CHAPTER

14

Fire Prevention, Detection, and Response

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OUTLINE

CHAPTER OBJECTIVES

- Identify the three components of a fire triangle
- List typical hazard areas where fires may occur
- Identify the types of fires
- Explain the use of five types of fire extinguishers
- Emphasize the necessity of developing a fire plan

Fire has long held a position as one of the most feared threats to life and property. Fires not only destroy homes and buildings, but they can also consume vast expanses of wilderness or entire neighborhoods and take the lives of people within the area affected. Once initiated, fires spread rapidly and become extremely hard to control or extinguish.

Our best defense is the prevention of fire before it begins. Through effective controls and inspection, this threat can be significantly reduced, to the benefit of everyone. In all fire situations, the protection of human lives must be the most important factor. Property can be replaced, information recompiled, and other materials remade. Protection of human lives must be the overriding consideration in every prevention and response plan.

FIRE BASICS

Fire is, in its basic mechanics, nothing more than an extremely rapid conversion from one state to another. This reaction requires three components to occur and must continue to utilize these three components to be sustained. As such, in looking at the prevention and response to fires,

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it is essential that everyone understand these parts, known as the "fire triangle."

1. **Fuel**—For a fire to exist, there must be some materials available that are capable of combustion. The material could be as simple as paper or wood, or as complex as magnesium. In every case, fuel is the component that undergoes the conversion from its current state to a different state. In most cases, conversion is from a solid to a gas, with some solid materials remaining.
2. **Oxygen**—The conversion of states in a fire situation requires an interaction with available oxygen. In most cases, fires are entirely dependent on the oxygen in the surrounding air; in other, fairly rare, cases the material that is being consumed may produce oxygen as a result of this process.
3. **Heat**—The final component required to cause the fuel in an oxygenated environment to begin the process of conversion is some source of heat. The heat release rate (HRR) is a measure of how quickly fire temperature will increase.

The interactions in the fire triangle can vary based on fuel types, environmental conditions, and room or compartment factors. It should be noted that furniture and other contents that are primarily wood or ordinary combustibles will develop HRR at a slower speed. With fuel that is synthetic in nature the fire temperature will increase dramatically faster.

Without the presence of all three components, a fire cannot begin or be sustained. This leads us to the basic concept that cleanliness is a major contributor to the prevention of accidental fires. If all available fuels are stored in a manner consistent with fire prevention practices, they will be sufficiently removed from identified sources of heat, and the chance of combustion is reduced. This means that all identified sources of fuel must be identified and properly utilized and stored, to prevent exposure to heat (Fig. 14.1).

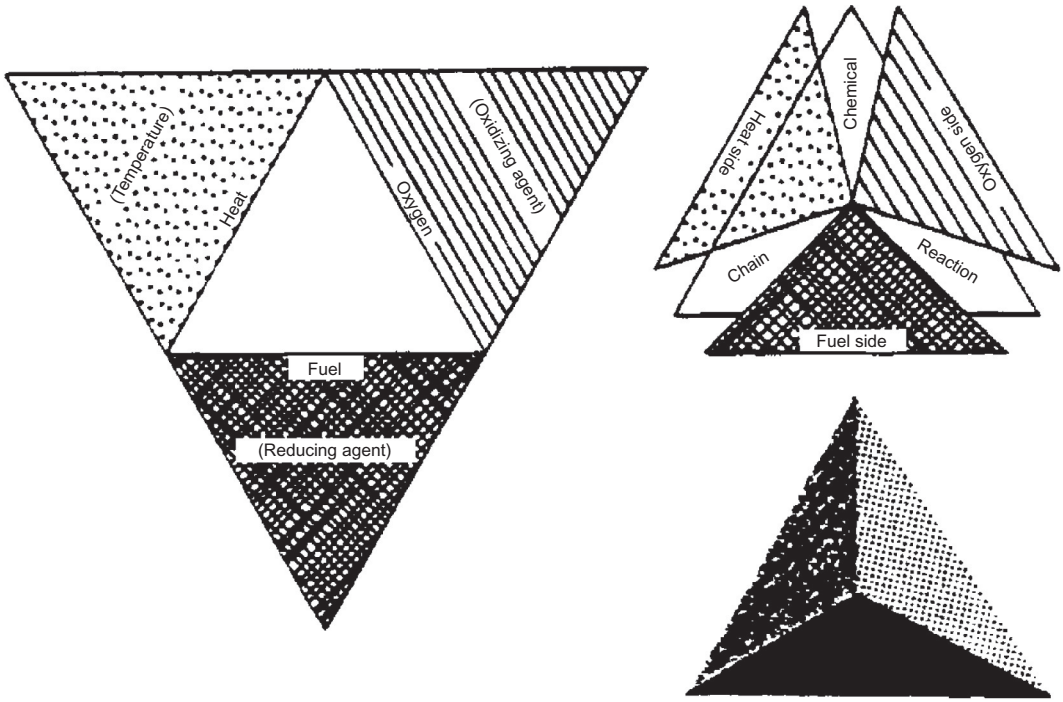

FIG. 14.1 The fire tetrahedron.

For example, one of the more common fire locations in the hospitality industry is the laundry area. The operation of industrial dryers requires the production of heat. When drying cloth, there is a certain amount of lint that is produced. As a result, there is a ready supply of fuel (lint is very combustible) in close proximity to a heat source. The prevention practice is extremely simple: remove and clean the lint filter after each load, or at least on a regular basis.

Other typical hazard areas to inspect could include the following:

1. Boilers, heaters, and furnaces
2. Cooking areas
3. Electrical equipment and breaker rooms
4. Storage areas for flammable liquids
5. Vehicle storage areas
6. Work areas that utilize oils, paint thinners, and other combustible liquids
7. Process areas that utilize an open flame.
8. Smoking areas

As a general rule, areas that are cluttered tend to have an increased chance of fire hazards and should be frequently inspected until they are properly cleaned. Poor housekeeping is likely reflected in a decreased awareness and priority of overall fire safety. This supports a cultural priority to maintain good housekeeping and a high level of fire safety.

When inspecting for fire hazards, which should be a constant aspect of every patrol, it is also essential that identified hazards be corrected, documented, and prevented from reoccurring. Educating people in the importance of fire safety can help to reinforce the role of each person in maintaining a safe work environment.

DETECTION METHODS

If prevention methods fail and a fire begins, the specific hazard must be detected so that the response program can be effective. The two methods of fire detection are human observation and electronic systems.

Human observation is often more effective, since it allows for the use of reasoning and judgment to determine the nature of the actual situation. In this case, however, there must be people present to make the discovery. Patrol officers have excellent opportunities to identify potential fires through smell, sight, and even sound and touch. In some cases, officers observe fires in such an early stage of development that they are able to effectively extinguish them without outside assistance. In addition, by obtaining the cooperation of other people in the environment, the chances of human observation can be increased. Often, these other observers must be given some form of basic training to identify hazards or early stage fire threats so that they can be more effective. Every person should be trained in the actions to take if a fire is discovered. This type of training can be conducted during on-boarding and annually thereafter.

Electronic detection can also be highly effective, especially in areas where chances of observation by people are relatively low due to infrequent travel or visual obstruction. Electronic systems of detection can include sensors that watch for smoke, rapid increases in temperature, temperatures above certain levels (regardless of how quickly that temperature is reached), and even early combustion of airborne particles. Unfortunately, electronic sensors can also trigger alarms as a result of situations other than fires. It is because of this that all alarms must be investigated to determine the actual cause. Any alarm activation should be taken seriously until investigated. Failure to thoroughly investigate or turn off the system prematurely has contributed to numerous large fires.

The ideal detection program is, of course, a combination of human observation and electronic monitoring. By thoroughly training the protective force and offering basic training to all other people who will be in the area and utilizing an electronic system as a backup to these components, you greatly increase the likelihood of identifying fire situations. Officers should be competent in the specific actions to take when fire is discovered.

As previously stated, it is essential that fires are identified at the earliest possible moment, so that they have not had a chance to grow too large to be contained and extinguished.

FIRE TYPES

Although based on the same concept, fires can be divided into four basic types, determined by the nature of the fuel component of their fire triangle. It is important to know these types and the differences in their fuels, as it can make a difference in how the fire is contained and extinguished. The basic classes are given in the following:

1. Class A fires generally have common solid, combustible materials as their fuel. This may include such fuels as wood, paper, and cloth. This is a very common form of fire. It is also the most basic.
2. Type B fires are fueled by liquid or gaseous fuels, such as gasoline, kerosene, and compressed gas tanks like propane.
3. Type C fires are initiated by, or contain an element of, energized electrical involvement. Fires in a breaker box, power strip, frayed extension cord, or item of powered equipment would fall into this category. De-energizing a Type C fire will create a Type A fire.
4. Type D fires are caused by burning metals, such as magnesium. They are often extremely intense and require special equipment to handle.
5. Class K fires involve oils and greases normally found in commercial kitchens and food preparation facilities using deep fryers.

Once the nature of a fire is understood, it becomes a determining factor in how to handle a particular situation. For the most part, classes A, B, and C fires of sufficiently small size can be contained and extinguished by a person utilizing an appropriate extinguisher. Class D fires require such specialized equipment that most responders will not be able to effectively handle them and should be cautioned to maintain a safe distance in the process of evacuating the immediate area (Fig. 14.2).

EXTINGUISHERS

The most critical aspect of deciding if you are going to attempt to extinguish a fire is determining if you can do so without serious risk to your own safety or the safety of others. Make no mistake: fighting a fire is dangerous. By its very nature, this activity requires that you intentionally remain within, or move within, close proximity to a highly hazardous environment. Care should be taken to ensure that the responding person understands the dangers and the

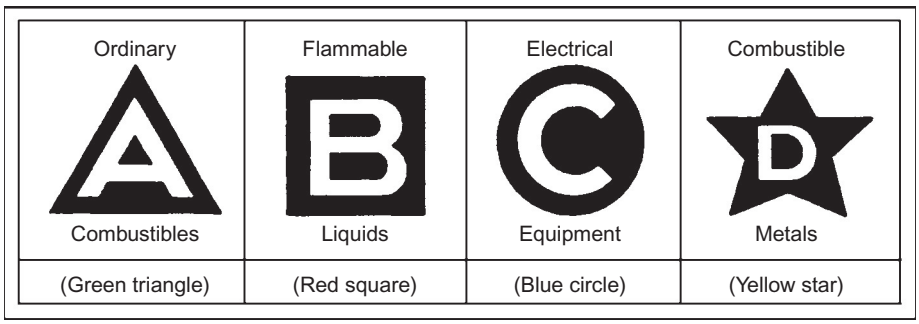

FIG. 14.2 Fire classifications.

equipment to be used, as well as its limitations. The purpose of fighting a fire is to save lives and property, not to risk them needlessly.

When working in an environment with extinguishers that you may not have used before, it is recommended that a test unit be obtained, even in a group setting, so that the area of effect, limits of range, and duration of use can be explored. Using an extinguisher on a fire, without previous training, can contribute to making the fire worse or injuring people. Security officers should complete annual training in the use of extinguishers to increase their capability levels.

When deciding if it is appropriate to attempt to extinguish a fire, it is important that the equipment you select matches the fire type. Mismatching the extinguisher and fire types may result in a marked increase in the level of personal danger to which the responder is exposed. With this in mind, some of the more common extinguisher types and the class of fire they are intended to be used on are as follows:

- **Dry chemical**—These utilize a powder that is expelled from the nozzle in a stream of pressurized, nonflammable gas. Dry chemical extinguishers are usually classified as usable on Class A, B, and C fires, as they will be both effective and relatively safe in those applications. Dry chemical extinguishers extinguish the fire by coating the fuel of the fire, making it unavailable for combustion.
- **Carbon dioxide**—These units produce a cloud of snow-like particles that quickly evaporate into a carbon dioxide layer. This layer reduces the available oxygen and cools the area, breaking the fire triangle. They are commonly classified as B and C type extinguishers.
- **Water based**—Water is a good extinguishing agent for Class A fires but can aggravate other types. If used on burning liquids (Class B), it can spread the fuel, thus enlarging the fire area. If used on electrical fires (Class C), it can cause serious harm to the responder, as it may conduct an electrical charge, causing an electrical shock to be delivered to the holder of the unit or others standing in the runoff from it.
- **Halogenated units**—These are referred to as "clean agent" extinguishers because they contain a chemical that leaves no residue on evaporation. They cool and smother fires, making them typically usable on Class A, B, and C fires. These are the ideal type of unit for responding to computer or other delicate electrical equipment fires, as they are far less likely to cause damage to the equipment in the process of extinguishing the fire.
- **Foaming agents**—These units produce a foam layer that blocks the flow of oxygen to the fire area. They are very effective against Class A and B fires. Unfortunately, foaming agent extinguishers often utilize a water-based agent and so should not be used on Class C fires.

In the past, there were extinguishers that had to be inverted to cause a reaction between the main tank contents and a bicarbonate material, resulting in development of pressure. It has been recognized that this motion, the inversion of a heavy extinguisher, may not be within the capabilities of persons with disabilities, and their use has been largely discontinued. In the United States, such extinguishers do not comply with the Americans with Disabilities Act and should not be present in the workplace.

Extinguishers should also be checked and inspected on a regular basis. Most fire codes required annual inspection. If there is high traffic in a given area, especially one that is open to the public, checking extinguishers daily, or even on each 8-h shift, might be in order. It is important to ensure that they have not been discharged or tampered with so that they will be available for use if a fire is discovered. Officer awareness of extinguisher type and location can make a difference in the outcome of a fire incident.

PERMANENT EXTINGUISHING HARDWARE

In addition to extinguishers, which may be carried by possible responders, there are some more elaborate extinguishing devices that are installed in buildings:

- **Automatic sprinklers**—these operate through a spring-loaded valve that opens when exposed to certain minimum temperatures. These valves, called "sprinkler heads," are located at regular intervals throughout the entire building. Once the valve opens, the feed pipe that is attached to it will continue to supply it with water until the control valve for that area is closed or the sprinkler head is replaced. In most systems, the feed pipe has a sensor added to it to activate the alarm system if the water begins to flow toward an activated sprinkler head.
- **Range-hood systems**—in kitchen areas, there are often specialized systems designed to blanket the entire working area with a special chemical agent. This is designed to be highly effective on grease fires and other common kitchen fires, yet still be relatively easy and sanitary to clean up. These systems are triggered manually by persons who observe a fire.
- **Stand pipes**—based on application of fire codes, most buildings have a stand pipe system that allows for the connection and supply of fire hoses. Like an extension of a fire hydrant, these provide the fire department, or in-house fire brigade, with an available source of water.

Specialized areas such as computer rooms or high hazard process areas may require different styles of extinguishers. Security officers should be trained in all types of extinguishers that are located in their patrol area.

It is widely accepted that, even under the best of circumstances, these types of automatic or large-scale systems usually slow or contain a fire, but often do not extinguish it. As a result, it is essential that each activation is investigated, and the fire department becomes involved to ensure that the hazard is properly eliminated.

CONTAINMENT

In addition to the actions of responders and the utilization of various systems and equipment, there are usually design limitations that aid in the containment of a fire. In most jurisdictions, and within many companies, there are specific design and construction requirements, with regard to the use of fire-resistant building materials. Such items as fire-resistant doors, designed to resist the spread of a fire for certain periods of time, aid greatly in the containment of a fire. However, to be effective, they must be in their proper position and working in accordance with their original design. As part of every officer's patrol, confirming that fire doors are in proper condition and not propped or wedged open should be a constant component.

Toxic smoke from fires can spread quickly affecting personnel at a distance from the fire. In all, 85 people died, most by smoke inhalation, at the devastating 1980 fire at the Las Vegas MGM Grand Casino and Hotel fire. The largest number of fatalities occurred remote from the fire itself as toxic smoke spread through the hotel.

FIRE PLANS

Designing a fire plan, prior to an actual event, is the most effective step in any fire prevention, fire detection, and fire response program. It is through this plan that all of these factors should be addressed and given structure, detail, and actions to be taken.

Developing such a plan must be done in cooperation with those expected to execute the plan.

Fire safety personnel and security officers should be involved from the beginning. Without this, it is possible that aspects of the final plan may be unrealistic. Lack of collaboration on development of a realistic plan could prevent an effective program from being implemented. The planning process has additional benefits of relationship development among safety personnel.

The written plan should include the following as a basic guide:

- Emergency contact names and telephone numbers
- A formal chain of command for routine accountability and command in the event of an incident.
- Detailed explanations of the responsibilities of each person or department in prevention aspects.
- Detailed explanations of the responsibilities of each person or department in response aspects.
- An explanation of the equipment available, the frequency of inspection, and the method of documentation.
- An explanation of the training that personnel receive, the frequency of retraining, and the specific responsibilities bestowed as a result of this training.
- Charts and diagrams of the property, detailing equipment locations, routes of egress, evacuation meeting locations, and similar fixed points.

It is critical that senior management reviews this program and supports it. Senior management's attitude toward the safety process will impact all aspects of plan execution and priority. It is also essential, and in some areas required, that the fire marshal have a chance to review the fire plan and approve it prior to implementation. Sharing the plan with area responders will also benefit safety of personnel and property in the event of an incident. Knowledgeable police officers and fire department personnel will increase effectiveness of the plan.

As part of a formal plan, alarm systems should be regularly inspected and tested to ensure that the components are functioning properly. Inspection and testing should be conducted to comply with local requirements and codes. This should include activation of every sensor through cooperation with a qualified/certified inspector or installer and the presence or approval of the fire marshal. All inspections and testing should be documented.

Above all, the response portion of a fire plan must be realistic in its assignments and expectations. It should be written with the following limitations in mind:

- Assign duties only to people or positions that will always be present. If you work in an area where the patrol officer is the only position that is staffed at all times, the response plan should assume that this will be the only person present for its critical aspects. It is easier to assign an extra person to a new duty than it is to find an extra person for a vacant function. The plan should be written based on roles, not individual people. As an example, the officer on beat 123, not Officer Smith, should be expected to take action. This ensures that people will be trained based on roles and responsibilities.
- Write each phase with the protection of lives as the primary focus, and property concerns as a secondary motivation.
- Write the plan based on existing equipment and supplies only. Do not count on having time to obtain other items before the plan must be put into action.

The plan, once developed, has to be exercised after people have been trained. This ensures that the plan as conceptualized on paper will meet real-world situations. Officers need to be part of the drills and exercises conducted. An untested plan is just a concept.

The most important point about fire plans is that *they must be put into effect!* What good is a

plan that is exhaustively researched, designed by a broadly scoped committee, approved by every member of the team, and then put on a shelf and never utilized?

ARSON

Fires are not always accidents or acts of nature. An alarming number of cases are thought to be fires that are intentionally set for any of a vast number of reasons. In some cases, insurance fraud is believed to be the motivator; in others it is due to psychological disorders. Whatever the motive, arson fires are some of the most dangerous. Often, accelerants are utilized to cause the fire to grow rapidly beyond the containment and extinguishing capabilities of the responding fire department. In some tragic cases, this means that those within the structure don't have time to escape before falling victim to smoke inhalation. In even more sinister cases, arsonists have been known to block or lock doors, preventing escape from the flames.

Your best protection against arson is a combination of highly visible patrols to deter the attempt, and effective securing of unused rooms and flammables. These steps will reduce the areas of concealment, which the arsonist often relies on to prepare for the incident, and also cause the arsonist to have to bring their own materials, which could draw attention to them. Much like other crimes, a motivated and dedicated arsonist will eventually find a way to attempt to carry out their crime, but you can create an environment where the arsonist, looking for a random place to start a fire, will be less likely to feel comfortable.

All fires should be thoroughly investigated to determine their cause and origin. A clever arsonist may start a small fire to gauge response. Investigating all fires provides a visible message that fire safety is important.

FIRE AS A WEAPON

Fire has been utilized as a weapon since its discovery. Security officers' actions in these instances will save lives. Officer awareness of patterns or materials being delivered can be important in overall situational awareness. A large cargo truck of flammable liquids that pulls into the parking lot could be a legitimate delivery or the precursor to a terrorist action. Employees attempting to take dangerous materials off site or using them for vandalism can be another precursor when officers must use fixed fire protection systems. The security officer's observations and actions are on the front lines of preventing the use of fire as a weapon in an attack.

Officer familiarity with the occupancy preplan will be critical in the event of any incident. All security force members should be trained in plans involving evacuation or sheltering in place. Officer actions in these instances will be taken long before fire and police resources arrive. Officer knowledge, awareness, and actions are critical to the outcome of any human caused event.

CONCLUSION

Know the basics and apply them to every patrol. Train each member of the team who is supposed to respond to fire situations so that they are not hesitant when that time comes. Train everyone in how to prevent fires and respond to discovering them, for their own safety. Fire can be a devastating event, especially if the response is uncoordinated or slow. Regularly check and inspect equipment to ensure that it is in usable condition, should the need arise.