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## **Module 12: Fire Protection and Prevention**

### **Module Description**

This module has been designed to deliver firsthand information about fires and fire protection measures. After completing this module, you will be able to identify different types of fires and define the safety measures that can be taken to avoid a disastrous situation. We will also discuss the different types of fire extinguishers in use and discover how careful planning and precautionary measures can be taken to save lives and property.

This module is intended for the general audience. For more information, please contact your local fire department and consult your fire safety and security maintenance supervisor.

### **Module Learning Objectives**

At the conclusion of this module, you should be able to:

- Identify different types of fires and fire extinguishers.
- Discuss fire related-injuries and their immediate remedies.
- Discuss fire protection systems and evacuation during a fire.
- Create evacuation plans and prepare for emergencies.

# Lesson 1: Fire Safety Essentials

## Lesson Focus

This lesson focuses on the following topics:

- Fires
- Fire Extinguishers
- Fire Safety Alarms
- Rescue and Evacuation
- Injuries and First Aid
- Burns

## Fires

The event of something burning (often destructive) is called a fire. Fires occur when the following elements are present:

- Oxygen—air, compressed oxygen
- Burning medium—wood, combustible materials, paper, gasoline, etc.
- Heat source—flames, sparking elements, heaters

## Fire Prevention Is Important

Employers should:

- Plan how to prevent fires.
- Train employees on fire prevention.
- Promote strong fire prevention practices, and methods.
- Perform regular inspection of workplaces.

## Fire Prevention Plan

OSHA standards require a fire prevention plan to prevent fires and protect all employees from fire hazards.

A fire prevention plan details:

- Names of employees responsible for controlling fire hazards from fuel sources.
- Names of employees responsible for fire prevention equipment or equipment to control fires.
- Safeguarding controls and maintenance of safeguards to prevent accidental fires caused by heat causing machinery, equipment, and materials.
- Handling and storage of combustible or flammable materials.

- Naming specific fire sources and locations and available equipment for fighting fires.

### **Note: What can start a fire?**

A fire can start because of:

- Malfunctioning electrical equipment
- Cigarettes and tobacco related products
- Overheated wiring and equipment
- Welding arcs
- Heating equipment

## **Types of Fire**

Following are the different types of fires:

- **Class A:** Ordinary combustible (rags, paper)
- **Class B:** Combustible/flammable liquids (petroleum, diesel)
- **Class C:** Electrical fires (equipment, breakers)
- **Class D:** Flammable/combustible metal fires (magnesium, potassium)

### **Class A: Ordinary Combustible**

Class A fires involve ordinary combustible materials such as wood, paper, rags, rubbish, and other solids.

### **Class B: Combustible / Flammable Liquids**

Class B fires occur due to flammable and combustible liquids such as gasoline, fuel oil, paint thinner, hydraulic fluids, flammable cleaning solvents, and other hydrocarbon fuels.

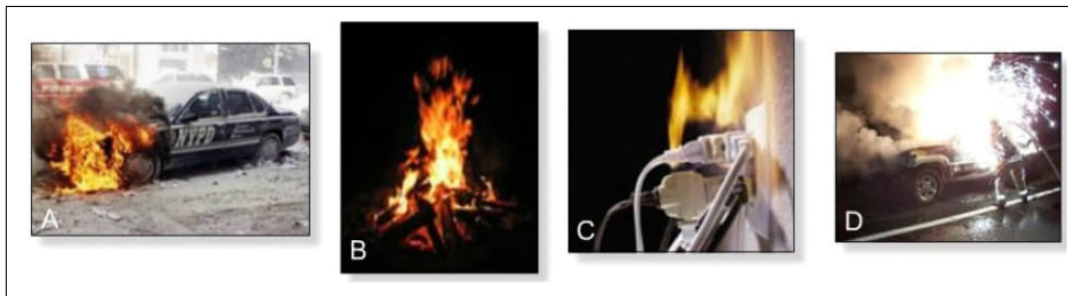
### **Class C: Electrical Fires**

Class C fires involve energized electrical equipment such as power outlets, circuit breakers, defective wiring, and overloaded circuits.

### **Class D: Flammable/Combustible Metal Fires**

Class D fires occur in combustible metals such as magnesium, aluminum powder, and alkali metals.

Many newer model autos have magnesium parts. Auto fires should never be countered with water. Magnesium will react violently to water. In the picture (D) below, the reaction was caused by spraying water onto a magnesium part on the steering column.



## Fire Extinguishers

A fire extinguisher is a device used for putting out fires.

There are four different types of fire extinguishers classified according to the type of fire they extinguish. The four different types of fire extinguishers are Class A, B, C, and D. The classes relate to the type of fire they extinguish. Older fire extinguishers used geometric shapes to identify their type, but more current extinguishers use a labeling system that incorporates both words and pictures to distinguish the type of fire they are best suited for.

**More Information:** Class A and Class B fire extinguishers have a numerical rating that is designed to determine the extinguishing potential for each size and type of extinguisher.

### Classification of Fire Extinguishers

The types of extinguishers and their uses are given below:

- **Class A**-Pressurized water cans, clean agent/halogen, and wet chemical for specific applications
- **Class B**-Carbon dioxide, dry chemical, wet chemical, clean agent/halogen
- **Class C**-Dry chemical, carbon dioxide, clean agent/halogen
- **Class D**-Dry powder
- **Multi-class extinguishers**-carbon dioxide/dry chemical



**More Information:** Extinguishers must be placed in an easily accessible location and should be in good operating condition. Extinguishers should be placed adjacent to a normal path of travel. At a minimum, fire extinguishers must be placed at all points of egress on construction projects and in close proximity of combustible/flammable materials stored on the site. The proper class must be marked on the extinguisher, so that it can be used according to the class of fire.

### **Class A Extinguishers**

Class A extinguishers are water-based or wet chemical solutions that are used on paper, cloth, wood, trash, and other common combustible fires. These extinguishers utilize a cooling and soaking stream that is effective on Class A fires. The numerical rating for this class of fire extinguisher refers to the amount of water the fire extinguisher holds and to the amount of fire it will extinguish.

### **Class B Extinguishers**

Class B extinguishers are pressurized with non-flammable carbon dioxide gas, dry chemical, wet chemical, or clean agent/halogen. Carbon dioxide reduces, or smothers, the oxygen content to a point where combustion cannot continue. Carbon dioxide is a clean, non-contaminating, odorless gas and can safely be applied to clothing, equipment, and valuable documents without causing extreme damage.

Class B extinguishers are used on fires involving flammable liquids including grease, gasoline, oil, paint thinner, hydraulic fluids, flammable cleaning solvents, and other hydrocarbon fuels. Carbon dioxide is extremely cold when disbursed from the extinguisher.

The numerical rating for this class of fire extinguisher denotes the area in square feet of a flammable liquid fire that a person can expect to extinguish.

### **Class C Extinguishers**

Class C fire extinguishers are used on fires involving energized electrical equipment. Such fires must be extinguished using a non-conductive extinguishing agent such as carbon dioxide or a dry chemical or a clean agent/halogen. Carbon dioxide is most effective in extinguishing electrical fires, as it does not leave a residue that can harm sensitive electronics.

This class of fire extinguishers does not have a numerical rating. Class C extinguishers have only a letter rating because there is no readily measurable quantity for Class C fires. The presence of the letter "C" indicates that the extinguishing agent is non-conductive.

## **Class D Extinguishers**

Class D extinguishers are designed for use on flammable metals and are often specific to the metal in question. Metals such as magnesium, potassium, titanium, and sodium burn at high temperatures and give off sufficient oxygen to support combustion. These metals react violently with water or other chemicals and must be handled with great care. The most common extinguishers for Class D fires use a dry powder designed specifically for this purpose. A common method of extinguishing small flammable metals fires is to cover the fire in dry sand.

No picture designator is used on Class D extinguishers and this type of extinguisher generally has no rating.

## **Multi-Class Fire Extinguishers**

Many fire extinguishers can be used on more than one class of fire and are called multipurpose extinguishers. Multi-class fire extinguishers are labeled with more than one class designator, such as A-B, B-C, or A-B-C. Multi-class fire extinguishers typically contain dry chemicals and an extinguishing agent that uses a compressed, non-flammable gas as a propellant.

## **Fire Safety Alarms**

### **Smoke Alarms**

In case of a building fire, the first step is to warn the occupants and to evacuate the building as soon as possible. Early fire warnings can be given by means of active smoke and fire alarms installed in strategic locations throughout a building.

The two primary types of smoke alarms in use are ionization and photoelectric alarms. Ionization smoke detectors activate more quickly in fast, flaming fires that consume combustible materials rapidly and spread quickly.

The photoelectric type of smoke detector is quicker to respond in slow, smoldering fires. These types of detectors provide early detection of smoke. When installed correctly, they provide accurate and dependable smoke detection.

**Note:** A combination of both types of detectors provides the greatest protection against fast moving fires and smoldering fires.

## Fire Sprinklers

Fire sprinklers are designed to provide 24-hour protection by detecting and controlling fires before they become a threat to lives or property.

Fire sprinklers are designed to react quickly and independently of one another so that only those detectors in the affected area activate. Most fires are controlled by one or two sprinklers disbursing a minimal amount of water, which reduces the fire and water damage significantly.

## Rescue and Evacuation

Comprehensive evacuation plans are designed to assist employers in meeting or exceeding workplace safety standards. These plans must be a cooperative effort between the employers and the employees. Copies should be posted near all exits, stairways, fire extinguishing equipment, and at any other location suitable for maximum exposure.

These plans must contain pre-assessed escape and exit routes, designated assembly points, emergency call points, and the locations of fire extinguishing equipment.

## Injuries and First Aid

The majority of fire-related deaths (50-80 percent) are caused by smoke inhalation. Actual flames and burns are second to smoke inhalation as the cause of deaths in fires.

The National Traumatic Occupational Fatalities surveillance system recorded 1,587 fire and flame-related occupational fatalities among the civilian workforce in the United States between 1980 and 1995. Of these fatalities, 433 resulted from 127 incidents that involved 2 or more victims.

**More Information:** Never enter a fire scene unless you are properly trained to do so and have the appropriate safety equipment immediately available.

## Smoke Inhalation

Although smoke inhalation is the primary cause of deaths in fires, it is second to burns in the cause of injuries. Smoke from a fire may contain poison gases or may be hot enough to burn a victim's throat and lungs, resulting in serious breathing problems and even death. Symptoms of heavy smoke inhalation include breathing trouble, coughing, drowsiness, an upset stomach, vomiting, unconsciousness, and death.



It is important to evacuate from a smoky room as quickly as possible. If available, use a piece of wet cloth to cover your mouth and nostrils as you crawl as close to ground level as possible to safety. Once you're in fresh air, rest while taking deep breaths, and do not enter the smoky area until the fire is completely extinguished, all smoke has been removed, and fire officials have cleared the area.

## Burns

### Treatment of Burns

For all burns beyond mild first degree burns, seek medical attention immediately. Improper treatment can exacerbate damage. Minor first degree burns can be treated by flushing the area with cold running water. Apply a clean, water-cooled cloth over the area to relieve pain. Do not apply ointment. Seek medical attention if the pain persists or if the burn appears worse.

### Electrical Burns

Even if there is no visible evidence on the surface of the skin, electrical burns can cause deep tissue damage. Commence CPR/EAR if pulse and breathing are absent. Immediately seek medical attention.

## Lesson Summary

While the majority of fire-related deaths are caused by smoke inhalation, actual flames and burns follow this. Although fire sprinklers are designed to provide 24-hour protection by detecting and controlling fires before they become a threat to lives or property, a combination of both types of fire detector (ionization and photoelectric) provide the greatest protection against fast moving and smoldering fires.

Some of the newer fire extinguishers can be used on more than one type of fire. Multi-class fire extinguishers are labeled with more than one class designator, whereas class C extinguishers have only a letter rating because there is no readily measurable quantifier for this type of fire.

Class B extinguishers are pressurized with non-flammable carbon dioxide gas or other product designed for this application. Carbon dioxide reduces, or smothers, the oxygen content to a point where combustion cannot continue. The numerical rating for this class of fire extinguisher denotes the area in square feet of a flammable liquid fire that a person can expect to extinguish.

Class A and Class B fire extinguishers have a numerical rating that is designed to determine the extinguishing potential for each size and type of extinguisher. Class A extinguishers typically have water-based solutions. The numerical designator here refers to the amount of water the fire extinguisher holds and the amount of fire it will extinguish.

## **Lesson 2: Fire Prevention and Safety Measures**

### **Lesson Focus**

This lesson focuses on the following topics:

- Ignition Hazards
- Temporary Buildings
- Open Yard Storage
- Indoor Storage
- Emergency Planning
- Portable Firefighting Equipment
- Fixed Firefighting Equipment

### **Ignition Hazards**

Electrical wiring and equipment should be installed by an experienced electrical professional in compliance with the requirements of applicable safety and building standards.

Smoking should be strictly prohibited in any area that could pose a potential fire hazard. Such areas should be clearly marked with "No Smoking" signs.

Pipe joints to tanks or vessels that carry flammable gases or liquids must be liquid and vapor tight. Above-ground piping must be secured to prevent disengagement at the fitting or at the piping system. This design is mandatory to ensure that any spill resulting from any disengagement could not unduly expose persons, buildings, or structures.

### **Temporary Buildings**

Temporary buildings should not be constructed in any location where the means of exit could be adversely affected.

If a temporary structure is constructed within a building, it is recommended that the structure be made of non-combustible material.

Temporary combustible structures, covering a maximum area of 2,000 square feet, should be constructed at least 10 feet away from any other building and should never be used for storage and handling of flammable or combustible liquids, gases, explosives, or blasting agents or similar hazardous materials.

## Open Yard Storage

The following information pertains to open yard storage:

- Combustible materials should be stored in a stable condition and should not be stacked or piled higher than 20 feet.
- Driveways between combustible storage spaces should be at least 15 feet wide and should be properly maintained for easy access.
- The storage site should be kept free from the accumulation of unnecessary combustible materials. Weeds and grass shall be properly maintained and regular checks should be made to ensure cleanup of the storage areas.
- No combustible material shall be stored outdoors within 10 feet of a building or structure.
- Portable fire extinguishing equipment, clearly labeled for the type of fire, should be provided at convenient and conspicuously accessible locations.
- The maximum travel distance to the nearest fire extinguishing unit should not exceed 100 feet.

## Indoor Storage

The following information applies to indoor storage:

- Storage should not obstruct exits, no matter how secure the fire evacuation plan may seem. Material shall not be stored within 36 inches of a fire door opening.
- All materials should be stored, handled, and piled with due regard to their fire or ignition characteristics.
- Material should be stacked to minimize the spread of fire internally and to permit convenient access for firefighting.
- The distance from the top of the storage pile to the nearest sprinkler should be at least 18 inches.
- Lighting and heating units should be properly installed and regularly checked to prevent accidental ignition.
- A clearance of 24 inches should be maintained for the path of travel, unless a barricade is provided, in which case no clearance is needed.

## Emergency Planning

In the event of a fire, a safe and speedy response depends on how well employees and employers are prepared for emergencies. The response requires proper planning and cooperation among workers, including the planning of escape routes, prevention of fires spreading, and safe evacuation procedures. These well-executed plans can ensure that every worker will safely evacuate in the event of a fire.



Proper planning includes regularly-scheduled safety inspections, and methods of informing fire and rescue personnel if, and when, fires are discovered.

**More Information:** It is essential that an emergency plan be reviewed at least annually and modified as required. All workers must be provided access to the fire safety plan.

## **General Requirements**

The following are some general requirements for a fire protection plan:

- It is the employer's responsibility to develop a fire protection plan that can be implemented and enforced throughout a company or workforce.
- The employer is also responsible for providing any and all required firefighting equipment and for providing immediate access to such equipment at all times.
- Firefighting equipment must be conspicuously located and maintained in good operating condition at all times. Any defective equipment must be immediately replaced. Employees should either be instructed in the use of this equipment or instructed to not use the equipment.
- The employer should consult with a professional fire protection organization should assistance be needed in implementing an effective fire protection plan.

## **Water Supply**

The following information describes the requirements for maintaining a water supply:

- A temporary or permanent water supply that can provide a sufficient volume, duration, and pressure should be available for the proper operation of firefighting equipment.
- The water supply must be installed and tested as soon as possible.

## **Portable Firefighting Equipment**

### **Fire Extinguishers and Small Hose Lines**

The following information concerns fire extinguishers and small hose lines:

- If employees are expected to use fire extinguishers, they must be selected and placed based on the potential type and size of fire that can occur. The employer shall distribute portable fire extinguishers for use by employees on Class A fires so that the travel distance for employees to any extinguisher is 75 feet (22.9 m) or less.
- At least one fire extinguisher should be located adjacent to a stairway.
- Extinguishers and water drums which are subject to freezing should be protected from cold conditions.

- Carbon tetrachloride and other toxic vaporizing liquid fire extinguishers are prohibited.
- Portable fire extinguishers shall be inspected periodically and maintained in accordance with safety standards.

## **Fire Hose and Connections**

The following information concerns fire hoses and connections:

- Uniformly spaced standpipe systems or hose stations and 1 ½" or smaller hose connected to a sprinkler system installed for emergency use by employees are acceptable as long as they provide total coverage and the employees are trained at least annually in their use.
- If fire connections are not compatible with local firefighting equipment, the contractor should provide adapters, or the equivalent, to permit connections.

## **Fixed Firefighting Equipment**

### **Sprinkler Protection**

Automatic sprinkler protection should be installed, if possible, and should be placed in service as soon as possible.

During demolition or alterations, existing automatic sprinkler installations should be retained in service as long as is reasonable.

### **Fire Alarm Devices**

The following information applies to fire alarm devices:

- An alarm system, telephone system, siren, etc., should be established by the employer so that the employees on the site, as well as the local fire department, can be alerted during an emergency.
- The alarm code and reporting instructions should be posted at or near phones and employee entrances.
- Fire walls and exit stairways, which are required for completed buildings, should be given construction priority.
- Fire cutoffs must be retained in buildings undergoing alterations or demolition until operations necessitate their removal.

## Lesson Summary

In the event of a fire, a safe and speedy response depends on how well employees and employers are prepared for an emergency. Thus, proper response requires planning and cooperation among workers, and includes the planning of escape routes, guidelines to prevent fires from spreading, and safe evacuation procedures.