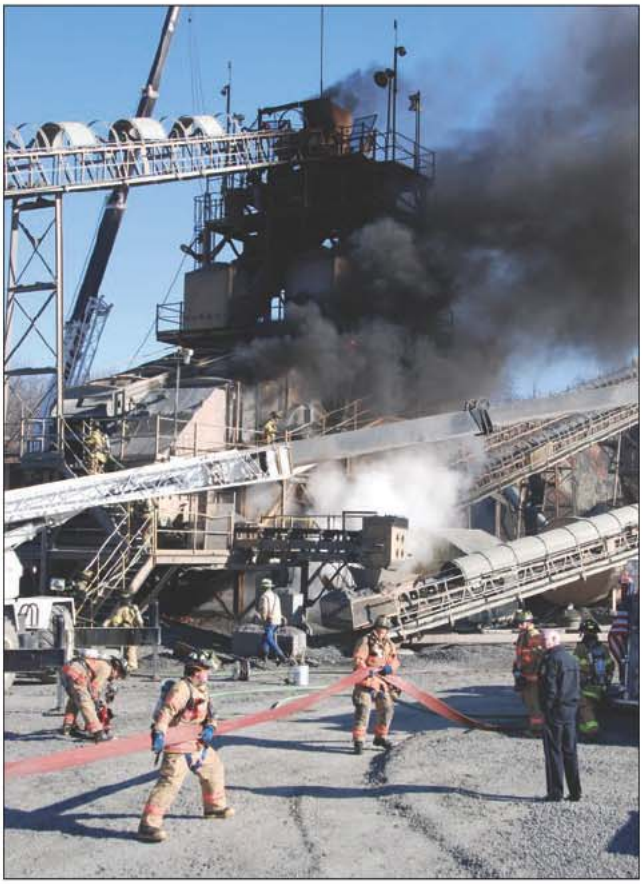

Fig. 20–19. Fires in industrial occupancies require the reach, penetration, and cooling effect of large lines. Here firefighters stretch a 5-in. (125-mm) line to a ladder truck. (Courtesy of Brian Duddy)

Stretching. We will now explore the stretching responsibilities of each position on an attack hand line. These positions include the officer, the nozzle operator, the backup position, and the door position. Each position is critical for a successful hose stretch (figs. 20–20 and 20–21).

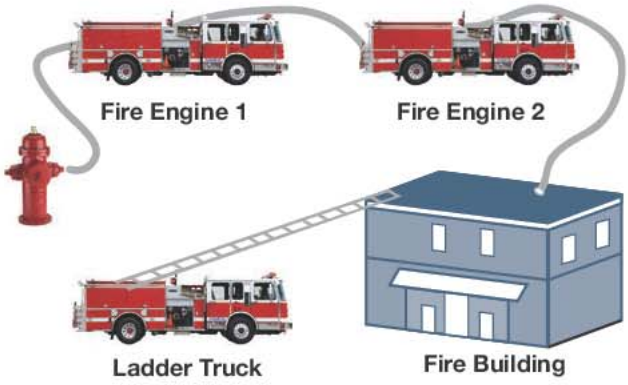

Fig. 20–20. Engine apparatus is positioned to establish a water supply and get the first hoseline in operation. Truck companies are positioned for search, rescue, ventilation, and other truck functions.

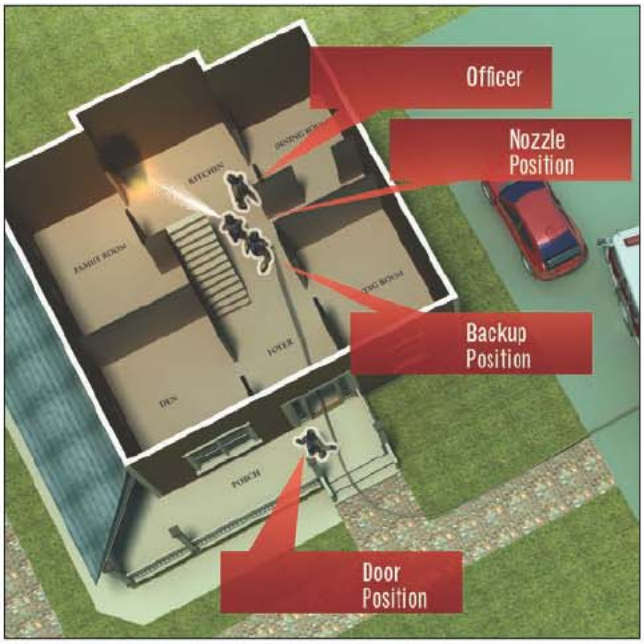

Fig. 20–21. Inside the fire building, each firefighter has a specific assignment and responsibility.

Officer duties in the stretch. The engine company officer (and, in some cases, a senior Firefighter II) is responsible for getting water on the fire as quickly as possible. Generally this officer will take direction from a chief officer on the scene. However, if the engine arrives before the chief, the engine officer will have to make some very important decisions and take decisive action. The engine officer can then pass command to any incoming officer or unit if appropriate. There are several subtasks the officer must accomplish to ensure water gets on the fire as quickly as possible.

1. Size up the fire (i.e., the size and number of lines).
2. Clearly order changes from the SOP.
3. Locate fire and tell the crew the best route to it (fig. 20–22).
4. Determine goal of line: exposure protection, fire attack, personnel protection, etc.
5. Be sure the line will not endanger others.
6. Keep members out of doorway "flue."
7. Keep members at floor level, below dangerous heat levels.
8. Coordinate timing of ventilation.
9. Be the eyes and ears of attack team.
10. Supervise the nozzle operator.
11. Call for relief when necessary.
12. Be responsible for the lives of the team.

Fig. 20–22. Here the engine officer directs the nozzle operator.

Nozzle operator duties in the stretch. There is a variety of ways to pack hose and an equal variety of methods get hose off the engine and to the fire. Described here are basic, universal skills that can be slightly modified to meet your department's specific attack line hose load. These are skills that will serve you and your company and department well if you learn, practice, and maintain them at a high skill level. In fire department terminology this is called **stretching the line**.

Nozzle operator duties

1. Carry the nozzle and the first 50 ft (15 m) of hoseline.
2. Work under command of the officer.
3. Know your department SOPs.
4. Get information from the officer.
5. Stop and wait for the backup position to shoulder the assigned hose.
6. "Bleed" air at door, check the flow, don facepiece.
7. Communicate with the officer and backup position during stretch and advance.

The nozzle operator is responsible for the first 50 ft (15 m) of hose, that is, to remove it from the engine or pumper and carry it to the point of attack (fig. 20–23). This length of hose is called the working line or lead length. It is the hose you will advance into the fire area with to kill the fire.

The nozzle operator shoulders the first 50 ft (15 m) of hose and carries it toward the fire. While moving toward the fire, an important step is to stop and wait for the backup position to shoulder his or her amount of hose. The nozzle operator should stop about 40 ft (12 m) away from the engine and wait just a couple of seconds for the backup position to grab the hose and carry it from the engine (fig. 20–24). Now moving together, you and your backup are stretching the initial attack line! If this is a 200-ft (60-m) preconnected hoseline, then you are carrying 50 ft (15 m), there is about 50 ft (15 m) between you, the backup is carrying 50 ft (15 m) and he or she is dragging the remaining 50 ft (15 m) off the engine. Properly executed, you two can stretch 200 ft (60 m) of hoseline (fig. 20–25).

Fig. 20–23. The nozzle operator has the working length on his shoulder and is moving away from the engine.

Fig. 20–24. The nozzle operator must wait a few seconds for the backup position to shoulder the load of hose. These few seconds will save a lot of time in the overall stretch.

Fig. 20–25. The door position clears the bed of any remaining hose, or if the load is not preconnected, will determine how much hose is needed and connect it to the pump discharge.

The **point of attack** is the point at which you as the nozzle operator will drop your working length, flake it out, and request to your officer that the line be charged with water. This is termed **calling for water**.

You will have to use your size-up observations to determine where to drop your working length. In this case, because you don't know exactly where the fire is behind the front door, you will charge the line just outside the door.

Preparing to charge your line requires you to flake out your working length (fig. 20–26). Dry hose can be literally thrown to allow water to flow through it easily and to minimize kinks that can reduce water flow and pressure.

Fig. 20–26. The nozzle operator and backup firefighter flake out their line in the direction of their advance.

It is at this point that you don your facepiece from your SCBA (figs. 20–27 and 20–28) and await the water in the line. When the hose is being charged, open the nozzle to allow the air that is trapped in the hose to bleed out. When the line is solid and fully charged with water, flow the nozzle fully to ensure that the pump operator has given you adequate pressure and volume of water. If you only open the line a small squirt, that is all you know you have, a small squirt. Flow the line for about 10 seconds to be sure you have full flow, correct pressure, and pattern selection for combination nozzles.

Fig. 20–27. Firefighters don their hoods and facepieces. Note they are holding their helmets between their knees so they don't get kicked around or lost.

Fig. 20–28. Firefighters must be able to don SCBA facepieces and hoods with gloves on. This reduces the preparation time needed to attack the fire and prevent injuries. Firefighters must learn to conduct all necessary actions (full escape, reduced profile maneuver, etc.) with gloves on. Burned hands cannot help you save your own life.

All the while you are stretching, flaking out, and advancing the line, you should be listening for a variety of things on the fireground. First, you should be listening to the radio to hear that coordination has been done for ventilation and that it is being planned or accomplished. Listen for the sound of glass breaking and/or the ventilation saw running. Good, timely ventilation will reduce the possibilities of flashover and backdraft that could injure or kill you. Listen also to reports from the search and rescue teams. Ensure that you will not push fire or superheated products of combustion onto them, causing injuries, burns, or death.

Listen for the sound of the line as you operate the line inside. The sound of the line will indicate if the stream is bouncing off the walls or ceilings. The sound will also indicate openings like doors and windows and also holes in floors.

Backup position's duties in the stretch

1. Second firefighter in stretch.
2. Carry second 50 ft of line and drop it at appropriate time and place.
3. Communicate with nozzle operator.
4. Relieve the nozzle reaction for nozzle operator during the advance.
5. Watch the nozzle operator's body and head positions during the advance.

FFI 5.3.10 The backup is the second firefighter in the stretch, responsible for carrying 50 ft (15 m) of hose and dropping the hose as the line is laid out (fig. 20–29). The door position drops his or her line first. Like the nozzle operator, door position must be continually be evaluating the position of the engine relative to the fire building location. From this observation, door position will determine where and when he or she will drop the length and assist in the stretch.

In our example, the point of attack is going to be at the front door. The backup firefighter will drop the hose and flake it out in a position such that it does not kink and allows for an easy advance into the fire area if the 50 ft (15 m) of working hose the nozzle operator has is not enough. Once the backup position has flaked the hose out so that it will not kink, he or she should quickly move toward the nozzle operator and assist him or her in flaking the line and preparing to attack the fire.

The primary responsibility of the backup firefighter is to relieve all the nozzle reaction from the nozzle operator. As water is discharged and flowing from the nozzle, an equal and opposite reaction is realized by the nozzle

operator. This is called **nozzle reaction**. Generally, the higher the nozzle pressure and greater the flow, the greater the nozzle reaction. During the advance into the fire area, the backup position must push the hoseline forward to counter this nozzle reaction so the nozzle operator does not tire and continues to advance and attack the fire.

Fig. 20–29. The backup position, moving in conjunction with the nozzle operator, carries one length of hose.

Each member should be able to carry approximately 50 ft (15 m) of hose and drag the same amount, allowing them both to efficiently stretch 200 ft (60 m) of hose. In our example, the point of attack will be at the front door. The backup will drop the hose and flake it out so that it does not kink. This will allow for an easy advance into the fire area if the nozzle operator's 50 ft (15 m) of working hose is not enough (fig. 20–30). Once the backup's hose is flaked out, the backup should quickly move toward the nozzle operator to assist in flaking that line and preparing to attack the fire.

Fig. 20–30. The backup position drops the hose first, allowing the nozzle operator to continue the advance to the fire.

Door position duties in the stretch. The door position is the third firefighter in the stretch. In our example, the door position is responsible for making sure that the preconnect bed is clear of hose, following the line quickly to remove any kinks, and feeding hose to the nozzle operator and the backup firefighter.

As the officer, nozzle operator, and backup position prepare to advance into the fire, it is important that the door position be very mobile (move back and forth along the line) and ensure that there are no kinks in the hoseline and that he or she can quickly supply the team with the amount of hose they need to advance to the seat of the fire.

Third person in stretch clears preconnect bed (fig. 20–31), carries the last 50 ft (15 m) of line toward the fire, chases kinks, feeds the line from edge of the fire area outside the "immediate danger to life and health (IDLH)" atmosphere, can relieve the nozzle operator, backup firefighter, or officer, because the third person has conserved air by being outside of the IDLH environment. The third firefighter also has a safety link to outside, and knows how far and where the team has advanced

Fig. 20–31. The door position makes sure the hosebed is clear of all hose during the first part of the stretch.

When the nozzle operator advances into the smoke, the door position must be careful to push just the right amount of hose to him or her. Since the line is rigid, the door position can push the nozzle operator into areas he or she may not want to go or push the nozzle out of his or her hands. A good technique is to push up a bow of hose onto a door frame or wall and allow the backup position or nozzle operator to pull it in as needed. This causes less physical exertion on them and provides hose only when needed, and doesn't push into dangerous areas.

The door position is responsible to see that every foot of hose needed by the nozzle team is provided to them so they can control their advance (fig. 20–32).

Fig. 20–32. One of the door position's responsibilities is to keep the hose advancing. This may require him to move hose around objects that snag the line. These include car tires, fence posts, trees, door frames, and saddles.

Advancing charged hoselines

Officer duties during the advance. The officer will be the eyes and the ears for the nozzle operator. Often the stream blocks the view of the nozzle operator. The company officer can be off to the side of the nozzle operator and provide a better view of the progress of the fire attack, for example, if the stream is hitting the desired target. As the officer controls and monitors the progress of the company, the officer has two hands free to send important radio transmissions and other important tasks. The officer will monitor the level of fatigue for the company and request additional firefighters, companies, or hoselines to assist if required. The officer's other duties include pulling the company out when possible as they become less combat effective. Tired firefighters are dangerous firefighters and are prone to injuries. In the end, it is the company officer who is responsible for the overall safety and accountability of the company members.

Nozzle operator techniques during the advance. There are a variety of ways to position yourself when you advance. There is no right way, and it is important to note that you may use many or all of these during your advance into the fire area until final extinguishment. Fatigue, speed of fire control, and other conditions will determine your speed of advance and subsequent positions while operating or backing up the nozzle operator.

In figure 20–33, the nozzle operator demonstrates good technique, with the nozzle out in front at about arm's length where he can rotate it around and distribute the water into the fire room. He has it under his armpit, using the large muscles of his shoulder to hold it. His right elbow is braced against his knee to help counter the nozzle reaction.

Another nozzle operator position that provides a great deal of stability while advancing is demonstrated in figure 20–34. It allows the nozzle operator flexibility to direct the stream in almost any direction and to move in quickly when necessary. This position provides a great degree of overall flexibility, allowing one leg to be out in front confirming that the floor is safe. The knees can be switched to allow the bunker pants insulation to cool and reduce the chance of burns. Having only one knee on the floor instead of both reduces, by 50%, the chance of contacting nails, hypodermic needles, and dangers such as broken glass on the floor.

The two-knees-down method has the following disadvantages: It does not allow for rapid movement of the nozzle inward toward the fire, or for the firefighter to feel to see if the floor is intact ahead. Also, the thermal insulation in the knees of the bunker pants is compressed and can lead to painful burns if the floor is hot, if the floor covering is melted or was burning, or if hot water soaks through. Also note that the backup position is holding the hose too high, causing the nozzle operator to fight the spring action of the charged line (fig. 20–35). Firefighters should consider the charged line a solid pipe from the nozzle back 12 ft (3 m). Keeping this "pipe" straight will reduce fatigue on both the nozzle operator and the backup position.

The backup is a key position in the aggressive interior fire attack (fig. 20–36). The backup takes a firm grip on the hose and pushes forward to relieve all the nozzle reaction. This makes the nozzle operator's job much easier and more effective. The backup position can also use an alternate grip to relieve the nozzle reaction to assist the nozzle operator (fig. 20–37).

Fig. 20–33. Proper nozzle handling technique while stationary

Fig. 20–34. Proper nozzle handling technique while advancing

Fig. 20–35. Improper two-firefighter hose-handling technique while advancing

Fig. 20–36. Proper two-firefighter hose-handling technique while advancing

Fig. 20–37. Alternative two-firefighter hose-handling technique while advancing

The position in figure 20–38 allows the most rapid advance and provides a high degree of safety for the nozzle operator because both knees are off the floor. It puts the nozzle operator in a little higher position, which helps detect high heat levels that may precede flashover, thereby preventing advance into deadly conditions. Being higher also allows the backup to be in better position to relieve the nozzle reaction. This position is favored by experienced nozzle operators.

Fig. 20–38. Alternative nozzle position hose-handling technique

As the advance begins, the nozzle team must remain low in the door (fig. 20–39). This will allow the smoke and heat to vent over their heads as they enter. Some experienced firefighters have professed that you should wait to see what the smoke does when the door is initially forced. The theory is that after the door is forced, if the smoke gets drawn back in, this may be a warning sign of backdraft. This is potentially difficult to see as it may be

caused by the natural convection of air into the fire area. Remember the warning signs of backdraft, and look at what the smoke is doing before you force the door. Smoke is always a reliable indicator of the fire condition when you learn to read it.

Fig. 20–39. The hose team needs to stay low as they make entry to the fire building.

As you enter the structure, move into the room and out of the door opening. When you operate the stream, rotate the nozzle and listen to the sound of the water splashing off the ceiling, walls, and the floor. The sound will indicate any openings, including windows, doors, and holes in the floor (fig. 20–40).

It is important to remember that the hoseline will be charged with 50–100 psi (350–700 kPa) of water pressure. When the line is first charged, it will quickly straighten out. Hold it firmly and crack the nozzle to release the air. Flow the nozzle at full volume to ensure that you have proper water pressure and volume. If you crack the nozzle and release a squirt, you only know that you have a squirt, but you need to know you have full volume.

Fig. 20–40. Sweeping the floor with the line will wash debris away from you; this can be any type of hazard, whether biological, sharp, or other. Sweeping the floor will also cool the floor, reducing the potential for burn injuries.

Water hammer. The hoseline is pressurized, and when the nozzle is open the water has significant velocity as it flows through the line and nozzle. Always open and close the nozzle slowly to prevent water hammer. Water hammer is pressure that is created when a flow of water is rapidly stopped and the pressure is redirected to the path of least resistance. Water hammer can increase pressure by as much as six times the pressure contained in the hose. This obviously can cause a burst length or damage to the pumper and other appliances.

Door position duties during the advance. The door position is the third member of the engine company and has an important role in the advance of the hoseline (fig. 20–41). The door position remains at the door during the advance and is responsible for chasing kinks from the door outward and supplying hose as needed by the nozzle operator and backup position.

The door position must be careful not to push in too much line because it will kink or could push the nozzle team into areas where they do not want to go.

Figures 20–42 and 20–43 show good techniques that the door position can use to supply the appropriate amount of hose to the nozzle team.

Fig. 20–41. The door position assists in the advance by feeding line in from just outside the fire area. He tries to maintain a full tank of air so he can assist and relieve the nozzle team when they become fatigued.

Fig. 20–42. Making a loop of hose on the floor allows the nozzle team to advance quickly and easily.

Fig. 20–43. Putting a loop of hose up on the wall allows the nozzle team to very easily pull the hose in as they move down the hallway. This is not always possible but is an excellent method.

The well hole stretch. This is a special type of stretch commonly used in older apartment buildings. It can be used whenever you encounter a well hole in the stairwell. The well hole is the space between the stairs and the edge of landing of the public hall in a multiple dwelling. Using the well hole will reduce the number of lengths required in the stretch, speeding the stretch and reducing friction loss (fig. 20–44). On average, one length of hose will reach from the base of the stairs to the fifth floor.

After dropping the folded hose at the base of the stairs, the second firefighter will proceed up the stairs, assisting with the stretch. When sufficient hose has been hauled up to the point of attack, the line must be secured by hose straps to the railing before the line is charged. When the line is charged, there is a possibility that the weight of the water could cause the line to fall back down the well. Having sufficient line at the point of attack cannot be overstressed. When the line is secured and charged, it is extremely difficult to haul up more line.

Additional firefighters can assist in the stretch, making sure that enough line has been brought into the building and properly flaked out. When the line is charged, they can chase kinks as they move up on the line.

If the well is wide, the nozzle operator may opt to carry a length to the drop point before hauling the line up the well. If a second line is required to be stretched up the well, the nozzle operator has no option but to take only the nozzle up the stairs. When advancing the line up the stairs, the nozzle operator must pass the second line

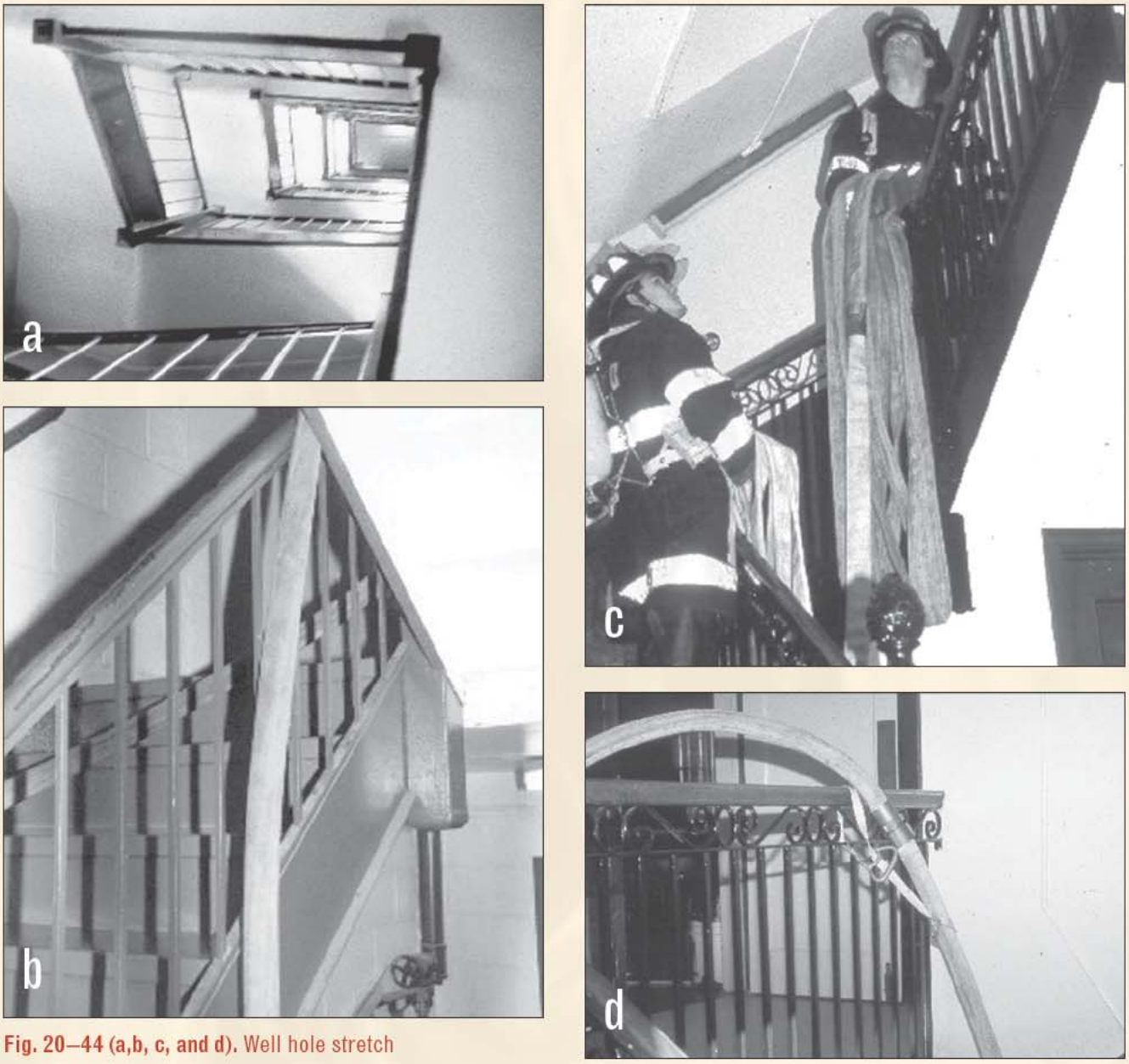

Fig. 20–44 (a,b, c, and d). Well hole stretch

around the first to prevent the two lines from becoming twisted around each other.

Often companies will store utility ropes in empty bleach bottles or other plastic jugs to facilitate rope stretches or hauling tools to the roof. If the well is wide enough for the jug to fall down it, a utility rope stretch can be used to get the first or the second line up the stairs.

Standpipe stretch. Standpipe stretches are another type of important stretch. Standpipe systems are covered in greater detail in chapter 30, Fire Protection Systems, but is also covered here as an introduction.

Simply put, a standpipe system is a fixed set of water supply piping with hose valves that is typically installed in high-rise and large area buildings. Standpipes avoid the necessity of stretching hose all the way from a fire engine in the street to a remote part of a building; firefighters simply attach their hand line to a hose valve close to the fire area to attack the fire. The standpipe system is usually pressurized with water (but not always); a fire department connection (FDC, also known as a "Siamese") at street level allows firefighters to pump water into the system to supplement it. In a high-rise, hose valves are most often located in the stairwells.

Operating hoselines from standpipe systems can be challenging. It requires close coordination on many levels to be not only safe but also effective. It requires the pump operator on the street to supply the correct pressure to the system for the floor the nozzle will be operating on. Simple friction loss calculations don't apply. It is important to coordinate the efforts of the firefighter at the floor outlet where the line is hooked up who maintains the correct pressure and an experienced nozzle team that ensures the nozzle is flowing properly.

Whenever a hoseline is stretched from a standpipe outlet, a pumper must supply the FDC to ensure an uninterrupted water supply. The hookup location must be out of the IDLH environment and never run the risk of being exposed because if there is any problem with the line, the firefighter controlling the outlet must be able to make corrections without the stresses of heat and smoke. The closest location that satisfies both criteria is often an enclosed stairway on the floor below. That stairway should be designated the **attack stair**, and all firefighting efforts should be started from that stair. If building occupants can be alerted of this stair's designation, escaping occupants can be directed to an **evacuation stair** and thus will not be subjected to heat and smoke.

When the hookup site is selected, based on fire conditions, closest to the fire and providing access to the fire area, sufficient hose must be brought to the location. In addition to lengths of hose, a standpipe kit is required. This kit must consist of items to facilitate the hookup with some contingencies. When operating from standpipes, the apparatus can be many floors away, so a complete kit can save a great deal of aggravation.

Some equipment that may be necessary in the kit includes, but is not limited to, a pipe wrench large enough to remove stubborn caps or pressure-reducing devices; spanner wrenches to tighten hoselines, to prevent excess water from accumulating on floors and creating slip-and-fall hazards or unnecessary water damage; and any specific adaptors that may be required for your location (fig. 20–45). Often adaptors are required to convert from pipe thread to hose thread or between municipal threads. Door chocks are always useful when stretching lines, and they take up little room and add little weight to the kit.

Every standpipe kit must include either a pressure gauge or flow meter to ensure that the correct pressure or flow is being supplied to the line. A firefighter must hook up the gauge after the standpipe has been tested, so that any debris flushed from the pipe does not damage the gauge. A firefighter must be positioned at the outlet when the attack begins to make any corrections to pressure or flow when water is flowing. If available, this firefighter should remain in this position in the event of an emergency, burst length, and so forth.

Fig. 20–45. Standpipe kit showing different components

Once the hookup has been made and the fire attack is to begin, charge the line and bleed the line as you would at any other fire operation (fig. 20–46). But when stretching from a standpipe, a final check of the stairs must be made before the door to the fire area is opened. Occupants' floors above the fire will be exposed to the toxic smoke. *A fire attack must never be commenced with civilians above the fire floor in the stairwell.* If a firefighter is available to be posted as a sentry on a floor above the fire floor that provides access to the other stair, this firefighter can remove any occupants from the attack stair to the evacuation stair.

Fig. 20–46. Hoseline attached to a standpipe Siamese connection

When the door opens and the line is advanced in to the fire area, firefighters will be needed to advance the line down the hall. Flaking the line up to the next landing in the stairs will aid in the advance due to the weight of the line being pulled down the stairs.

Buildings that require standpipes are typically office buildings, high-rise apartment buildings, and "projects." They are built of steel and concrete, and the combination of the two will produce some of the hottest fires you will ever feel. Exacerbating the situation, these buildings have limited means of ventilation. These "brick ovens" will require a skilled team of firefighters with knowledgeable leadership to extinguish the fire and reduce injuries.

Methods of aggressive interior fire attack. There are four methods of structural or aggressive interior fire attack: combination, indirect, direct, and modified direct (as described in chapter 16, Fire Streams). Note that before an interior attack is initiated, several factors must be considered. Here are a few basic thoughts to consider:

Is the building safe to enter? Advances in lightweight construction have resulted in buildings that simply will not tolerate a fire load and will collapse rapidly, trapping and killing firefighters.

Heavy fire in any building should be carefully analyzed before firefighters are committed to entering the building and attempting an aggressive interior fire attack.

Are there salvageable human lives inside the building? "Risk a lot to save a lot; risk a little to save a little" is something a wise old fire officer once said. If fire is blowing out of every window in the house and through the roof, the odds of someone surviving are near zero. Firefighters are occupants also, so we must be careful not to unreasonably endanger the "new occupants" (firefighters) if the old occupants are already dead.

Similarly, if there is a reasonable chance that we can make a rescue, and we are not assured that everyone is already out of the building, a search and rescue operation is the key event at this fire. It is of the utmost importance to recall that trapped occupants cannot wait until the fire is extinguished to be rescued. After the fire is out, this operation is in fact a recovery (of a dead body), not a rescue operation.

Is there any property left to save? We don't have to get inside on every fire. Consider the outcome of many fires: heavy fire upon arrival, firefighters make an aggressive attack, one or more firefighters die or are injured, the fire is extinguished, and the insurance company pays huge sums of money so the building is built back better than it was before!

The point is this: We must take risks on the fireground to save lives and property. We must ensure that these are manageable and reasonable risks for ourselves and our members.

Recall that the doctrine for aggressive interior fire attack generally follows this sequence: Truck company members or other firefighters will force entry into the building to conduct search and rescue operations. Engine company members will establish a reliable water supply and stretch a hoseline to fire building to the seat of the fire or between the victims and the fire. Other truck company members will ventilate the fire building just before the engine crews push in to attack the fire. Officers will plan, direct, and coordinate these actions. Because firefighters will enter the building before water is applied, and the fire is at its most dangerous time (it now has an unlimited amount of oxygen causing it to grow unchecked), rapid, aggressive, and proper fire attack operations often will make the difference between life and death for other members inside. It can be argued that nothing is more important than extinguishing the fire because it minimizes all other hazards on the fireground.

Modified direct method of attack. The modified direct method of fire attack is the most common type of attack used. It is used when the fire has gone through the flashover phase or extended beyond one room to several rooms or fire areas, heavy smoke has obscured visibility, and/or conditions are impossible to make a direct attack (fig. 20–47). The room may literally be filled with fire from floor to ceiling. A good sign that these conditions are present is fire pushing out a door or window or heavy smoke throughout the fire area (fig. 20–48).

Fig. 20–47. This room has gone to flashover. The chair on the left and sofa on the right are fully involved almost to the floor level, and flames fill the entire room from floor to ceiling. Ceiling temperatures reach 2,000°F (1,093°C) or more.

Fig. 20–48. Heat from flashover will force firefighters to the floor and make conditions impossible for firefighters to operate in until the fire attack begins. Turnout gear will become saturated with heat and not protect you from flashover conditions. The modified direct attack will help cool the atmosphere and extinguish the fire, allowing firefighters to enter, attack the room, and move through to the next room or fire area.

When these conditions are present, the modified direct method of fire attack (as described in chapter 16, Fire Streams) is the most appropriate. This is an aggressive interior fire attack. The nozzle operator operates the nozzle in a straight stream or "zero degree fog" position if using a fog nozzle. Preferably, a smooth bore nozzle would be used for this type of attack.

The nozzle operator directs the stream in circles, starting at the ceiling level and moving the nozzle in a clockwise or side-to-side motion. The water bounces off the ceiling and is broken up and distributed in large drops of water that hit the burning fuel and extinguish it. The nozzle is rotated around, and the fire stream will directly hit the burning fuel (direct attack effect). This water will also cool the ceiling and walls. This reduces the heat that is radiated back into the room. It also helps cool the upper atmosphere in the fire area.

Note that cooling the fire area does not extinguish the fire. By cooling the room, in effect, you are treating the symptom (heat) and not the disease (fire). The large water droplets that are bounced off the ceiling and land on the burning fuel are large enough to extinguish that bit of fire, which contributes to the overall extinguishment process.

The nozzle operator uses the reach of the stream to put water on the fire, not only to first control some of it, but to see how the fire was going to react to the application of water. Live electrical circuits, flammable liquids, and **water-reactive chemicals** in the room may react violently with the application of water. Better that this happens when the nozzle team is outside the fire area rather than in it!

FFI 5.3.12 There are several important facts to understand when using the modified direct method of attack. According to The United States National Institute of Standards and Technology (NIST) report NBSIR 80-2120, *Fire Development in Residential Basement Rooms,* tests that were conducted utilizing 16 full scale burn tests of living room fires resulted in ceiling temperatures reaching 2,000°F. The room you are entering to extinguish the fire has very dangerous products of combustion near the ceiling that you do not want near you. It is therefore vital to maintain the thermal balance of the fire room during the attack (fig. 20–49).

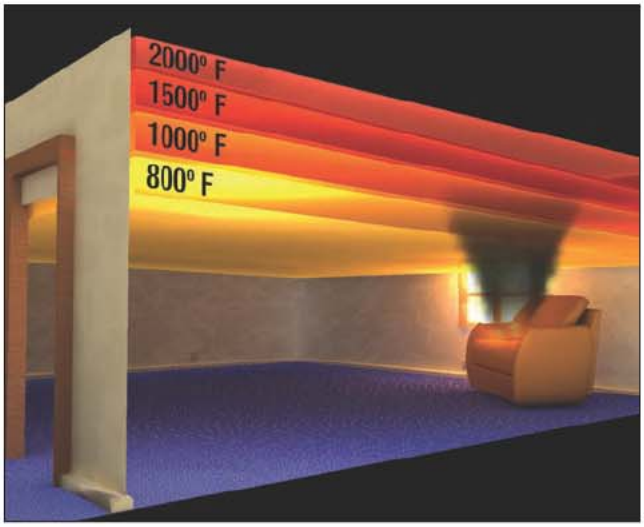

Fig. 20–49. Thermal layering simply means that the hottest air is in higher levels of the room, and cooler air is in the lowest level, near the floor.

Nozzle choice for modified direct attack. The most proven fire stream (and the safest for firefighters) for interior fire attack is a solid stream from a smooth bore nozzle or a combination nozzle set to a straight stream pattern from a fog nozzle.

Because of the dangerous conditions inside during a modified direct attack, it is important to choose the correct nozzle and stream pattern. Since we are inside during the combination attack, it is important not to disturb the thermal balance that the fire has established. In essence you want to leave the bad (superheated) air up and away from you and keep the good (coolest) air down near you at the floor level.

The modified direct method of attack pits us against a fully involved fire inside the fire building where it is the most dangerous. Using a straight stream from a fog

nozzle or a solid stream provides us the most fire-killing power and the least danger as proven by both experience and laboratory testing.

All fire streams will move air into the fire area as a result of their water movement. Firefighters usually enter through a door directing the stream into the fire area. Thus there is an unlimited amount of air that can be pulled into the fire room or area.

From actual air measurements, we know that a straight stream or solid bore nozzle will move about 725 cubic feet per minute (cfm) (20.5 cubic meters per minute [cmm]) into the fire area. This small volume of air can be adequately vented via a window or door ahead of the nozzle team. The result is that the thermal balance in the room where firefighters are operating is maintained as much as possible. The hottest air remains at the ceiling, and the coolest remains at the floor.

Maintenance of the thermal balance allows firefighters to move through this room that has just been extinguished and into other fire involved areas.

Fog streams: combination and indirect attacks. If you choose a fog nozzle and select a spray or fog pattern, huge amounts of air will be drawn into the fire area. In tests conducted at the Rockland County, NY, Fire Training Center, air volumes of 2,000 cfm (57 cmm) (were measured when a fog stream was used. Estimates of air moved range as high as 6,000–10,000 cfm (170–283 cmm) from 1¾-in. (45-mm) fog nozzles. The 30°–60° fog pattern from a combination nozzle moves so much air into the fire area that it completely disturbs the thermal balance.

It is also important to remember that liquid water expands into steam at an expansion ration of 1,700:1. This further mixes and pressurizes the fire room and its superheated air and smoke.

Use of fog or spray patterns inside for an aggressive interior fire attack is dangerous for another reason: the massive amounts of steam they create. The water droplets are a much smaller size and therefore provide a greater surface area to absorb heat from the fire. To the inexperienced this seems to be a good characteristic. However, the reality is that once the heat is absorbed by these small water droplets, they turn into steam, vastly increasing their volume and adding to the **overpressurization** of the room. More importantly, this steam is stirred up by the air movement returning to the nozzle and backup position, which may burn the backup position and prevent advance into additional rooms of unchecked fire.

Since these small drops of water were vaporized, they did not make it to the burning fuel to extinguish the fire. Although the symptom (heat) was partially removed, the fire (disease) continued to burn, spread, and threaten occupants' (civilians' and firefighters') lives.

A particular hazard created by fog streams when used for interior firefighting is that they can actually push the fire with the massive amounts of air they introduce. These streams can drive fire into void spaces (walls, ceilings, and truss spaces). They can also drive fire from one room to another or through an entire building, much like a poorly placed ventilation fan. This is possible because the reach of the fog stream is very limited. The limited reach, coupled with the massive air movement, results in fire being moved throughout the building because the water does not reach the seat of the fire. Often firefighters do not know the full extent of this disastrous effect because it is often concealed by smoke and steam.

A similar and equally dangerous effect created by fog nozzles when used inside a fire building is that if a nozzle team inadvertently moves down the hall past a room of fire, then operates a fog stream, it is very likely that the fire and superheated products of combustion will be drawn back onto the attack team, creating the potential for injuries and cessation of the fire attack (fig. 20–50).

Fig. 20–50. Firefighters have disturbed the thermal balance with a fog stream inside causing superheated steam to envelope them, creating the potential for injury and stopping the fire attack in the first room.

Further confusing the issue is that a fog stream appears to be a very successful technique for firefighting, especially from the nozzle operator's limited point of view. Holding the fog nozzle, you have a wall of water in front of you. The water spray leaving the nozzle, usually at 100 psi (700 kPa), makes considerable noise and nozzle reaction. Essentially the nozzle operator is fooled into thinking there is a significant strategic weapon in his or her hands.

LESSON LEARNED

We responded to a garden apartment that had fire blowing out one window. The assistant chief told me to take the nozzle and move into the left. After several attempts at operating a fog pattern in a circular motion, and with the heat increasing each time, we retreated. We found that we were drawing superheated air from the room adjacent to us. We did not make the sharp turn into the fire room, and our fog stream pulled fire onto us from the next room.

Additionally, when demonstrating the use of fog nozzles in a parking lot, the fog stream appears to provide protection from the fire by the massive amount of air that is moved past the nozzle operator toward the fire area, thereby "pushing" all the dangerous heat and smoke away from the operator. This "parking lot experience" is in fact exactly the opposite of what happens when a fog nozzle is used inside, as described earlier in the nozzle selection section.

A myth developed that you can "breathe off the nozzle" if you put your face close to the stream. Used frequently before SCBA became a part of our personal protective equipment, air was available here because it was being drawn in from a clean air source behind the nozzle team. Some firefighters even incorrectly believed that oxygen was being broken off the water molecules. If this were true, the remaining hydrogen atoms would have created a very explosive condition in the fire area.

The fog stream in reality has little reach and penetration to reach the seat of the fire. Many a nozzle operator and backup position have been burned by using a fog stream inside a fire room.

It is important to understand the limits of a fog hand line and its dangers for interior firefighting. Do not base your fire attack strategy and techniques on your experience with one-room fires or parking lot experience.

The fog streams of the indirect and combination methods of fire attack (described thoroughly in chapter 16, Fire Streams) prevent firefighters from entering the compartment/building for search and rescue. Recall that the indirect method of attack was developed for shipboard firefighting where no one was occupying the cargo hold areas. The combination method is an extension of the indirect method, with a rotating fog stream in a compartment. The indirect and combination methods doom anyone still inside to certain death by scalding steam and toxic products of combustion. It also allows fire that the steam cannot reach in void spaces to continue to grow and spread unchecked.

YOU ARE HERE

1. Size-up
2. Strategic plan
3. Establish water supply
4. Force entry/exit
5. Search and rescue
6. Fire attack
7. **Ventilate**
8. Protect exposures
9. Fire control and overhaul
10. Pick up and return

Ventilate the fire building

FFI 5.3.11 Ventilation is often described by experienced firefighters as the key to success for any aggressive interior fire attack operation. If ventilation is performed in the right place at the right time, it allows the engine company to rapidly advance on the fire and extinguish it, which will minimize all other problems on the fireground. Ventilation, or opening up of the fire room or building allows the products of combustion, heat, and smoke to exit the building, raising the thermal layers, raising the smoke layer, increasing visibility, and decreasing the potential for flashover. See chapter 14, Ventilation, for a detailed explanation of ventilating different types of buildings. There are four types of ventilation: horizontal, vertical, positive pressure, and hydraulic ventilation.

Horizontal ventilation. As its name implies, horizontal ventilation consists of using or making horizontal openings (doors or windows) to ventilate the fire area or building. Horizontal ventilation will provide more efficient venting when doors and windows are opened opposite the advancing hoseline. The hoseline can drive smoke and heat from the building through the horizontal openings. A single firefighter with a tool (hook, pike pole, Halligan, or portable ladder, depending on whether it's a first- or second-floor fire) can create a great deal of ventilation (fig. 20–51).

Fig. 20–51. a) Horizontal ventilation is most often accomplished by removing windows. b) When ventilating a window, remove all glass, screens, curtains, shades, and blinds. Remove the window sashes as well, so firefighters can escape quickly if necessary (make a door out of a window). (Courtesy of Tom Bierds and Brian Duddy)

Vertical ventilation. Vertical ventilation is the opening of a hole in the roof to allow the products of combustion, smoke, and heat to leave the building via the newly created opening. As with horizontal ventilation, vertical ventilation will allow the products of combustion, heat, and smoke to exit the building, raising the thermal layers, raising the smoke layer, increasing visibility, and decreasing the potential for flashover. The purpose is the same; the tactic is different (see fig. 20–52).

Fig. 20–52. Vertical ventilation

If fire has penetrated the attic space due to failure of the gypsum board ceiling or walls, opening the roof will draw the fire through the opening instead of allowing the closed up roof to cause the fire to mushroom and spread horizontally inside the attic (fig. 20–53).

Coordination of the venting is required. As the line is charged and is moving into the fire area, the windows should be removed. Venting prior to that can cause the fire to increase in intensity. This could cause more damage to the building, thus increasing our fire problem or causing more injury to the victims who may still be inside.

In figure 20–54, truck company members have done an excellent job by cutting the roof allowing smoke and heat to escape. This prevented the fire from spreading into the main part of the house. When possible, ladders should not be positioned over windows. If fire erupts out these windows, firefighters could be trapped on the roof. In this case firefighters could escape safely with a short jump to the ground level.

Fig. 20–53. Fire drawn up through vent hole. (Courtesy of Tom Bierds)

Fig. 20–54. Firefighters exit the roof after successfully venting the fire.

Positive pressure ventilation. Positive pressure ventilation (PPV) is generally considered to be the use of large fans (upwards of 30,000 cfm [850 cmm] for typical PPV fans), positioned outside the building to create an increased or positive pressure inside the building (fig. 20–55). These large-volume fans force clean air from outside the building through the building and drive contaminated air outside via a second ventilation opening. For many years firefighters used smoke ejectors, which were smaller fans (10,000 cfm [283 cmm]) to create a suction or negative pressure from inside the building to move contaminates from inside to outside the building.

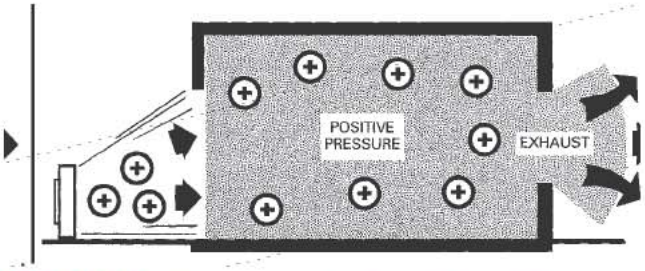

Fig. 20–55. Positive pressure involves placing a blower outside a room to force pressurized air inward, driving contaminants to the exterior.

PPV is very effective and can be used on small structures or very large commercial structures, high-rises, and other large buildings. The effectiveness of PPV comes from the basic physics principle that one only needs to increase the pressure a small amount to create an air flow in the direction desired.

There are two main ways to successfully use PPV. First, the fan can be positioned by the front door before the fire attack commences. The theory behind this use is that it will force heat and contaminates out as firefighters move in with the hoseline. Many fire departments use this method, while others prohibit it during fire attack. The obvious danger to this is that the increase in air supplied to the fire causes the fire to grow very, very rapidly and also be driven into voids and concealed spaces as well as *at* trapped victims. Additionally, if the fire does grow rapidly, it can cause firefighters to be trapped and killed. *Extreme caution must be exercised when using PPV during a fire attack.*

Another successful application of PPV is to position the fan after the fire has been knocked down to blow out contaminates—heat, visibility, and toxic gases—in order to improve conditions so firefighters can conduct overhaul operations (fig. 20–56). This has proven very successful in many fire departments. The danger of this tactical use of ventilation is that firefighters must be sure the fire is sufficiently under control, to prevent the building from "lighting up" because of the introduction of fresh air (rapid fire growth), creating danger for firefighters inside.

Fig. 20–56. A PPV fan placed at the front door will drive smoke and heat out horizontal ventilation openings created by firefighters. By controlling what windows are opened and closed firefighters can control the air flow through the building ventilating specific rooms as needed.

PPV has significant applications, especially in high-rise buildings, where it can be used to pressurize stairwells and keep them smoke free for occupants to escape through. By opening doors on specific floors, entire floors can be positively pressurized and cleared or kept clear of smoke and products of combustion.

Like all tools in the fire service, PPV has to be used under the right conditions, at the right time and as part of a fire attack system. There are no magic bullets in the fire service.

Communications. Fireground communications are critical to this ventilation. The firefighter assigned to vent should be listening for the engine officer to order the hoseline charged. This should serve as a warning that they will be ready to move in shortly. If any doubt exists about when to vent, ask the officer directly. The FDNY has a written procedure that only the ladder company officer can order horizontal ventilation of the fire area. This ensures that members in an apartment are not exposed to the increase in fire from premature venting.

YOU ARE HERE

1. Size-up
2. Strategic plan
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8. **Protect exposures**
9. Fire control and overhaul
10. Pick up and return

Protecting exposures

FFI 5.3.10 Confine, then extinguish is the overall strategy to limit fire spread. Protecting exposures is the first step in confining and limiting the spread of fire, and ultimately extinguishing the fire. Confining the fire essentially means cutting off the fire spread and not allowing it to extend to other areas or buildings.

Exterior exposures. An **exterior exposure** is a building that, left unprotected, will be ignited by radiant, convected, or conducted heat from the original fire building or room.

When a fire attack operation is going to be defensive, one of the most common goals of a hand line is exposure protection. Remember that this goes back to the main goal of firefighting—to confine and extinguish the fire. By confining the fire to the building on fire, you are protecting the exposure. Protecting the exposure may involve placing the hand line between the fire building and the exposure, in this case, the neighboring structure (fig. 20–57).

When officers order a line to be stretched for exposure protection, they must make it clear what the goal of the line is going to be. A large hand line or ground-based monitor will probably be in a fixed position outside. A large hand line may be advanced into the exposure to direct their stream on the fire building. These are important distinctions that must be clear to the firefighters on the line.

An important note: When selecting the exposure that needs protection, the rule is to protect the exposure with the greatest value, not necessarily where the fire is going to spread.

Fig. 20–57. A hoseline is positioned between the fire building and the exposure building to protect the exposed building. (Courtesy of Brian Duddy)

To properly protect this exposure, a large-caliber hand line should be positioned between the fire building and the exposure. In this way the line can be used alternately on the fire building and the exposure. Water is applied *directly* to the exposure; water should be applied at the top of the wall so that it will cool the surface of the wall as it runs off.

Further exposure protection may involve getting into the building and removing any curtains or drapes from the windows and any flammable materials that could ignite from the radiant heat. Operating a hoseline from the exposure is often a tactic. But in this case, because they are so close, that may not be appropriate since it might only allow smoke and heat to damage the structure.

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Fire control and overhaul

FFI 5.3.10 Once the fire has been knocked down (i.e., when all visible fire has been extinguished), it is important to let it blow. Letting it blow means allowing the heat and smoke vent from the building so that any unextinguished fire can be discovered. If a hoseline is operated too long, it will overcool the area and the smoke will not lift. When to shut down the line is generally an officer's decision. If the timing is left to the nozzle operator, be alert for changing conditions and the need to open the line again.

This may be a time when a hoseline can be used for ventilation. A hoseline set to a fog pattern, held 4–5 ft (1.2–1.5 m) back from the window and directed out, will move the heat and smoke out. The same may be accomplished with a solid stream nozzle; by taking the tip off and using a broken stream from the shutoff, similar effects can be felt.

At this point the members assigned to overhaul should be allowed into the fire area with their tools to open up the area and examine for extension.

The process of opening up means that the interior wall, ceiling, and other burned surfaces must be removed. The idea is to expose the concealed spaces behind them until the unburned areas are exposed (fig. 20–58).

Fig. 20–58. Opening walls and ceilings after the initial fire attack must be done quickly to search for hidden fire. Fire can travel undetected in void spaces and is a serious threat to firefighters. (Courtesy of Tom Bierds)

Once the walls, floors, or ceilings are open, the engine company can come back in and wash down any hot spots. The hoseline should be directed on any charred surfaces until they are cooled. Particular attention should be paid to the areas where structural members are attached. Where floors lay on beams and where boards are nailed together can hold heat and continue to smolder. These members should not be removed, but instead the stream should be directed to drive the water between them until completely cool.

Some of this work may be performed by relief crews from other companies. If the first units must perform this work due to personnel shortages, officers may allow the work to be performed without SCBA. Carbon monoxide levels must be monitored, and the physical condition of the firefighters must be the prime consideration in making this decision.

LESSON LEARNED

We responded mutual aid one night to a fully involved house. The chief met me on the front sidewalk of the involved home and directed my line to put water on the exposure. My line operating off tank water, which saved the home next door and was not wasted on the fully involved, nonsalvageable home.

YOU ARE HERE

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10. **Pick up and return**

Pick up and return

Generally, by the time we have made an aggressive interior attack on a working fire, we are all pretty well exhausted. Repacking hose and replacing ladders and tools now seems to take on a low priority. Resetting for our next alarm is, however, very important.

How well we reset and recover our equipment from this alarm may well determine how our company, or maybe even another group of firefighters, will perform next time. Like packing your own parachute, take time to do it right because lives—firefighters' lives—will depend on it.

When repacking hose, inspect it for damage. Worn jackets can indicate that the hose is compromised and may fail when pressurized. All firefighters should be familiar with their department's procedure for reporting damaged hose. If there is any doubt as to the serviceability of any length of hose, it must be tested before it is returned to service. Steps should be taken to prevent a damaged length from becoming mixed with serviceable ones.

Hose should be repacked when it is clean and dry. Mild soap and water is usually enough to clean the hose. Follow the manufacturer's recommendation and department SOP.

When the hose gets repacked, the important thing is not that it goes on but how it will come off. This has been compared to packing a parachute.

Tools. FFI 5.5.1 Preparing your tools for your next alarm is also very important. Hand tools should be inspected for damage, cleaned, and placed back in their proper places on the rig according to your company and department policies. There is nothing that looks less professional and competent than a firefighter going from cabinet to cabinet looking for a tool at an emergency.

Power tools such as saws need to be refueled, oiled, and sharpened if necessary. All blades must be inspected to determine whether the blade is the correct one for the saw, has the required teeth, and is in generally good condition. Damaged or worn blades and saw chains can be swapped out to put the saw back in service quickly.

SCBA also needs to be inspected, serviced, cleaned, and tested before you put it back on the rig. Remember that this is life-saving equipment that you or other firefighters will depend on at the next alarm. Be sure to read and comply with manufacturers' instructions for cleaning and servicing. Harsh cleaners and cleaning methods should never be used. Simply reading the directions and properly maintaining SCBA will save your life one day. Improperly maintained SCBA may result in your death.

After action review. Before you leave the scene, maybe even before you recover your equipment and repack hose and ladders, your officer should conduct the **after action review (AAR)**. The purpose of this informal review, often held on or near the back step of the rig, is to capture any lessons learned from this fire. It is a time to review what SOPs you used or deviated from, how successful the operation was, what actions you want to sustain because they were successful, and what actions you want to improve or change.

It is important to do the AAR as soon as possible because we all want to "sanitize" our memory of the fire. That is, we want to dwell on what we did well and forget what we did that was not so effective or sometimes even just incorrect. Remember, this is not a critique of the fire or firefighters! It is a time to review the scenario you pulled up to, the size-up (was it really what you thought?), the tactics and strategy used, and what unknowns made this fire unique. It is also a great time to praise actions that were appropriate or outstanding.

A good technique to conduct the AAR is to look for three things you did well and three things that you would change. Ask firefighters first for three "ups"—what they did right. Then ask for three "downs"—what they did wrong. Additionally, a great question to ask is: What would you do differently at the next similar fire? Often you will get answers such as: "Well, I did this and it worked OK, but this other technique may have been better." This kind of discussion is noninflammatory and fosters the concept of what could we have done better, not what did we do wrong.

Above all, remember this is an after action review, not a critique of personal actions. In the end, it should help share information and develop the team, not criticize individual actions.

SCENARIO: FIRST FLOOR FIRE IN A ONE-AND-A-HALF-STORY HOUSE

Here are the details of your fire scenario:

This scenario assumes that you are familiar with your rig or apparatus (engine or truck) and its hose loads, ladders, hand tools, and all other equipment. This scenario is not intended to replace your department's standard operating procedures (SOPs) but to offer a good introduction to fire attack. As always, operate according to your department's guidelines.

It is 0223 hours, and you are dispatched to a one-and-a-half-story house fire with reported fire on the first floor (figs. 20–59 and 20–60). It is a prosperous neighborhood, a relatively new development with a lot of young families with children. To provide an overall understanding, we will keep this scenario simple and understandable: Only four units are responding: Engine 1, (your unit), Engine 2, Truck 1, and a battalion chief on the first alarm. The engine companies have a driver, an officer, and two firefighters. Truck 1 has a driver, an officer, and two firefighters.

Fig. 20–59. The house

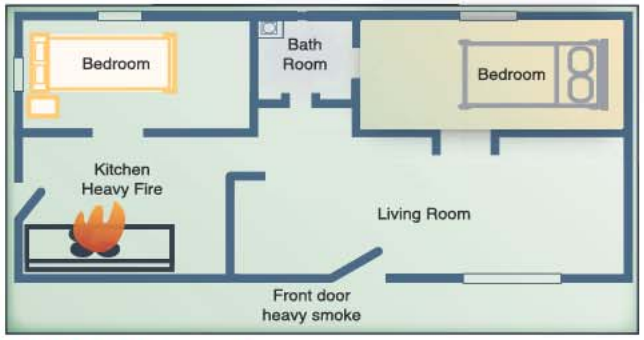

Fig. 20–60. Diagram of scenario

Description of scenario: Heavy fire out kitchen window, heavy black smoke out front door, fire out side door, rear windows seeping smoke, and heavy smoke from the gable vent at the roofline. Occupants outside in their pajamas report that their teenage son did not get out.

To conduct a safe and effective response to this alarm, we will individually examine the necessary steps for success. In this scenario, as in most structure fires, these are the large steps or **benchmarks** that must be considered and dealt with. It is important to note that these steps may be accomplished concurrently or in sequence or not at all depending on the specific situation. Firefighting is not a cookbook type operation. It is one-third training, one-third experience, and one-third art and science. Firefighters and fire officers must be mentally agile to adapt to the situation and conduct the most critical operations and prioritize others, if personnel is insufficient to do all of them at once. For the purpose of this scenario, we will have adequate personnel.

So let's go step by step at this fire.

Size-up

Let's consider size-up in the context of our 1½-story house fire scenario and how it will affect the tasks you may be assigned:

1. *Location of fire* and *type of construction*. Fire is on the first floor. It will be easily accessible to both search and rescue crews and engine company members. The fire is exposing the unfinished attic (this is the uninhabited half story), but vertical extension is not a top priority right now. If this house was built with lightweight construction, wooden I-beams or trusses collapsing would always be a concern. Collapsing roof rafters, wiring, and attic contents have killed firefighters inside. Since this is a house, it is likely fully open and unenclosed inside.

2. *Life hazard*. You have reliable information that at least one person is still in the home. Immediately this puts emphasis on the need for search and rescue operations. The last reported position of the victim was in his bedroom, but the smoke alarms may have awakened him, and he could be anywhere in the home. Based on this information, you will start the search in the most likely place to find the victim, then move on to the most dangerous place (closest to the fire), and finally, if there were upper floors, above the fire (which is not the case in the particular fire since there are no occupied floors above the first floor).

   Due to the confirmed life hazard at this alarm, truck company emphasis will be on forcible entry, search, and ventilation. Since the aerial device will not be used due to the low height of the building, the truck company members may be assigned like this:

   The inside team: Two members with forcible-entry tools are assigned to force the front door if necessary, enter, and search. The outside team: Two members are assigned as a second search team and will attempt to gain access via a different manner from the first team. The remaining two truck company members will perform ventilation from the outside of the building to vent hot gases and smoke to make the engine company's push-in easier, safer, and faster.

3. *Fire control*. The fire building is a home, and we are making an aggressive interior fire attack so 1¾-in. hoselines will be adequate because the fuel load is not excessively high. A good general rule is two rooms of fire per hoseline. Even though your size-up reveals that one line should be sufficient, always stretch a backup line. Engine 1 has laid a supply line from the nearest hydrant, following their SOP. The driver has stopped the engine just past the building, leaving room for the ladder truck. Engine 1 has left one member at the hydrant who will charge the line when the driver is ready for water. Engine 1 officer has received orders from the chief on the scene and has told the crew to stretch an attack line to the front door and make a modified direct attack (described below) on the fire. Engine 1 officer has requested Engine 2 officer to send personnel to Engine 1, stretch a second attack line as a backup line to the first attack line, and assist with advancing the initial line.

4. *Forcing entry*. This is a home in a good neighborhood, so forcible entry should not be a problem. It is likely that there will not be excessive locks or security devices. Homes generally have wooden doors and frames and can be forced easily and quickly with hand tools.

   This function will be taken care of by the truck company crew who forced entry for their search mission and at the same time paved the way for the engine company to stretch and advance the attack line.

5. *Ventilation*. Rapid ventilation will greatly assist the search team and the engine company pushing the line in. Windows provide excellent sources of horizontal ventilation openings. This important function was taken care of by two members from the truck company. Their initial actions will be horizontal ventilation to support the search and fire attack, then vertical ventilation of the roof if necessary.

6. *Stretching considerations*. Stretching at this fire will be relatively easy. The first line will go to the front door across the lawn from the engine parked just past the fire building. Stretching off the rear of the engine is unobstructed by fences, hedges cars, and so forth. The working length of line at the front door should be enough hoseline to reach all parts of this building. A four-person engine company can establish a water supply and rapidly stretch the first attack line. The second engine company can assist with the first line if necessary and add a second backup line.

7. *Water supply*. Your size-up shows active fire that may extend into the attic of the structure. Where is your hoseline's water supply coming from? Are you oper-

ating solely with water from your engine's booster tank, or is the water supply coming from a hydrant, drafting source, or tanker shuttle? Standard operating procedures vary from department to department, but a good choice here is for the driver to provide water to the single attack line from the 500-gal (1,893-L) booster tank. This gives the driver about 2 minutes to hook up the supply line and get a reliable water supply from the hydrant.

Strategic plan

In our 1½-story house fire scenario, we have chosen the offensive strategy for the following reasons:

- The building is safe for us to enter.
- There is or may be a need for search and rescue operations.
- Properly placed hoselines can cut off the fire spread.
- Property can be saved with a manageable or reasonable risk to firefighters.

It is very important to note at this point that we know several factors, but several others we do not know.

What we know (or think we know):

- Where is the fire?
- What and how much is burning?
- What will it take to extinguish it?

What we don't know:

- Are there victims in the house, and if so, where are they?
- How far has the fire spread inside?
- What hazards await us inside?
- Are there backdraft conditions inside?

Establish a water supply

Your engine company has chosen to lay a supply line from the hydrant (forward lay) to conduct the first phase of your mission: Establish the reliable water supply. Engine 1 stops near the front of the building but leaves the actual front for the ladder company.

In rural settings it may be necessary to establish a tanker shuttle or drafting operation. For urban fires there may be a hydrant at the corner of each block. No matter where you are, a high priority is establishing a reliable and adequate water supply.

Force entry/exit

Forcible entry is usually accomplished by the search and rescue crew as they enter the building. In this case, firefighters from Truck 1 will be conducting this important task. However, engine companies should assign someone to bring forcible-entry tools in the event the truck's arrival is delayed.

Search and rescue

In our scenario, members of Truck 1 will force the front door and search for those in the most danger first, usually closest to the fire or above it (is it possible the teenager has a bedroom in the unfinished attic?). A second team will attempt entry into a bedroom window in the rear of the house, near the Division B and C corners. This provides them direct access to a bedroom where there is a good chance the teenager will be found and provides an escape route for firefighters if they are trapped by worsening conditions.

How does this affect the engine company with the hoseline? Consider all the moving parts. Members of the truck company are out ahead of you searching; members of the outside team are in remote areas, possibly out of sight, moving through rooms for victims. How can you protect them with your hoseline? There are three critical options for the engine company:

1. Place the line between the truck team and the fire.
2. Protect the means of egress (and interior stairs).
3. Don't drive the fire toward the truck team. The nozzle team needs to maintain awareness of everything that is going on around them. At first this may seem chaotic and arbitrary, but as you gain understanding and experience, you will see that this is a well-choreographed performance.

Fire attack

The engine company is responsible for stretching the attack lines to the seat of the fire in this offensive fire attack. Getting water on the fire quickly is their most important task. Consider what has happened to the fire environment. As the search crews entered the 1½-story single-family home, they moved through an open door or window. Both of these access points were left open

as previously described to provide ventilation and immediate exit points if needed. This has allowed an unlimited amount of air for the fire. Most structure fires are controlled by the amount of air they have available. More air means more free burning fire.

In our example, we are conducting an aggressive interior fire attack based on the officer's size-up and strategy. The heart of the fire attack is stretching and operating the first hoseline. Although other hoselines will be stretched for this fire, let's focus on the all-important first line. As you approach the scene, your Engine 1 officer turns and tells you the company will be stretching a line directly to the seat of the fire.

This is a residential fire, so a 1¾-in. (45-mm) hose will provide the required water volume to begin our attack and possibly extinguish the fire. The recommended water flow is 180 gpm (681 L/min). This target flow provides for a margin of error incase of kinks in the line, inadequate pump pressure, or other real-world issues that happen on the fireground. This flow will also provide some extra flow to knock the fire down quickly and provide for an adequate amount of water for possible encounters with special hazards such as a broken gas main, leaking propane tank, or leaking and burning fuel oil tank. Using a 1¾-in. (45-mm) line is the SOP for your department for residential fires. Your officer should have sized up the fire and determined that the best route to the fire is through the front door. Your line will go directly to the fire or fire room and conduct a modified direct attack. Your officer's size-up will continue and will do his or her best to determine that this line will not push fire onto other members or into unburned areas

After the line is stretched to the front door, the engine officer will call for water, and the line will be charged. At this time this officer will call command and advise that the line is in position; command will direct that ventilation be accomplished so you can push in. Also, among the engine officer's many responsibilities is to verify that the company members are down near the floor below the heat level and out of any door ways during the attack.

A modified direct attack is selected for this fire. The nozzle operator directs the solid/straight stream into the fire area from outside the room to darken down the fire. The nozzle operator will use the reach of stream to begin to extinguish the fire. This firefighter will then move into the room or down the hallway to complete extinguishment.

Ventilate

In our 1½-story home fire scenario the proper ventilation to support the fire attack is horizontal ventilation of the windows in front of the hoseline. In reality, it is very likely that windows in and near the fire area or room will be broken out by firefighters. Other windows in areas that are not severely exposed can be opened normally by firefighters. Often sashes and storm windows can be removed, limiting damage to the property. However, as previously stated, rapid and effective ventilation is often the key to success at fire attacks, resulting in rapid fire suppression and saving significant property. Conversely, by not taking the windows, the push-in by the engine company due to untenable conditions results in excessive dangers to firefighters (flashover, backdraft, burns) is delayed, and often the building dies a slow death, consumed by fire in void spaces concealed by smoke and steam.

In our example, vertical ventilation of the roof is likely not required by first-in companies. Assuming the fire has not breached the walls or reached the upper level of the home (the uninhabited ½ story attic), cutting a hole in the roof to vent out fire gases will do no immediate good. It will cause additional damage to the building that may not be necessary.

If, however, fire has reached the unfinished attic above the first floor, it will be necessary for firefighters on the roof to cut the roof shingles and sheathing, opening up the roof. The ideal place to cut the roof, of course, is directly over the fire.

Protect exposures

In our scenario, we have interior exposures, adjoining rooms, adjacent rooms, and rooms above the fire room. Hoseline placement was designed to push the fire back into the room of origin and prevent it from extending to exposed areas outside that room. There are no exterior exposures since the home is not close to adjacent buildings.

Fire control and overhaul

Since we were able to contain the fire to the kitchen and adjacent bedroom area, we can focus our efforts on checking for extension in these areas. We can use a hydraulic vent out the kitchen window with our hoseline to clear the area of smoke, exposing any pockets of fire. We must also open up the walls and check for extension

into the unfinished attic. A thermal imaging camera can be used to "see" any hot spots.

Pick up and return

While this was a "bread and butter" fire, fought routinely by any department, there are always things to learn. What did you learn at this fire? Did any unusual things happen? How well-coordinated were the firefighting operations? Your officer will often take a few moments after picking up to go over the fire and discuss any important issues. Take this time to ask questions while the fire is still fresh in your mind.

Ensure that all of your tools and equipment have been picked up and returned to the apparatus. When you get back to the fire station, perform any equipment maintenance (including SCBA) or tool refueling tasks so they are ready for the next fire.

ADDITIONAL FIRE SCENARIOS: SIZE-UP CONCERNS

Now that you have thoroughly analyzed a typical first floor fire in a 1½-story home, we will move on to other scenarios. The following examples of alternative locations for a fire in a single family home (in the basement, for example) and other types of occupancies build on your understanding of basic fire attack. Each of the succeeding examples reviews the size-up issues that may be encountered. However, only the size-up concerns that change are identified for brevity purposes.

Basement fires in a private dwelling

Basement fires provide some unique challenges to firefighters.

Location. The location of the fire makes this not a favorite among firefighters. For basement fires we often have to work above the fire, which is one of the most dangerous places. The key to safe and successful response to basement fires is to get below it or at least be on the same level with it during the fire attack.

The way to do this is to gain access to the outside doors if available and control the fire from that position (fig. 20–61). Attacking the fire by pushing the attack team down the interior stairs is the least viable option and the most dangerous. Consider the condition of interior basement stairs before the fire and after they have been exposed to fire.

It is often difficult to determine where the fire is in the structure since smoke may be rising and filling the entire structure. A good way to determine if the fire is in the basement is to take out a small basement window with a tool. You will immediately be able to determine if the fire is down there or not.

Fig. 20–61. Access a basement fire from outside. (Courtesy of Ryan Hart)

Once you have determined that the fire is in the basement, check to see if it has extended to the first floor or attic. If this is a balloon frame home (see chapter 7: "Building Construction"), a fire in the basement will rapidly extend to the attic and often other floors. If the fire is extending vertically for any reason (pipe chases, balloon construction, floors burned through, etc.) you must get lines into position on these areas rapidly.

Before committing firefighters to these dangerous areas, always check for structural integrity. If trusses or wooden I-beams were holding up the first floor and the basement fire has involved them, expect an early collapse and use defensive tactics (fig. 20–62).

Fig. 20–62. Wooden I-beams

Utilities in the basement may provide a heavy fire load and rapid fire development. Oil tanks, natural gas lines, and meters will result in heavy volumes of fire if they are involved (fig. 20–63).

Further complicating a basement fire may be the huge fuel load from stored materials. Simply said, more stuff equals more fire.

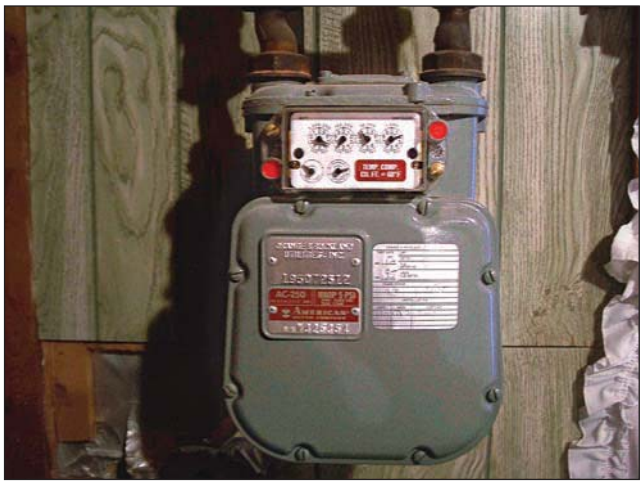

Fig. 20–63. A gas meter inside a building

Life hazard. Basement fires can threaten occupants of the building in ways described above. In apartment buildings, upstairs occupants may not be aware that there is a fire in the basement, which will complicate your search and rescue operations. With real estate prices escalating across the country, basement apartments have become more and more common.

It is very important to remember that we are occupants too! It cannot be overemphasized, if the first floor is being supported by lightweight construction (trusses, glue-lam beams, etc.), keep members out from underneath and from on top of this very dangerous type of construction.

Fire control. Controlling the fire in a basement is an extreme challenge to firefighters because of its lack of accessibility. The least desirable method of accessing the basement is by using the interior set of stairs within the home—this point of access is like descending a fireplace chimney. Some basements have exterior access through a set of "clamshell" bulkhead doors or a set of exterior stairs in a well—these are the more desirable ways of accessing a basement fire because it minimizes the punishment firefighters must take while descending the stairs (fig. 20–64).

Fig. 20–64. Clamshell doors provide exterior access to basement.

When using the interior stairs to attack the fire, first position a hose line at the top of the interior stairs. When ready to move as a single unit, the hoseline team begins its descent down the stairwell, paying particular attention to the condition of the stairs. Moving down the stairs must be done swiftly and in a coordinated fashion so that no one stays on the stairs more than is necessary to move down them. The goal is to get the hoseline team out of the "chimney" and onto the basement floor.

If a very large body of fire exists in a basement (heavy fire is showing at most or all of the window/door openings), and it has been determined that no one is in the basement or there is no savable human life there, consider putting the nozzle in the window you broke to see if there was fire in the basement. Often knocking down the fire this way prevents firefighters from having to enter this very dangerous fire building which may be on the verge of floor collapse (particularly for exposed wooden beams, and especially for lightweight wooden trusses or wooden I beams). *Note that hoselines are never directed into windows when the building is occupied by civilians or firefighters as this can result in serious injury or death.*

Because basements are frequently not finished, exposed wood joists and subflooring will be involved in fire, creating more of a fire load. Also remember to shut off utilities from the outside before firefighters enter for any fire attack.

Force entry. Remember that the goal is to get even with or below the fire if possible. The outside doors to the basement often provide this access. If there is a full-size personnel door in a well, by all means use it, forcing with standard techniques. Be prepared for a face full of fire when you open this door, because you are on the fire floor—it is now just below grade.

As described above, basements often have clamshell doors leading down a few steps that end at the basement floor level. These doors cannot generally be forced by standard means and require cutting with metal-cutting saws.

Gaining access to the basement is only part of the issue with basement fires. Planning your secondary means of egress is the more important part. Generally, for many types of occupancies, there are two ways into and out of the basement: the interior stairs and, if present, the outside stairs. If you make your advance through the exterior stairs and it becomes blocked, your only other egress option is via the interior stairs. Attempting to conduct an emergency egress via the interior stairs has the following problems: First, is the door locked from the first floor? If it is, forcible-entry tools will be necessary. It is important to note that the area at the top of the stairs is usually very constrained space and may not allow forcible entry tools to be used, causing you to become trapped. Interior stairs are generally not well maintained, may be weakened by rotting due to previous or exiting water in the basement, and may not have handrails or other safety items.

Since this area is the highest part of the fire area, it will collect the most heat and densest smoke and will likely flashover first; certainly this is not a good place to be, especially during an emergency egress!

Windows to basements are generally small, too small for a firefighter to exit, and often placed high in the exterior walls to allow some light and ventilation. Although windows may be present, they are of little value as a secondary means of escape.

Ventilation. Ventilation of basement fires requires special tactics. First, use what the building has made available to you, the windows above the exterior grade, high in the foundation. These are in a very good place, high in the fire area, and will be a good first step. Usually these windows are small and therefore provide limited capability to release heat and smoke. Often basements have low ceilings, further trapping heat and smoke, so ventilation may be a critical step in gaining access for firefighters.

An alternative tactic for ventilation of basement fires is to cut a hole in the floor above and vent smoke out through the first floor then out a nearby window (fig. 20–69). Be wary of fire-weakened floors when performing this tactic. Be especially careful in newer buildings of lightweight construction; it is important to recall how rapidly trusses and laminated wood joists fail under even moderate fire loads. Working above or below a floor constructed with these lightweight members must be performed with extreme caution—they are easily capable of quickly killing firefighters when they collapse.

Stretching considerations. Basement fires present unique challenges to engine company members as well. Because you are in a confined space with the fire, you must ensure you have enough line to fight your way all the way to the seat of the fire. Delays and interruptions in flowing water will cause the fire to light up, possibly trapping you and your team. By the same token, basements are generally cluttered and mazelike areas, so too much hose will cause problems like kinks that will delay or cease your attack, again endangering you and your crew. Using the floor above to lay out hose is a good tactic to help you advance.

No matter which access to the basement you are using, interior or exterior, remember that your advance will have to be rapid as heat and smoke will be pouring out of the upper levels of that door way. Get below it fast.

Water supply. A basement is the worst place for a fire in the building because it will expose and threaten the entire building above it. When considering water supply, simply have enough in case the fire finally involves the whole structure. If the fire building becomes fully involved, make sure you have enough water to protect exposures as well.

FIREFIGHTING CONSIDERATIONS IN OTHER TYPES OF OCCUPANCIES

Now that we have an understanding of the basic fire attack principles using our single family dwelling

example, let's move on to fires in other types of buildings. We will not examine every phase, but rather focus only on the different and specific size-up challenges faced by firefighters in these common structures. In this "basic" *Firefighter I* chapter, we examine these different types of building occupancies from your perspective as the firefighter. As mentioned at the beginning of this chapter, you, as a Firefighter I, will be asked to perform a specific task, under an officer or senior Firefighter II's direction. Firefighter I training instructs you *how* to perform these specific tasks.

In the future, if you enroll in a Firefighter II training program with this textbook, you will use these same set of buildings and occupancies to examine the fire problems from a leader's perspective. Firefighter II training emphasizes the "decision-making" aspects of firefighting—specifically *where* and *when* to ventilate, search, and attack the fire.

Wood frame garden apartments

Garden apartment type buildings have become common in suburban and even rural areas. They are economical to build and provide residences for substantial numbers of people that can either rent or own them if the co-op ownership method is used (fig. 20–65).

In a sense, garden apartments are simply a group of single family homes put together both horizontally and vertically, and many of the same issues must be dealt with by firefighters in much the same way as detached single family homes. Let's take a look at some of the important differences for firefighters.

Fig. 20–65. Garden apartment. (Courtesy of Tom Bierds)

Location of fire and type of construction. Garden apartments are usually set back off the road or parking lot. This causes firefighters to have to carry ground ladders, tools, and hoseline greater distances than to fight a single family dwelling. It is important to pace yourself in walking to the fire building so you are not too fatigued to fight the fire when you get there. Resist the temptation to run to the scene. When you don your mask to enter the building, you will quickly deplete the air supply because of the stress of the run from the rig to the building.

Construction of the garden apartment will affect the overall strategy. Lightweight construction often has no level of fire resistance; no protection is provided for the structural members holding the building up (in the form of gypsum board covering the individual floor and roof beams, for example). This lack of fire resistance will often cause incident commanders to quickly abandon offensive operations and move to defensive operations for the safety of firefighters. Defensive operations use larger hoselines, portable monitors, and water tower operations.

Life hazard. As a result of the dense population in garden apartments, search and rescue operations often require many more firefighters than a single family dwelling. A fast moving fire, especially in a lower unit, will rapidly endanger people in units above and adjacent to the fire apartment. Simultaneous search and rescue will often be necessary to save lives. For firefighters, occupants rescued from apartments and brought out to the public hallway will need to be carried or at best assisted down the stairs and out of the building.

Fire control. Fire control can be very challenging in garden apartments simply because there is so much to burn. Lots of people mean lots of furnishings, beds, clothing, computers, and the like. Also, items such as bicycles and outdoor toys are stored in living areas. Firefighters on hoselines can get caught and trapped and die during what was thought to be a routine fire attack in a couple of rooms of fire.

In addition to all the furnishings and property inside a garden apartment, there is a tremendous amount of fuel in the wood framing, flooring, sheathing, and interior trim of garden apartments. Since the entire building and contents are combustible, often a huge fire load results in a huge fire. When fires in these buildings gain control of the building and involve the wood structure, it is difficult to get enough water on the fire quickly enough to stop it. When attacking fires in garden apartments, consider the use of big lines quickly.

A good technique for fire control if the engine company cannot get in the fire apartment is to breach the wall in the adjoining unit or next to the front door and apply water through this hole. This firefighting technique may hold the fire to a room and contents fire, thus preventing it from extending to the void spaces, which would lead to eventual destruction of the building.

Forcing entry. Gaining access to a residence is generally not a problem unless it is in an urban area or one plagued by crime. In areas where residents have fortified their apartment doors, firefighters should come armed with more effective and possibly hydraulic tools to speed entry.

Ventilation. Ventilation of garden apartments is very similar to that for single family homes. Taking windows in front of the hoseline is always a good technique. This may be a bit more difficult because windows can be two or three stories above the ground. Use of ground ladders (carried around the building because of the set back) will be required.

Roof ventilation will be necessary for fires that have entered the attic void space. Often the attics are not divided and provide a rapid lateral and vertical fire spread opportunity. Since the building is usually wood frame and the roof is sheathed with plywood, firefighters can use rotary or chain saws effectively.

Stretching considerations. Stretching hoselines at garden apartments can be very challenging. In order to make the units appealing and supply the garden appearance, U-shaped or zig-zag layouts are used in the design. This means that hose stretches have to be very long. If your engine company uses preconnected hoselines, these will almost always be too short.

Many engine companies that have garden apartments in their fire due area use a thief line. A **thief line** consists of 200–300 ft (60–90 m) of a 2½-in. (65-mm) hose, with a wye or water thief at the end to reduce the friction loss and supply the required volume. Smaller-diameter attack lines can be attached to the wye or thief and used for interior fire attack. Preconnected lines can be detached from the engine, shoulder carried, and used; or apartment packs can be carried in canvas bags or tied together with webbing or quick-release straps.

Water supply. Multiple reliable and high-volume sources are necessary for these types of fires. Experience has shown that if fire walls or interior gypsum board partitions and ceilings are breached by fire, it will turn into a fast moving and large body of fire requiring huge amounts of water.

Taxpayers

Location of fire and type of construction. Taxpayers are a general classification of buildings that contain a business on the first floor and apartments or living space on the upper floors. These are typical Main Street–type buildings.

Compared with strip malls (below), these buildings are usually of ordinary construction and are relatively fire resistant. However, basement fires in these occupancies often present a problem because of stock or storage items from the business.

For firefighters, access to fires in taxpayers are relatively easy. Large front windows and front doors for customers provide good access directly off the street. Beware, however, of the parapet (a decorative set of brick or other masonry unit that is constructed on top of the front wall of the taxpayer), as it is often not well supported laterally and can easily fall during a fire (fig. 20–66).

Life hazard. Life hazard in the storefront is usually minimal. Store patrons or employees are awake and alert when the store is occupied. Residential occupants upstairs can be a real problem. Frequently a door to the side of the storefront leads up a set of stairs to the upstairs apartments. In older buildings, these stairs are steep and narrow. Fires originating down below can cut off access to these stairs, trapping occupants on upper floors.

Fire control. Controlling the fire can be a challenge in taxpayers as the storefront may contain anything from a candy store to a hardware store, a pharmacy and general goods, a toy store, or an auto parts store. Firefighters should consider using large, 2½-in. (65-mm) high-flow hand lines for these fires. Ladder towers placed near the front of the building with buckets placed near the ground can direct master streams effectively up into the ceilings of the stores (to get at hidden fires) with excellent results. The large-caliber streams make fast work of the fire and prevent the hazards to engine company members from making an interior attack.

Fig. 20–66. This taxpayer's parapet is leaning and may be unstable.

Forcing entry. Forcing entry can be a very challenging process. Roll-up gates, sliding gates, and other heavy security measures often are present. Rear doors may have been bricked up or, at a minimum, contain very strong security measures. Heavy-duty tools and power tools will be required to gain access to these doors, which are critical as a secondary means of egress for horizontal ventilation.

Ventilation. Since these stores are usually side by side, ventilation in the front and rear is essential for first floor fires. Display windows can provide large openings in the A side of the building. These are readily available at ground level.

Large fires in one-story taxpayers may extend in to the **cockloft**, the combustible void space above the ceiling of the store. In such cases, vertical ventilation will be necessary to prevent the fire from moving in this concealed space and spreading to other parts of the building above the other stores. This will typically require a large primary vent hole directly above the store, and, in some cases, a trench cut to cut off the fire's horizontal movement in the cockloft.

Stretching considerations. Although hoselines can be easily stretched to the front of the building, and large windows provide excellent access if the first floor is involved, stretches to the rear can be difficult. A good firefighter decision is to stretch the hoseline through an adjacent building to gain access to the rear of the fire building.

Fire escape stretches, rope stretches, and other advanced methods may be required to get hoselines in proper position.

Water supply. As with any nonresidential structure, always stretch big lines right from the start. Big lines obviously require large amounts of water, so a reliable and redundant water supply is important.

Strip malls

Location of fire and type of construction. Strip malls are the modern version of the taxpayer (fig. 20–67). They are constructed cheaply and quickly of materials that do not maintain structural integrity under a fire load. Like taxpayers, they contain stores on the first floor. They may be one or more stories and are subject to early and deadly collapse from burning contents (fig. 20–68). Some strip malls are of non-combustible construction with metal bar joists and metal deck roofs. Other strip malls are of ordinary construction with wood joists or (more commonly) lightweight wood trusses or wooden I-beams.

Often, security issues that create limited access (fig. 20–69) or cost considerations during construction, such as leaving structural members unprotected (figs. 20–70 and 20–71), factor into firefighter safety concerns.

Fig. 20–67. The front of the strip mall shows it contains a variety of different occupancies.

Fig. 20–68. This strip mall has two floors on part of the building.

Fig. 20–69. The rear of the building provides limited access and usually high security. Note the roof-mounted HVAC units. (Courtesy of J. Knapp)

Fig. 20–70. Unprotected steel structural members will fail rapidly under a fire load.

Fig. 20–71. Note the lightweight and unprotected C channel members holding up the roof.

The location of the fire in the structure is of major significance to the firefighter. Fires are often in the rear of these buildings in storage or work areas. This means firefighters must push through the building, generally from the front to rear to attack the fire or conduct search operations. These firefighters are directly under the collapse zone of the unprotected steel trusses and beams supporting the HVAC units and the dead load of the roof itself. High security of rear doors ,if they even exist and are not bricked up, usually prevent rapid attack or access from the rear.

Life hazard. The life hazard of strip malls can vary depending on the occupancy.

Fire control. Fire control operations should be attempted from outside the structure if significant fire has attacked the unprotected structural steel components. Because of the small front-to-back distances of these structures, firefighters can use the reach of the stream to extinguish heavily involved areas. This tactic keeps firefighters out of the most extreme danger zone. Staying out from under this building and using the reach of the stream may be a life-saving tactic for you and your crew one day.

Force entry. Again, like taxpayers, strip malls may have extreme forcible-entry challenges, especially in bad neighborhoods. High security on doors and windows may necessitate cutting locks and gates with rotary saws. Barred and or bricked-up doors and windows in the rear are formidable challenges. Consider breaching interior walls as an alternative, especially if life safety is an issue.

Ventilation. It is very tempting to vent the roof of these buildings. The roof is easily accessible by ground ladder, usually flat and inviting to the aggressive truck company. A "traditional" roof of solid sawn wood joists offers the possibility of vertical ventilation, if necessary. However, other types of roofs are dangerous for firefighters attempting vertical ventilation. Firefighters must be aware of these critical dangers:

1. In the case of non-combustible construction, the structural steel joists are usually unprotected (bare steel without any fire resistance). Weakening and failure of the steel joists is a distinct possibility with a moderate or large fire below. Cutting the metal deck itself between joists can leave the portion of the deck where the firefighter is standing unsupported, resulting in the deck bending and sending roof firefighters into the fire. Ventilate using the front and rear doors and windows if possible. Stay off of the roof.

2. In the case of lightweight wooden trusses and wooden I-beams, firefighters must stay off the roof. In addition, a fire in the wood trusses or I-beams themselves results in the very real potential of collapse onto firefighters below. This happened in 1989 to two firefighters in Orange County, Florida who were killed when the wooden trusses collapsed. The smoke condition in the stores was light while there was a raging fire above their heads in the truss void. Use hooks to open up the ceiling and thermal imaging cameras to determine the extent of fire above the ceiling.

Stretching considerations. It is tempting to use small interior attack lines for fires involving these structures. The fire appears small because stores in strip malls are often small square footage. What firefighters must recall is that there is likely a very high amount of combustible material, which will require a high flow. Stretch and use a 2½-in. (65-mm) hoseline for these fires. The reach, penetration, and flow will make quick work of the fire from a position of safety outside the collapse zone.

Water supply. In the case of ordinary construction, a large combustible cockloft/void space will add tremendously to the fuel load in addition to the combustibles in the store itself. A large volume of water is necessary. Another problem with the Orange County, Florida fire cited above was the lack of a continuous water supply; the firefighters were relying solely on the water in the fire engine's tank rather than being connected to a fire hydrant. Fire can quickly get above the ceiling and spread laterally.

Big box retail

Location of fire and type of construction. Big box retail buildings are very much like a large strip mall that is undivided and has a higher ceiling (fig. 20–72). Many types of businesses may occupy these type buildings: pharmacy, toy store, hardware, housewares, grocery, and other retail businesses. The construction weaknesses under a fire load are similar to strip malls, though the size, square footage, and height vary.

The location of the fire plays a key role in firefighter safety and responsibilities. Fires may be in high-rack storage, hazardous materials may be stored in the building, or HVAC units may be on top of or under the roof surface. All of these are very dangerous type fires.

Fig. 20–72. Note the lightweight construction, unprotected steel, and large size of this building.

Life hazard. Big box stores may contain a relatively high life hazard. Occupants may not evacuate if there is not a perceptible danger (fig. 20–73). Fire alarms often go unheeded. Fire may grow in storage areas or void spaces, then flashover and spread, rapidly trapping or killing occupants who did not escape.

Fig. 20–73. Here a big-box-type construction building houses a retail outlet.

High ceilings in these buildings allow combustible gases to accumulate high above firefighters' heads, possibly igniting the roof deck. Use the thermal camera to check over your head to be sure you are not in danger from a fire in the roof itself or accumulating hot gases that could lead to flashover.

Fire control. These are generally large unenclosed (inside) buildings. Hose streams may not reach into all areas from outside the building. Consider using master streams from tower ladders or deck pipes off engines to obtain the necessary reach. Roof ventilation like the strip mall is very dangerous. Roof vents and scuttles can be used if available for ventilation. Sometimes these buildings are protected by automatic sprinklers; if they are, by all means use and support the systems.

There are lots of products to burn in these buildings. Always use a 2½-in. (65-mm) hoseline if you are going inside and have any significant fire. This size line will provide the reach and flow you will need to extinguish the fire.

The good news is that many of these buildings contain sprinkler systems. Sprinkler systems (discussed in greater detail in chapter 30, Fire Protection Systems) are your best ally. They work in the dark, don't need an SCBA, extinguish fire only when necessary, and function until we shut them off.

Force entry. Generally front entrances are the easiest to force. Large windows may be present for ventilation or entry. Rear access may be limited by security concerns similar to strip malls.

Ventilation. Retail stores make a profit by selling a volume of products. One advantage available to you may be a large loading dock door. This may provide excellent horizontal ventilation.

Stretching considerations. Parking lots usually provide good access to the front of the building. Stretching will be relatively easy until you get into the store. The building may be very deep from front to rear and require a long stretch similar to garden apartments. Always consider using big lines at these fires.

Water supply. Since this is a big box building that has big volume and big contents, a robust water supply must be established. If the building has a sprinkler system, be sure not to steal water from the system by using a nearby hydrant that may be trying to supply the sprinkler system.

Office buildings

Location of fire and type of construction. The location of the fire in office buildings is important because these buildings often are divided up into small offices or cubicles (fig. 20–74). The floor layout can become a deadly maze for firefighters. If it is an open office type floor plan, fire can spread rapidly from cubicle to cubicle quickly.

Office occupancies can occupy a variety of construction types, too many to be discussed here. Refer to chapter 7, Building Construction, for specific construction hazards.

Fig. 20–74. Office building

Life hazard. Typically occupants will be awake and alert in office buildings. Accounting for occupants can be easy if there is a fire plan and they are well schooled in its use. However, this is more the exception rather than the rule, so plan for an extensive and extended search and rescue operation. Use of life lines and large area search procedures may be necessary.

Disabled persons working in the office may provide special challenges to firefighters. Many multi-story office buildings have designated "areas of rescue assistance" or "areas of refuge" for disabled people (fig. 20–75). These rooms and areas are typically separated from other areas by a one-hour fire rated wall (sometimes these locations are actually inside stairwells) and will be provided with a two-way communications system with the building's lobby. These areas are designated with special signage identifying this area and may be equipped with a communications system that connects to a building's lobby. Refuge locations will be a high priority search area.

Fig. 20–75. Disabled people who are incapable of evacuating the upper floors of a multistory building on their own may be waiting for you in an area of rescue assistance such as this one.

Fire control. Most modern buildings will be protected with automatic sprinklers. As previously stated, these are a firefighter's best friend. Support the system with hoselines as early as possible. If the fire building is not equipped with a sprinkler system, plan for long hoselines and high fire volume because of a high fire load.

Force entry. Forcible entry concerns for offices are similar to any other building and are usually dependent on the level of crime in the area and need for security in the particular occupancy. Obviously, banks and financial institutions will have more security than a general purpose office. Some office buildings may have secure areas with the main office area or complex.

Ventilation. Ventilation considerations depend on the type of building construction.

Stretching considerations. As previously stated, office buildings and layout can vary. Good preincident intelligence can go a long way in making your stretch successful. Some offices have a large open lobby or waiting areas. These areas will consume a large amount of hose before even reaching close to the fire area. Other offices with cubicles or highly divided floor space will present equally challenging and hose-consuming stretches.

Water supply. As with any structure fire, establish a reliable water supply.

Restaurants

Location of fire and type of construction. This category of building fire is really dependent upon the type of building construction the restaurant is housed in, how big or small the building is, and the type and size of cooking equipment in the kitchen (fig. 20–76). A common important factor you will deal with is something that has little to do with fire attack operations: how often and how well the hood ventilation system is cleaned and serviced. Grease builds up from frying of food in these systems and can trigger fast-moving and dangerous fires.

Fig. 20–76. Restaurant

Fast-food restaurants are special hazards that must be recognized by firefighters. In order to minimize cost and maximize profit, these restaurants are often built of lightweight material, with minimal fire protection systems and with no regard or minimal regard for firefighter safety. This is a class of "disposable" buildings that should never be paid for with a firefighter's life. Sadly, these buildings have taken several firefighters' lives in recent years. It is critical to remember these are designed by the chain owners as disposable buildings, built with the cheapest material and construction methods available solely to sell, sell, sell and maximize profit.

A common hazard in these disposable buildings is a lightweight truss supporting roof-mounted heating, ventilating, and air conditioning (HVAC) units. Under the roof deck are HVAC distribution systems; deep fat fryer duct work; and electrical, gas, and plumbing utili-

ties. From the inside, all this is hidden by a drop ceiling. If fire invades the truss space and has attacked the trusses, expect a rapid and fatal collapse. Obviously, firefighters can be trapped and burned to death in this common fire scenario.

Life hazard. The life hazard can be high during busy times when the restaurant is in operation. However, occupants, customers, and employees will be awake and alert and usually exit the building if they perceive danger.

If the fire occurs after business hours, check for maintenance or cleaning people in the building. However, always consider the risk to firefighters in these dangerous buildings. Another consideration is that you may be able to conduct a "search" from outside the building. Fast-food restaurants often have lots of windows and doors. If you open all these and simply look inside, because of the small floor space, you may be able to visually search the building from outside in a position of safety.

Fire control. Some restaurants will have built-in fire-extinguishing systems, especially in hoods and deep fryers. If these appliances are involved, activate the built-in fire-extinguishing systems if they have not already been automatically or manually tripped.

There is a very good possibility that the fire actually started in the cooking hood and ductwork due to the accumulated grease—these are very hot fires which can spread beyond the sheet metal ducts. Look for fire spread to surrounding combustibles (wood studs, stored paper goods, etc.) with the use of thermal imaging cameras and by opening up suspected fire extension locations.

Force entry. Forcible-entry considerations are similar to other structures. Large restaurants may have exit doors with panic hardware on the inside. After the initial team gains entry, these doors may provide excellent access for other firefighters.

Ventilation. Especially for kitchen fires, consider turning on the hood ventilation system to exhaust smoke from the building. *Make sure, however, that the fire is not in the cooking hood and duct system, a common fire location.* Other than this, usual ventilation considerations apply.

Stretching considerations. It is important to recall that restaurants come in a variety of shapes and sizes. We have all been in the mom and pop restaurant that is squeezed into a long narrow building, sometimes with a dining area up one or more floors. On the other side of the restaurant scale are large catering halls that seat hundreds. Obvious stretching considerations are associated with each of these varieties and everything in between.

Water supply. As always, establish a reliable water supply.

Vacant buildings

A wise old fire officer once asked, "What is in a vacant building to save that is worth the life of a firefighter?" Sure it is a challenge to attempt to put the fire out using an aggressive attack, but what are you saving? Never forget, whenever you enter a burning building, there are a lot of things, some of which we considered here and others, that in the end can kill you. If the building had enough fire in it that you need to aggressively attack it, how much damage is being done to that building, and what will it be worth after the fire? The answer is probably not much. Risk a little to save a little. A vacant is a vacant until the occupants (us) arrive and enter (fig. 20–77).

Fig. 20–77. Vacant building

Location of fire and type of construction. Vacant buildings are very dangerous. For the safety of members you must assume that the structure could be compromised. Here is an example: an old, heavy timber building can withstand a small fire for a relatively long time (due to the massive nature of the wooden structural members) before it becomes structurally unsafe. Simply put, these massive timbers provide us with time to get inside and extinguish the fire. That statement assumes the building is well maintained and the structural members have not been compromised. Since many heavy timber buildings have been around for a long time, they often are not well maintained and have had numerous occupancies during their long and storied lives.

If the building is vacant, how long has the hole in the roof allowed in rain and snow to help rot the wood or rust the connections? Have insects attacked the heavy timber to further weaken it? What types of changes were made by each occupancy over the years?

The point is, even the most fire-resistive structures and structural members may be compromised by forces during the time it has been vacant.

Some other safety concerns with vacants

- Have expensive conveniences been removed? Elevators and dumb waiters may have been removed or vandalized. Did the previous owner leave barrels of leftover hazardous materials or hazardous waste inside?
- Are heavy items left on shelving that may fall on interior teams?
- Were stairs and holes cut in the floor to allow the removal of large machinery?
- Were inexpensive repairs like tar paper put over holes in the roof made by the previous or current owner?
- Are windows and doors boarded up for security, thus limiting egress of the new occupants? (That would be us, firefighters, as we are occupants too!)
- Are there multiple fires in the building? Did the owner want it to burn?

Life hazard. A false report of squatters in an abandoned cold storage building caused the death of six Worcester, Massachusetts, firefighters in 1999. Consider the hazard to firefighters and the lack of reliability of on-scene reports before committing members to search this dangerous type of building. If you have to search the building, use search ropes and thermal imaging cameras. Be aware of the numerous hazards this building presents.

Fire control. Attempt work from the outside. Use the reach of the hose streams to darken down the fire from positions of safety. Use large-caliber streams with high volumes of water and long reach and penetration. Attack the fire if necessary from positions of safety.

Force entry. In vacant buildings, this usually means taking the plywood off the windows and doors. If truck company members get the door open and accessible, wait until they get a couple of other openings available to you to use before making entry. Vacants often have bricked-up or window security devices that are difficult to remove from the outside. Obviously, whatever prevents or slows down the mal-intentioned vandal slows down the well-intentioned firefighter.

Ventilation. Standard ventilation practices apply to vacant buildings—with one important caveat: You never know how sound the structure is, so assume it is not safe; for example, the roof is not safe to vent unless you are supported by a ladder or tower bucket. Consider the use of horizontal ventilation (windows) and not risking firefighters on the roof. Horizontal ventilation may be difficult, as noted previously.

Stretching considerations. This is not an aggressive interior fire attack so leave the 1¾-in. (45-mm) hose on the rig. Bring the big lines, and overwhelm this fire from the outside. Water damage is not an issue. Consider the use of portable monitor nozzles and large-caliber streams. The sooner you put the fire out, the less danger it is to everyone on the scene.

Water Supply. As always, establish a reliable water supply for the size of the fire you are fighting.

EXPOSURE PROTECTION

When protecting exposures, apply water directly on the exposed surfaces, as this is much more effective at absorbing heat and delaying or preventing ignition due to radiant or convective heat (fig. 20–78). Application of water on the exposed building is not only more effective but can be done with less water than other means. Water curtain nozzles were used for a number of years. Recent scientific evidence has determined that these water sprays are not as effective as applying water directly to the exposed surfaces (fig. 20–79). The water curtain is simply not dense enough to absorb all the radiant heat from the source fire. Water curtains have enjoyed success because they inadvertently apply water to the exposed surface. Additionally, these nozzles are supplied with 2½-in. (65-mm) lines, which require significant personnel to stretch and copious amounts of water, which may be in short supply on the fireground.

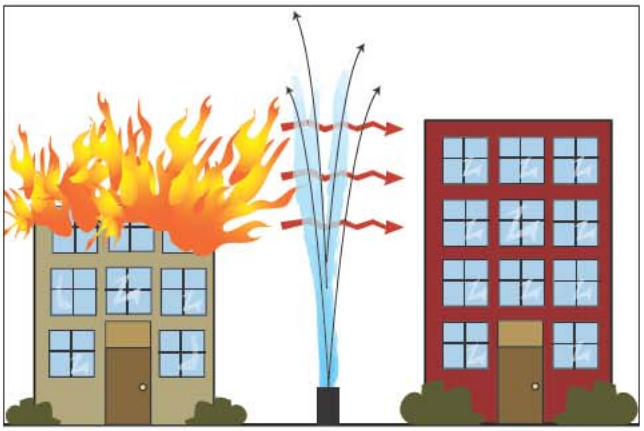

Fig. 20–78. Water curtains aren't as effective at absorbing heat than direct application of water to the exposed building.

Fig. 20–79. This is a good example of a firefighter with a properly positioned hoseline protecting a heavily exposed building. A good sign an exposure is getting ready to light up is paint discoloring and peeling, bubbling, and beginning to smoke. (Courtesy of Brian Duddy)

"SMELL OF SMOKE" CALLS

Often you will be called to respond to a "smell of smoke in the building" with only this vague information: odor of smoke in the building, 20 Main Street. This call presents unique and challenging situations to firefighters. The most important consideration at these calls is this: is there significant fire in the void spaces of the building that is hidden from you? Void spaces can be the truss space between floors of a building, the space above a drop ceiling, in the walls of a balloon frame home in attic or cockloft spaces, in utility chases or even in soffits above kitchen cabinets. If there is significant fire, follow standard firefighting practices. Always have hose lines in place when opening void spaces where you suspect there is fire. If you are looking for hidden fire and you find it you had better have something to extinguish it with. Firefighters have been killed after they opened a space and heavy fire was driven out by a flashover in that space caused by the newly introduced oxygen. Never underestimate the potential of hidden fire.

After you have determined that there is not significant fire in these void areas, it is often a challenging detective game to find the source of the smell or visible smoke. Ask the occupants obvious questions first: where did you smell it? Where was it the strongest, when did you smell it? What were you doing and what was happening in the building when you smelled/saw it? These questions will help you eliminate some potential sources and highlight potential suspected areas to concentrate your search. As employees enter the building for the first time that day or occupants return home, they may notice the odor or haze of smoke. If you can't find the source ask them to retrace their steps to determine what appliances or circuits they energized and eliminate these as possible sources.

In multi-family residential buildings, a "food on the stove" run is very common. Forgetful people leave a pot of food cooking on the stove after they leave the premises. Working fires can erupt in these situations. Overheated food on the stove has a distinctive odor; you will come to know the smell very well in your career.

Frequently it is electrical appliances or lighting fixtures that are the source of the odor. Always check the breaker panel to determine if an appliance, motor, fan, or lighting circuit has shorted or burned out, tripping a breaker or blowing the fuse. A tripped breaker may point directly to the source of the smoke. In addition, use the thermal imaging camera to scan circuit breakers in a panel—hot breakers (indicating an electrical circuit that is at capacity) will glow brightly.

In occupancies that have fluorescent lighting, check to see if one light fixture is not as bright as others. If you find one of these, the ballast or starter mechanism in the light maybe the culprit and the source of the smoke (fig. 20–80). An overheated ballast has a particular odor; you will recognize it once you've experienced it.

Especially early in the heating season, dust on heating appliances may burn off and cause an odor or some visible smoke. New appliances of any kind may emit odors when used for the first time. Ask occupants if there is anything new in the building.

Fig. 20–80. Starter and ballast

Use of the thermal imaging camera can be a great assistance in determining the source of the alarm. Use it to scan suspected appliances, motors, fans, and lighting fixtures you think maybe the cause. This is often the definitive step in determining the cause of the odor or light smoke.

Smoke detectors are another cause of fire department responses similar to odors of smoke. Typically a smoke detector will sound for a short time causing the occupant to call the fire department. By the time we arrive on the scene there is no apparent cause. Again this is a detective game to determine the cause similar to "odor of smoke" responses. Always rule out active or past fire as the first step.

Common non-fire causes of smoke detector alarms are: steam from a shower or other source, dust, cleaning or air fresheners sprayed in or near the detector, insects, or cooking.

In all these cases always remind the occupant to call the fire department again if the odor returns, the alarm sounds again or if they have any reason to suspect a dangerous condition. The last thing we want as firefighters is to respond to a working fire because of a delayed alarm.

OUTSIDE FIRES

FFI 5.3.8 One of the most common types of outside fires is the dumpster or trash fire (fig. 20–81). If these fires are small in size or contained to a small bin, they can easily be extinguished with a booster line or preconnected "trash line." Larger containers, larger piles of trash, and construction debris should be overwhelmed with an 1¾-in. (45-mm) line, or in case of a large debris pile, a 2½-in. (65-mm) hoseline or master stream device. When choosing the size line to extinguish the fire, always remember that you want to overwhelm the fire. A fair fight only exposes us to unnecessary dangers for extended periods of time. Take a cannon to the gunfight and you will win decisively.

Fig. 20–81. Dumpster

Most often with these types of fires, there is nothing to be saved, so no one and nothing should be risked. Use the reach of the stream to apply water to the fire from a distance. Once the fire is knocked down, firefighters will have to pull apart the debris to reach smoldering pockets for final extinguishment. Pike poles, commonly referred to as hooks, are used to pull apart debris to ensure final extinguishment.

Safety at outside fires is often deceiving. The fire is visible and easily accessible, and apparently will be easy to extinguish. We must always remember that closed containers or other hazards may be contained in the trash or garbage container. First, consider that if something started the fire, it could be a hazardous material that may produce toxic fumes. Possibly an arsonist started the fire to cheaply dispose of trash or to dispose of evidence or even a body. Disposal of hazardous waste is expensive. A common practice by unscrupulous persons may be to hide it in common trash. At construction sites or even in household waste, closed containers such as propane torch cans or 20-lb (9-kg) propane tanks may be found. Exposed to fire, they can explode (BLEVE), exposing firefighters to rocketing tanks and lethal shrapnel from tank fragments. Chemical hazards such as unused or outdated pesticides and used or unused cleaning chemicals and construction material can often be found in trash.

At a recent fire in the northeastern United States, a small propane cylinder became a projectile at a dumpster fire. It hit the building with such force that it set off the automatic alarm in the structure.

You never know what is burning in a trash or dumpster fires. For this reason it is important to wear full PPE and SCBA. A shift in the wind or a sudden flare-up of fire or smoke can expose firefighters to dangerous chemicals or

other hazards. If you always wear your PPE and SCBA, these are two decisions you don't need to think about on the fireground.

A good tactic for dumpster fires is to fill the container with water. Often dumpsters will have a drain hole in lowest part of the side of the container. Plug this with cone shaped wooden plug by tapping it in with a hammer or flat-head axe, then simply flood the container with water (fig. 20–82). This tactic reduces the time and hazards for firefighters. However, be careful when flowing water into them. Be wary of the weight of water that you are adding and the possibility that the dumpster will move with added weight. Occasionally, it may be necessary to remove the contents of the dumpster to properly extinguish the fire (fig. 20–83).

Fig. 20–82. Dumpster plug

Fig. 20–83. Here a large dumpster had to be unloaded to be extinguished. Trash fires are a common call for firefighters. Here firefighters extinguish a large fire in a container. Remember to always be aware of hazardous materials illegally concealed in trash fire. (Courtesy of Tom Bierds)

Junkyard fires

Junkyard fires are outside fires that pose unique and special hazards to firefighters. Junkyards and scrap metal recycling sites are often large and wandering areas, forcing us to make long supply hoseline lays. Frequently on the outskirts of town or rural areas, water supply may be limited to nonexistent.

Automobile junkyards often stack cars to save space, creating unstable stacks of cars that can fall on firefighters. Obviously, sharp metal, burning plastics, and piles of hot and possibly molten metal dripping down from stacked cars all present us with serious hazards at these fires.

Although these fires may be spectacular, resist the urge to conduct an offensive attack. There is nothing to be saved, so nothing should be risked. Use master streams right away, because they have greater knockdown and can be applied from a distance away, thus providing a margin of safety. It sounds simple but is an often underused method, using the reach of the stream to provide some standoff distance for yourself at these fires (fig. 20–84).

Fig. 20–84. At large outdoor fires, like this one in an automobile junkyard, the use of master streams is required. Note how far the streams reach providing a good margin of safety for firefighters. (Courtesy of Brian Duddy)

Outside tire fires

Rubber automobile tires are sometimes stacked in huge piles, either awaiting disposal or recycling. When these mountains of rubber catch fire, they are very difficult to extinguish (fig. 20–85). They are generally stacked to conserve storage space. This stacking provides just enough space for air and oxygen for combustion, but not enough accessibility for effective stream application. Because they produce huge quantities of heat and black smoke, it is difficult and sometimes impossible to provide and effectively apply enough water to effect extinguishment. These fires often burn for days. Experience has shown that the most effective extinguishment method is to physically separate the unburned tires from the burning tires. This is usually accomplished with contracted or on-site heavy equipment while firefighters control the fire spread for safety. Class A foams have some effect on increasing the ability of water to penetrate these difficult fires.

Fig. 20–85. Tire fire. (Courtesy of Robert Ladd)

Outbuilding fires

Another common type of outside fire is a shed or small storage building (fig. 20–86). These fires can be deceptive and often contain hazards to unsuspecting firefighters. A shed or detached garage may be referred to as an outbuilding, garage, shop, or barn. These buildings may contain products, chemicals, and processes that the home or business owner does not want in his main house or business. Common hazards found in outbuildings include pesticides, pool chemicals, herbicides, flammable liquids, and gases. Recently, a fire in an outbuilding sent eight firefighters to the hospital. The owner ran a seamless linoleum floor business and had a variety of toxic chemicals that were burning. Strategy for these types of fires is to prevent them from extending to surrounding exposures, which may include the main house, business, or storage building, other nearby buildings, cars, trucks, or wildland. Always use full PPE and SCBA.

Fig. 20–86. Firefighters prepare to extinguish a shed fire. Note that they are going to use the reach of the stream to apply water, thereby keeping themselves at a safe distance. There is nothing to be saved, so nothing should be risked. (Courtesy of Tom Bierds)

Groundcover fires

Small brush fires. FFI 5.3.19 A very common type of response involves small fires in vegetation, including leaves and grass. These brush fires often occur along roadways and railroads, sometimes sparked by improperly disposed cigarettes or hot exhaust systems in cars (a car's catalytic converter can ignite leaves and grass when it is parked on top of these combustibles). Other brush fires are caused by campers who leave campfires unattended. Brush fires can grow in size to become wildland fires, described below.

Small brush fires are usually controllable with a single fire company and small hand lines (1½-in. or 1¾-in. [38-mm or 45-mm]). A key to extinguishing these fires is to determine the direction of spread, anticipating where it is headed. These fires tend to move as a linear front and can be knocked down in a sweeping side-to-side attack along the front.

Be extremely careful of even small brush fires burning in windy conditions. These fires can grow exponentially in size, erupting into a full-blown wildland fire. Also, be wary of fires burning near buildings. In these situations, it is best to call for additional fire companies quickly, before the fire gets out of hand. Since many brush fires occur in locations where there are no fire hydrants, the available water supply—onboard water tanks on the fire engine—may not be enough to deal with the fire if it grows too large.

Wildland fires. FFI 5.3.19 Large fires involving vegetation have come to be known as wildland fires. Some of these fires occur in the "urban-wildland interface," locations where residential development has penetrated into forests and heavily vegetated areas. Some of these wildland fires involve large responses of hundreds of pieces of firefighting equipment from many states, much more equipment than even the biggest building fires.

While a complete discussion of wildland firefighting is beyond the scope of this textbook, it is important for you to have a basic understanding of the terms and equipment used in wildland firefighting.

The use of proper terminology in wildland firefighting is just as important as it is in structural firefighting. Some of the more important terms to describe a wildland fire are the **head**, which is the portion of the fire with the greatest rate of spread (usually the edge of the fire opposite from which the wind is blowing; a fire may have multiple heads); **fingers**, which are long narrow

strips that extend from the main body of fire; **pockets**, which are unburned areas between the main body of fire and the fingers; the **rear** or **heel,** which is the end of the fire opposite from the head; **flanks,** which are the sides of the fire; and **islands**, which are unburned areas within the fire's perimeter (fig. 20–87). **Spot fires** are small fires started by flying embers far ahead of the main body of fire. *Green* is an area that has not been burned (the material may be live or dead vegetation). *Black* is burnt area.

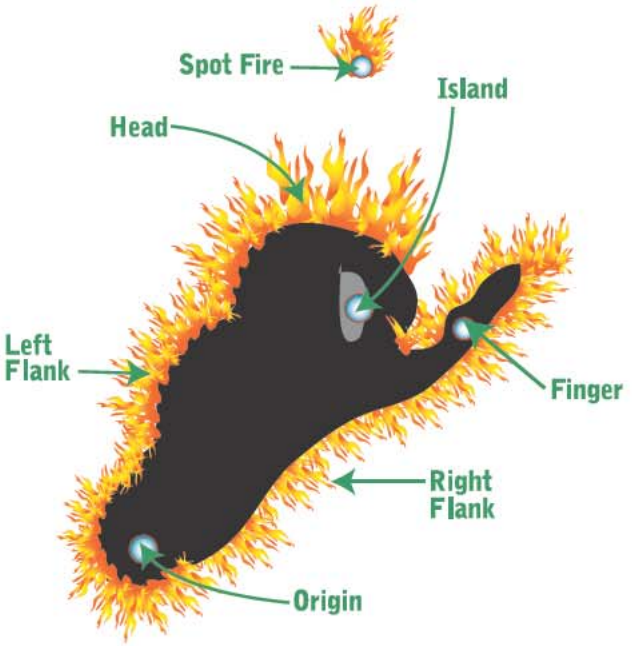

Fig. 20–87. A wildland fire

In terms of fire spread, creeping fires move very slowly. A running fire is one that spreads quickly with a well-defined head. A backing fire moves away from the head, downhill, or against the wind. A **crown fire** consists of serious fires that move across the tops of trees or shrubs, often independent of the fire at ground level (fig. 20–88).

Fig. 20–88. A crown fire in Yellowstone Park

Blowups occur when there is a sustained, rapid increase in the rate of spread, preventing control of the fire. A blowup will often necessitate changing the plan of fire attack. A **flare-up** is any sudden acceleration in the rate of spread for a short period of time.

Firefighters should be constantly aware of ground fire behavior, as well as changing weather and wind conditions when fighting ground fires. Escape routes and areas of safety should be identified and kept in mind throughout the firefighting operation in case of a sudden change in fire behavior.

When fighting a wildland fire, certain techniques are used. **Control lines** are "constructed" or natural fire barriers used to contain the fire. Firelines, on the other hand, are cleared strips or portions of a control line where flammable material has been removed by scraping or digging down below vegetation to mineral soil. An anchor point is the starting location for a fireline. A fire barrier is a safe anchor point. Using anchor points helps reduce the possibility of being outflanked by the fire while the fireline is being constructed. **Slopover** is fire that crosses the control line or natural barrier.

The primary methods for perimeter control of wildfires are direct and indirect attack. Direct attack is achieved through establishing control lines either at or close to the burning edge of the fire. Control lines for indirect attack are established at a distance from the fire, when the fire is too large or intense to use a direct attack.

When fighting a wildland fire, proper wildland PPE is required (refer to chapter 9, Personal Protective Equipment, for specifics on wildland PPE). In addition, the wildland firefighter carries a fire shelter (fig. 20–89). Shelters are used as a last resort when a firefighter becomes trapped and in danger of being overrun by the fire.

Fig. 20–89. Wildland shelter. (Courtesy of Andoni Kastros)

Wildland firefighters also use special tools and equipment. The most common hand tool is the Pulaski (fig. 20–90). It is a combined axe and mattock (a mattock is a chisel-like shape), which is capable of chopping down trees (the axe) and breaking up ground to create a fireline (the mattock). Large wildland fires necessitate the use of heavy equipment such as bulldozers, as well as air resources such as tankers and attack aircraft.

Fig. 20–90. Pulaski tool. (Courtesy of Andoni Kastros)

Specialized training is required for wildland firefighting. Such training includes safety procedures (LCES: lookouts, communications, escape routes, safety zones), constructing and maintaining firelines, wildland fire behavior, and tool use among many other specialized topics.

FIRES IN STACKED MATERIAL

Fires in stacked material, whether inside or outside a building, present two major challenges for firefighters: water application and collapse hazards. Common occupancies where you may find stacked material are lumberyards, junkyards, recycling plants, and warehouse or storage areas. Applying water to stacked material is difficult because extinguishment requires water to be applied on all six sides. Pallets of raw materials, parts, fabric, or other items are stacked on top of another to save space. As a result of this method of storage, fire can be on all four sides and the top and bottom. Bins or pallets of materials usually have access for storage, and retrieval from only the front side and may be stacked several deep. Further complicating water application is the fact that shelving may prevent water from dropping down onto the top of the burning material. In-shelf sprinkler systems are required to apply water to stored materials and are a good option. If these systems are in place in the building, always supply the system with one or more hoselines.

In the case of warehouses with automatic sprinklers, water application can be compromised by shelving in storage racks, blocking water from dropping down onto the top of the burning material. Rack sprinkler heads are required in such situations to apply water directly on to stored materials.

As the packaging material burns away, as in the case of a cardboard box or carboy container, its contents may spill out or fall. Wooden pallets that are the base for many types of container systems burn, and they may lose structural integrity and cause contents to shift and fall onto firefighters making an interior attack.

Falling debris from stacked material presents several hazards to firefighters. Obviously injuries can occur from this heavy material falling on unsuspecting firefighters. The falling debris will not be seen by firefighters below, because it will be obscured by smoke and can be initiated by lateral forces applied by hose streams. Falling debris can cover exit ways and hoselines, trapping firefighters or at the very least making a tactical withdrawal a very dangerous and time-consuming operation. Depending on the type of material stored in stacked fashion, the collapse or opening of containers by physical collapse or burning of containers can result in rapid fire progress, killing or injuring firefighters.

Extinguishing stacked material fires helps create an additional hazard that may kill or injure firefighters. Water will be absorbed by both packing and packaging materials and will therefore increase the weight of the stacked material. The weight of water, at 8 lb per gal (1 kg/L), can cause catastrophic failure of the shelving system. If the material is stacked without shelves (e.g., large rolls of paper or bailed materials such as hay or recycled materials), water can soften it, causing it to

sag or become unbalanced and fall on firefighters. Firefighters have been injured and killed in this exact scenario. Remember to stay out of the collapse zone for stacked material.

Foam use on stacked material

Class A foam can be used to increase the effectiveness of water on stacked material fires. (Foams are discussed in greater detail in chapter 31, Advanced Fire Attack.) These foams lower the surface tension of water and therefore make it more effective. The water penetrates baled materials with greater effectiveness because of the reduced surface tension of the water, thus increasing the cooling effect of the water applied. Essentially, the water is allowed to penetrate deep in the material instead of beading up like raindrops on a car hood because the water's surface tension is reduced. This is caused by the foam concentrate, which is a detergent-based synthetic foam. These concentrates are not designed for use on flammable liquids but rather on any Class A combustible.

When **aspirated** much like Class B foams, Class A foam has a cooling and smothering effect on Class A combustibles. Class A foams are generally used at less concentration than Class B foams; 0.1–1% and can be proportioned a number of ways. Used as a wetting agent, standard solid bore or combination nozzles can be used. When used for pretreatment (before the fire) or as a mop-up tool, air aspirating nozzles or compressed air systems are needed.

NOTES

1. The United States National Institute of Standards and Technology (NIST) report NBSIR 80-2120, *Fire Development in Residential Basement Rooms,* October 1980, (Fang and Breese).

QUESTIONS

1. What is some of the basic information that can be gained from a proper communication report of a fire officer that has arrived on scene?
2. List at least five steps to a successful fire attack.
3. What is the purpose of size-up?
4. There are seven specific points to size up that must be considered upon arrival. List all.
5. What are the primary differences between an "offensive vs. defensive" type of strategy?
6. Which type of strategy is the "blitz attack" method employed?
7. Why are doors the primary entry and egress points to initiate a fire attack?
8. What is the primary purpose of the fire attack line?
9. When performing a rescue of trapped occupants, what is the preferred means of removal?
10. An engine companies operations can do more to effect the rescue of trapped or injured persons than any other group of firefighters. What are the common ways this is accomplished?
11. List the primary responsibilities for the nozzle operator during the initial stretch.
12. List the primary responsibilities of the backup position during the stretch.
13. Which position of the fire attack line is responsible for monitoring fatigue levels of the crew, communicating with command, and requesting additional assistance during the advancement of the hoseline?
14. What type of building will most likely require the use of a standpipe stretch to get the initial attack line into operation?
15. When utilizing the direct or modified direct method of attack, the nozzle should always be set on which pattern?
16. What are the dangers of opening up a fog stream during fire attack?
17. What are some of the basic duties firefighters will perform during the pick up and return part of an incident?
18. What is one of the most challenging types of fires to control, and why?
19. When sizing up a garden apartment for fire attack, what must often be considered when making the hoseline stretch?
20. Taxpayer buildings present a unique combination of occupancy during firefighting operations. What types of occupancies can typically be expected?

21. Big box retail structures should always have what size of line deployed?

22. When sizing up a vacant structure for fire attack, what are some of the general considerations for this type of building?

23. Outside tire fires prove to be extremely difficult to extinguish and often burn for days on end. What is the most effective way to combat tire fires?

24. List some of the hazards firefighters face when combating fires in stacked material.