1.0 Fire Safety

Fire consists of heat, fuel, and oxygen involved in a very rapid chemical chain reaction. This oxidation/reduction reaction then produces heat, light, flames and smoke. The fire needs enough oxygen to sustain combustion, enough heat to raise the material to its ignition temperature, some sort of fuel or combustible material and the chemical reaction that is fire. If the oxygen, heat, fuel or chain reaction is removed, the fire can be extinguished. This is the manner in which fire suppression methods work.

Fire prevention, detection, and suppression are important steps to an effective safety management program that prevents injuries and illnesses, as the effects of fire can be significant. Each year, there are approximately 1,400,000 fires reported in the United States. Annually, these fires cause almost 3,000 deaths, 16,000 injuries, and over $15 billion in property damage.

Click Box

1.1 Fire Survival

The following topics are key to surviving a fire and should be addressed with employees through training and ongoing communications:

- **Fire Behavior:** Understanding fire behavior prepares employees to anticipate what the fire will do to better make an effective escape.
- **Fire Escape:** A prompt escape is critical, without waiting to be sure that there is actually a fire or to see if it comes closer.
- **Emergency Plans:** Understanding emergency plans and reviewing them often is critical such that when a fire starts, employees will already know their escape routes.
- **Stop, Drop, and Roll:** If an employee is on fire, they should know to fall to the ground and roll over and over. This activity will extinguish the fire and potentially save a life.
- **Building Fires:** The knowledge of how a fire is initially built, and then grows, will protect employees.

Click Box

1.1 Fire Survival

Teaching employees how to survive a fire is very important. Most don't know to get down on the floor to avoid the heavy smoke. Many don't know how to stop, drop, and roll. Many don't know that opening a window will draw the fire to that window. The following are some additional considerations:

Take Fire Alarms Seriously

It's a common error, especially in offices and industrial buildings, to assume a fire alarm is a false alarm. When a fire alarm sounds, employees should not hesitate to evacuate. As the safety manager, encouragement is necessary, with a statement such as, "The exit is this way…are you coming with me?"

Leave Empty-handed

After a fire alarm sounds, employees have one to two minutes at most to get out of a building safely. This is especially true of newer buildings, which are often made of lightweight materials that burn fast and give off toxic smoke. Employees should be reminded not to grab anything before they exit the building- no mementos, important papers, not even a laptop. A simple reminder that there is only a small window of time to get out and that their safety is the priority should be the encouragement provided by a safety professional.

1.1 Fire Survival

Select an Exit

A fire escape plan should include at least two ways out of any room. One can be the exit normally used, typically a door, while the other can be a window. For example, if an employee is in an office, the door knob can be tested for heat with the back of the hand before it is cracked open to inspect the hallway. If it is not safe to leave by that route, a second option already in place may be a window. If there's no safe way out of a room, the employee should be instructed to close the door, and if possible, use a wet towel or similar item to plug the crack between the bottom of the door frame and the floor.

Know When to Crawl

If employees can walk upright to reach an exit without passing through smoke, they should do so quickly. However, if there is smoke along the way out, they should be instructed to drop to their hands and knees and crawl with head down to stay below the smoke. To descend a smoke-filled stairwell, crawling down backwards is recommended, since one is less likely to lose their balance that way.

Use Window Exits Safely

Jumping out of windows should be the last resort. If an employee can get to the ground easily, or to a fire escape with a ladder, only then should they climb out through a window. If the roof is accessible, getting out of the building this way would also be suggested. Once out of the building, employees should immediately contact emergency services.

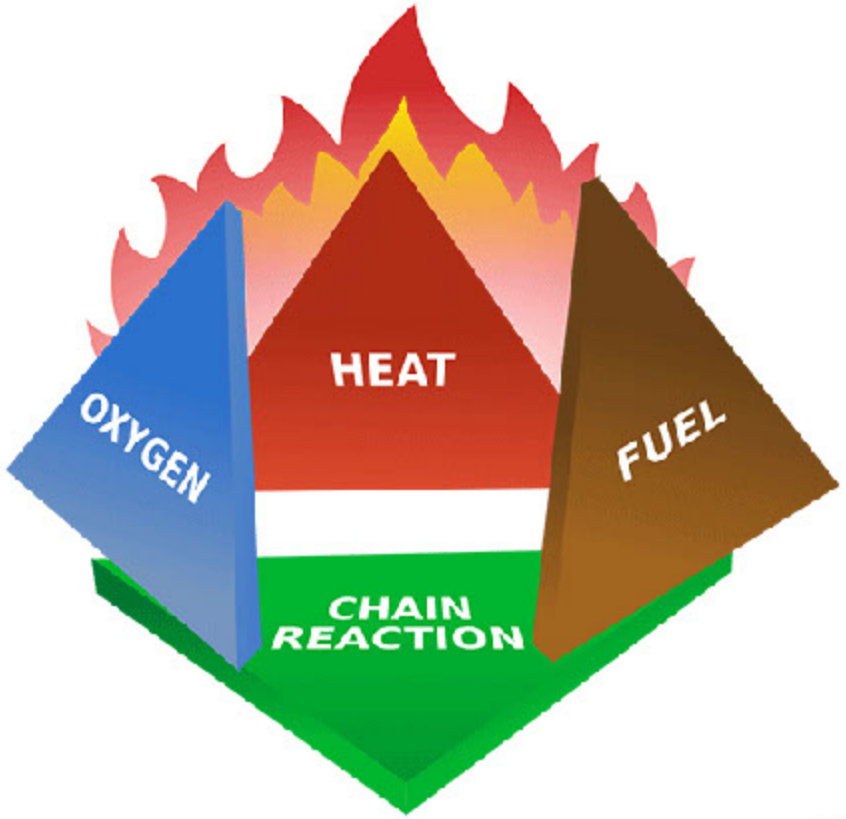
Click Box

1.2 Fire Tetrahedron

There are four things must be present at the same time in order to produce fire:

1. Enough oxygen to sustain combustion
2. Enough heat to raise the material to its ignition temperature
3. Some sort of fuel or combustible material
4. The chemical, exothermic reaction that is fire

Oxygen, heat, and fuel are frequently referred to as the “fire triangle.” Add in the fourth element, the chemical reaction, and you actually have a fire “tetrahedron.” The important thing to remember is if any of these four things is taken away, you will not have a fire, or the fire will be extinguished.



1.2 Fire Tetrahedron

The concentration of the fuel and the oxygen must be high enough to allow ignition and maintain the burning process. Combustion is a chemical reaction that requires heat to proceed. Heat is either supplied by:

- The ignition source and is maintained by the combustion, or
- An external source

Most fires can be extinguished by removing one of these components. For example, carbon dioxide may be applied to a fire and 'smother' it by removing oxygen. Water may be used for Class A fires to remove the ignition source and effectively remove heat. However, water applied to some types of fires (e.g., magnesium, and other metals) by itself generates enough heat to self-ignite and combust (spontaneous combustion), either as a fire or explosion. Details on this in Section 1.3.2.

A fire can be defined as a self-sustaining oxidation-reduction reaction with the evolution of heat and light. Each side of the fire tetrahedron represents one of the necessary elements of a fire. A fire requires sufficient heat, fuel in an ignitable form, oxygen in a proper mixture with the fuel, and a chemical chain reaction involving these elements. Removing any one of these elements will extinguish the fire.

1.3 Fire Extinguishers

If fire extinguishers are available for employee use, it is the employer's responsibility to educate employees on the principles and practices of using them, as well as the hazards associated with fighting small or developing fires. Portable fire extinguishers are to be properly mounted and identified in locations that are readily accessible to employees without subjecting the employees to possible injury. Only approved portable fire extinguishers are to be used and they should be kept in their designated places at all times except during use. They should be maintained in a fully charged and operable condition.

Portable fire extinguishers apply an extinguishing agent that will either cool burning fuel, displace or remove oxygen, or stop the chemical chain reaction so a fire cannot continue to burn. When the handle of an extinguisher is compressed, the extinguishing agent is expelled from the nozzle.

All portable fire extinguishers must comply with national applicable standards. To verify compliance with these standards, a nationally recognized testing laboratory must approve portable fire extinguishers utilized in the workplace. Equipment that passes the laboratory's tests are labeled and given an alpha-numeric classification based on the type and size of fire it will extinguish.

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1.3.1 General Requirements

General requirements regarding portable fire extinguishers include:

- Mount, locate, and identify fire extinguishers so that they're readily accessible. To prevent fire extinguishers from being moved or damaged, they should be mounted on brackets or in wall cabinets with the carrying handle placed 3-1/2 to 5 feet above the floor. Larger fire extinguishers need to be mounted at lower heights with the carrying handle about 3 feet from the floor.
- Only approved fire extinguishers are to be used.
- Carbon tetrachloride or chlorobromomethane extinguishing agents are prohibited.
- Maintain fire extinguishers in a fully charged and operable condition and keep them in their designated places at all times except during use.
- Soldered or riveted shell inverting type extinguishers shall be permanently removed from service.

1.3.3 Training and Education

Whenever an employer provides portable fire extinguishers for employee use in the workplace, an educational program to familiarize employees with the general principles of fire extinguisher use and the hazards involved with initial stage of firefighting is required. To ensure that the risk of injury due to portable extinguisher use is reduced, employees should know everything necessary to assure their safety. Employees should be trained and educated to recognize not only what type of fire is being fought and how to fight it, but also when it is time to get away from it and leave fire suppression to more experienced firefighters.

Training and education on the use of fire extinguishers located in the workplace should be conducted on an annual basis and can be obtained through a variety of channels. Often, local fire departments will provide basic fire suppression and general prevention training programs. Fire insurance risk management firms also can provide data and information. Extinguisher manufacturers often will conduct fire schools for customers in the proper use of their extinguishers. In meeting the requirements of this section, the employer may also provide educational materials, without classroom instruction, through the use of employee notice campaigns using instruction sheets or flyers or similar types of informal programs. The National Fire Protection Association and the National Safety Council will provide, at a small cost, publications that can be also be used.

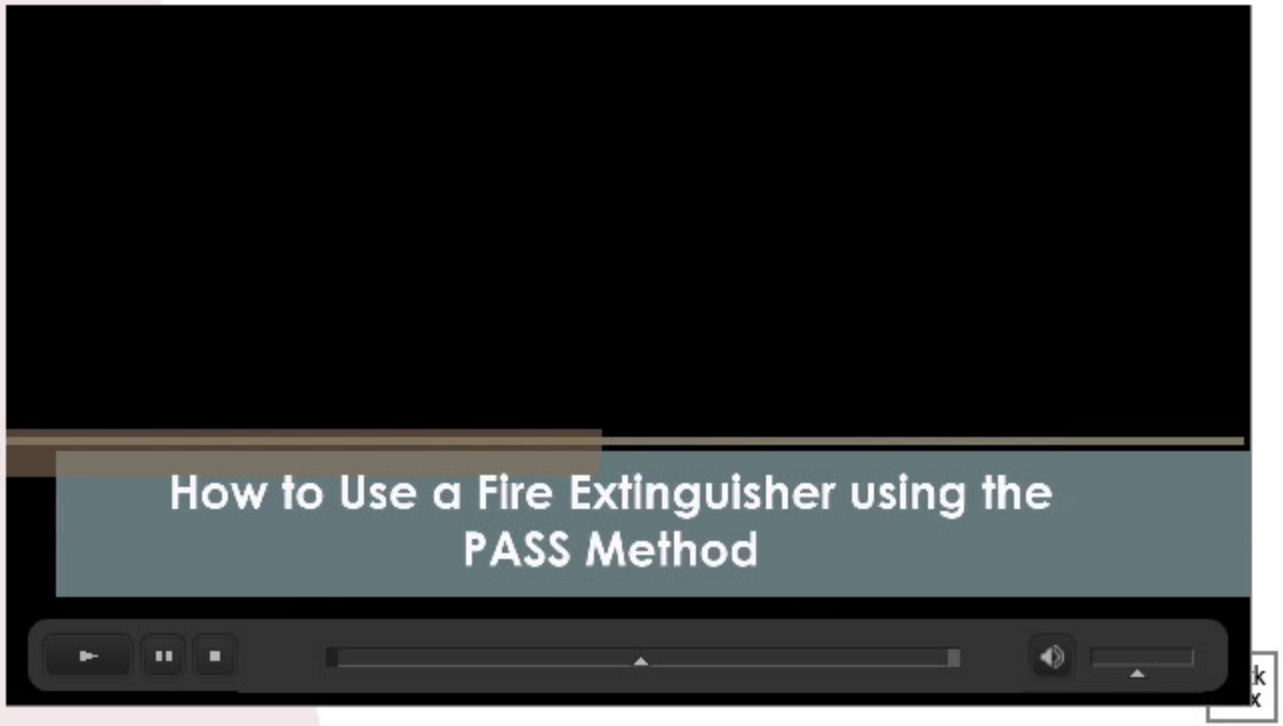
Click Box

1.3.3 Training and Education

One of the most effective training approaches in the operation of fire extinguishers is the use of the P-A-S-S technique:

- **P:** Pull the pin, which is a feature of the equipment that prevents accidental discharge.
- **A:** Aim low at the base of the fire, which is where the fuel source is. Typically, you must stand approximately 4-6 feet away from fire.
- **S:** Squeeze the lever above the handle to activate, then release the lever to stop the flow.
- **S:** Sweep from side to side. Moving toward the fire and continuing to aim low at its base, sweep until all flames are extinguished. Watch for re-igniting and repeat, as necessary.

In addition to practical, hands-on fire extinguisher training, there is virtual training software available on the internet for when live training sessions are not a viable option. Click play to watch an illustration of the PASS technique.



1.3.4 Inspection, Maintenance, and Testing

An employer is to ensure that portable fire extinguishers are maintained in a fully charged and operable condition and kept in their designated places at all times except during use. Portable fire extinguishers are to be visually inspected monthly, with a maintenance check to be performed annually. Records of any inspections and checks should be maintained. Given the variety of types of fire extinguishers, the standard calls for specific types of maintenance and tests.

The ultimate responsibility for the inspection, maintenance and testing of portable fire extinguishers lies with the employer; however, these responsibilities can be conducted by outside contractors if necessary. With contract work, the employer should ensure that the contractor is capable of performing the work that is needed to comply with this standard.

Click Box

1.3.4 Inspection, Maintenance, and Testing

If the employer should elect to perform the inspection, maintenance, and testing requirements in-house, then the employer should ensure that those persons doing the work have been properly trained to recognize problem areas which could cause an extinguisher to be inoperable. The National Fire Protection Association provides excellent guidelines in its standard for portable fire extinguishers. The employer may also check with the manufacturer of the unit to obtain guidelines on inspection, maintenance, and testing.

Anytime the employer has removed an extinguisher from service to be checked or repaired, alternate equivalent protection should be provided. Alternate equivalent protection could include replacing the extinguisher with one or more units having equivalent or equal ratings, posting a fire watch, restricting the unprotected area from employee exposure, or providing a hose system ready to operate.

1.4 Fixed Extinguishing Systems

Fixed fire suppression systems are commonly used to protect areas containing valuable or critical equipment such as data processing rooms, telecommunication switches, and process control rooms. Their main function is to quickly extinguish a developing fire and alert occupants before extensive damage occurs by filling the protected area with a gas or chemical extinguishing agent. While there are many purposes for employing a fire extinguishing system, this section is not intended to apply to automatic sprinkler systems or to systems installed to protect areas where there is no potential for employee exposure.

Fixed extinguishing systems as described in the Fire Protection standard applies to all employers who have a fixed extinguishing system installed to meet a particular OSHA standard. The standard contains specific provisions for any fixed system, regardless of the reason for it to be installed, that may expose employees to possible injury, death, or adverse health consequences caused by the extinguishing agent. These systems are only subject to the specific requirements as depicted in 29 CFR 1910.160. 29 CFR 1910.161 covers fixed extinguishing systems using dry chemical extinguishing agents, while 29 CFR 1910.162 covers fixed extinguishing systems using a gaseous agent as the extinguishing agent and 29 CFR 1910.163 covers fixed extinguishing systems using water spray and foam extinguishing agents.

Click Box

1.4 Fixed Extinguishing Systems

A fire extinguishing system is an engineered set of components that work together to quickly detect a fire, alert occupants, and extinguish the fire before extensive damage can occur. All system components must be:

- Designed and approved for use on the specific fire hazards they are expected to control or extinguish
- Protected against corrosion or either made or coated with a non-corrosive material if it may be exposed to a corrosive environment
- Designed for the climate and temperature extremes to which they will be exposed

Click Box

1.4.2 Operation, Maintenance, and Testing

Automatic fire suppression systems, particularly the total flooding variety, must be operated properly and regularly maintained and tested to guarantee employee safety and system effectiveness. An employer utilizing these systems is required to inspect each system annually, and operate and maintain them in a working condition, ensuring that they are always turned on, except during repairs or maintenance. Employees should be notified, and measurements established to guarantee their safety if a fixed extinguishing system becomes inoperable for any reason, with any defects or impairments conducted by trained personnel.

It is important to ensure that the sprinklers provide a maximum protection area, with a minimum of interference to the discharge pattern. Therefore, during inspections, the employer must ensure that there is a vertical clearance distance between sprinklers and any material below of at least 18 inches.

Click Box

1.4.2 Operation, Maintenance, and Testing

The weight and pressure of refillable containers should be checked at least semiannually. If the container shows a loss in net content, weight, or pressure, it must be subjected to maintenance. Factory charged non-refillable containers that have no means of pressure indication should be weighed at least semiannually. Any container that shows a loss in net weight should be replaced. Inspection and maintenance dates should be recorded and retained until the container is checked again or for the life of the container, whichever is less. Designated employees to inspect, maintain, operate, or repair fixed extinguishing systems should be provided appropriate training, reviewing their training annually to keep them up-to-date.

All employees should be trained with respect to the type of systems installed in the workplace, the hazards involved, proper activation in case of emergency, and the correct response to audible and visual pre-discharge alarms. This training should be provided for non-English speaking employees in languages understood by the affected employees and other individuals that may be exposed to the hazard. Lastly, an employer is to ensure the provision and appropriate use of personal protective equipment (PPE) for rescuing employees trapped in areas that have become hazardous due to an agent discharge.

1.4.3 Total Flooding Systems

Total flooding applications consist of protecting an enclosed space by flooding it with a gas, such as carbon dioxide or halon. This method is used to protect electrical equipment and other types of deep-seated smoldering fires that may re-ignite after the flame has been extinguished. Because these systems can create an oxygen deficit or toxic atmosphere, they deserve special attention. Click play to watch a total flooding system in action.

Click Box

1.4.3 Total Flooding Systems

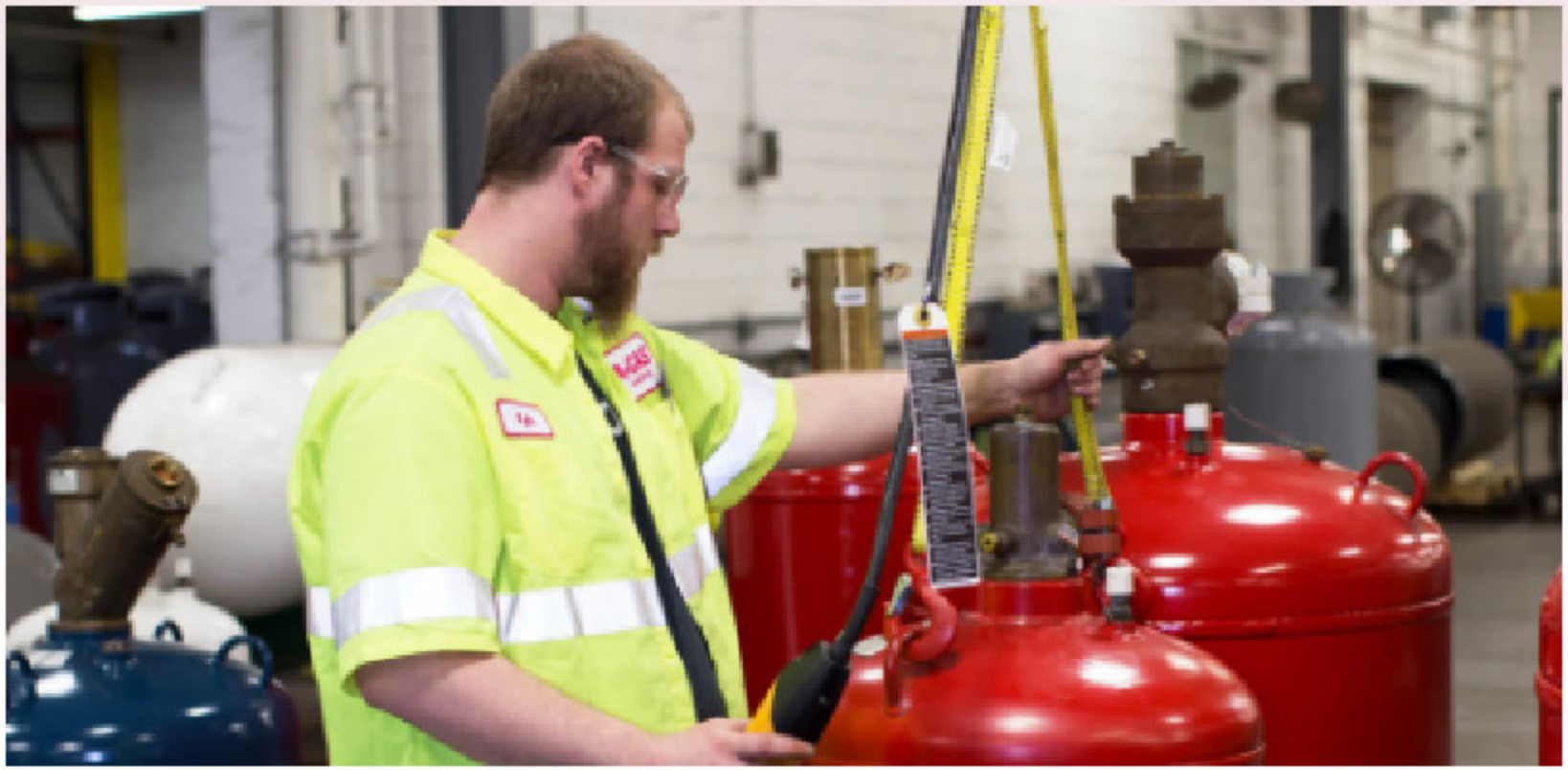
The following special provisions in the OSHA standards apply to all fixed suppression systems used for total flooding applications:

- Ensure that employees are not exposed to toxic levels of gaseous agent or its decomposition products. Several requirements under the standard apply only to total flooding applications.
- Maintain the designed concentration of gaseous agents until the fire has been extinguished or is under control except during overhaul.
- Ensure that the designed extinguishing concentration is reached within 30 seconds of initial discharge, except for Halon systems which must achieve design concentration within 10 seconds.
- Provide a distinctive pre-discharge employee alarm in each protected area that is capable of being perceived above ambient light or noise levels when agent design concentrations exceed the maximum safe level for employee exposure. The pre-discharge employee alarm should provide employees time to safely exit the discharge area prior to system discharge.
- Provide a pre-discharge employee alarm for alerting employees before system discharge on Halon 1211 and carbon dioxide systems with a design concentration of 4 percent or greater and provide a pre-discharge employee alarm for Halon 1301 systems with a design concentration of 10 percent or greater.

Click Box

1.4.3 Total Flooding Systems

- Do not use Halon 1301 in concentrations greater than:
  - 7 percent where egress from an area cannot be accomplished within one minute.
  - 10 percent where egress from an area takes greater than 30 seconds but less than one minute.



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1.4.3 Total Flooding Systems

The use Halon 1301 concentrations greater than 10 percent should only be used in areas not occupied by employees and the employer should ensure that no unprotected employees enter the area during agent discharge.

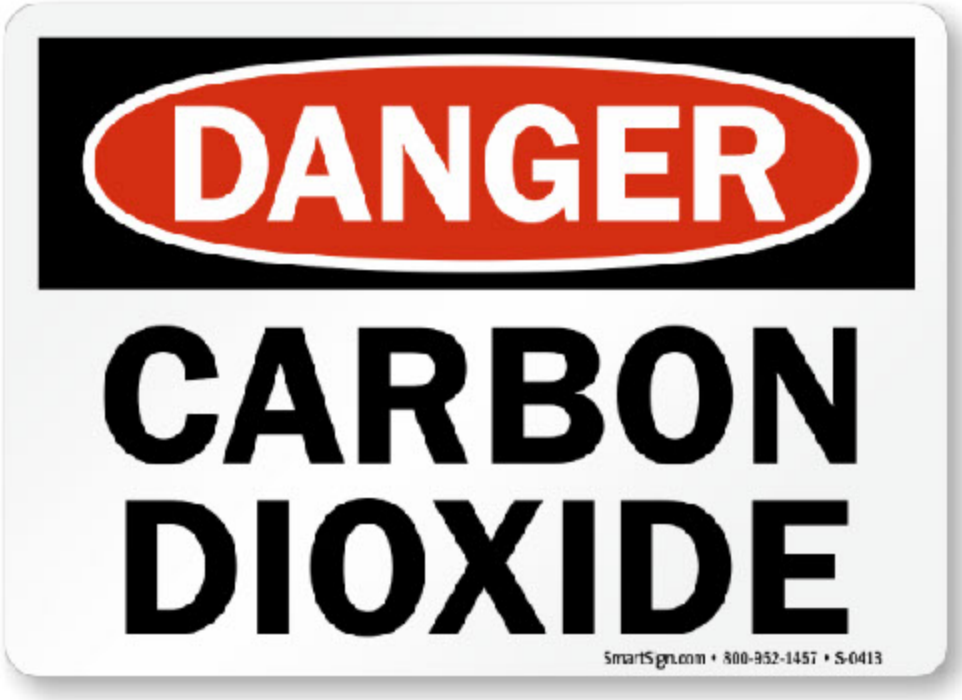
- Provide an Emergency Action Plan (EAP) in accordance with the standard to provide for the safe evacuation of employees from within each area protected by a total flooding system which provides agent concentrations exceeding the maximum safe levels set forth in the standard
- Install and connect fire detection devices to a control system which sounds a pre-discharge alarm and automatically activates total flooding systems
- Post signs in and at the entrance to areas protected by total flooding fire suppression systems which use agents that are a serious health hazard, such as carbon dioxide and Halon 1211
- Have personal protective equipment available and ready for rescuing employees trapped in areas that may become hazardous due to an agent discharge

Click Box

1.4.4 Safety and Health Hazards

The safety data sheet for each extinguishing agent should be available in the workplace. It is important that employees know the potential hazards of the extinguishing agents they may be exposed to and how to protect themselves. Additionally, employees who are likely to enter such areas should receive a basic level of training involving the operating principles of the system to include alarms and related hazards, as well as evacuation procedures.

Carbon dioxide and halon are the two most common extinguishing agents used for total flooding applications.



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1.4.4 Safety and Health Hazards

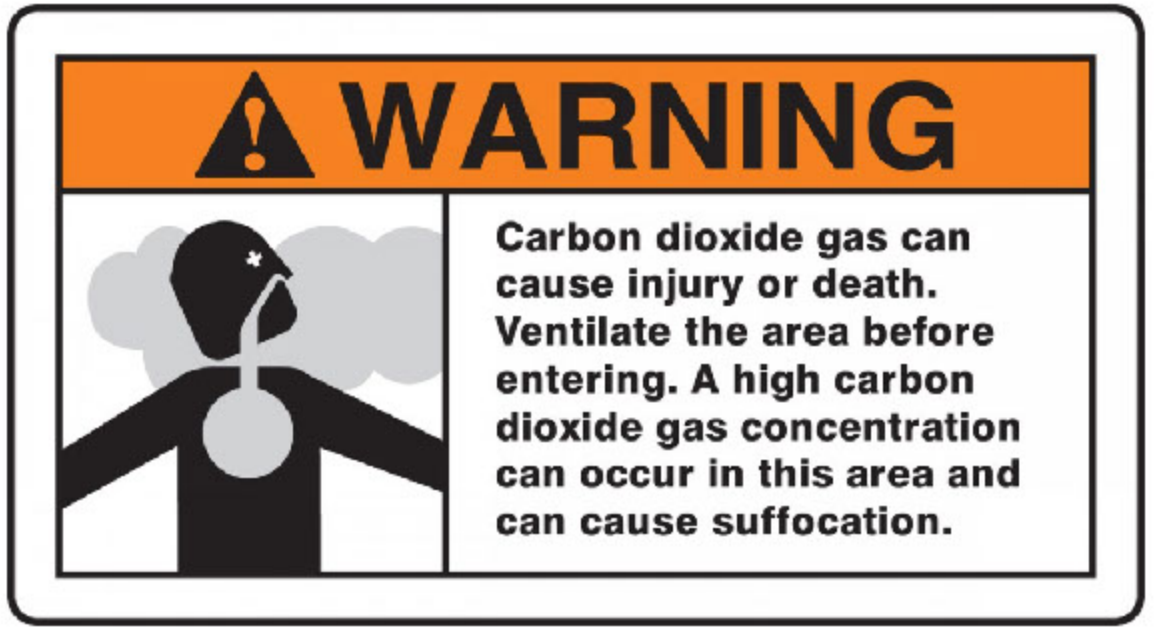
Carbon Dioxide

Under normal conditions, this gas is a colorless, odorless, electrically nonconductive gas that is approximately 1.5 times heavier than air. It will not disturb live electrical components, is non-corrosive, and leaves no residue to clean up. Carbon dioxide obtained by dry ice conversion to liquid is not acceptable unless it is processed to remove excess water and oil.

Specific hazards associated with carbon dioxide include:

- **Asphyxiation:** Exposure to high concentrations of CO2 gas may create an oxygen-deficient atmosphere.
- **Cold Temperature:** Direct contact with the vaporizing liquid during discharge can cause frostbite burns to the skin.

For further assistance, NFPA 12, Standard on Carbon Dioxide Extinguishing Systems should be consulted.



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1.4.4 Safety and Health Hazards

Halon Systems

Halons are a family of chemicals that include fluorine, chlorine, bromine, and iodine. Halon extinguishing agents are actually halogenated hydrocarbons, meaning one or more of the halon chemicals combine with a hydrocarbon. Halon works by stopping the chemical chain reaction of the fire and this process can be very dangerous to employees. The reaction products of halon on hot surfaces may result in the release of toxic substances and carcinogens. These areas should be clearly labeled as follows:

"Caution: Halon. This area is protected by a Halon 1301 fire suppression system. When alarm sounds or upon discharge, evacuate hazard area immediately. Do not re-enter until the area has been thoroughly ventilated."

Click Box

1.4.4 Safety and Health Hazards

Specific hazards associated with halon include:

- **Asphyxiation:** Exposure to high concentrations of halon can create an oxygen-deficient atmosphere.
- **Cold Temperature:** Direct contact with the vaporizing liquid during discharge can cause frostbite burns to the skin.
- **Central Nervous System (CNS):** Inhaling high concentrations of halon gas can cause dizziness, tingling in extremities and, in severe cases, unconsciousness.
- **Cardiovascular:** In some people, exposure to halon can cause an increased sensitivity of the heart to adrenaline resulting in irregular heartbeats and, in severe cases, heart attack.

When halon is exposed to temperatures above 900 degrees Fahrenheit, it could break down and create high concentrations of toxic gases. For further assistance, NFPA 12A, Standard on Halon 1301 Fire Extinguishing Systems should be consulted.

Click Box

2.0 Fire Detection and Employee Alarm Systems

The purpose of the employee alarm systems standard is to reduce the severity of workplace accidents and injuries by ensuring that alarm systems operate properly, and procedures are in place to alert employees to workplace emergencies.

OSHA's employee alarm systems standard applies to all employers that use an alarm system to satisfy any OSHA standard that requires employers to provide an early warning for emergency action, or reaction time for employees to safely escape the workplace, the immediate work area, or both.

Click Box

2.1 Fire Detection

When combined with other elements of an emergency response and evacuation plan, automatic fire detection systems can significantly reduce property damage, personal injuries, and loss of life from fire in the workplace. Their main function is to quickly identify a developing fire and alert building occupants and emergency response personnel before extensive damage occurs. Automatic fire detection systems do this by using electronic sensors to detect the smoke, heat, or flames from a fire and to provide an early warning.

If a workplace uses a fire detection system that was designed and installed to meet the fire protection requirements of a specific OSHA standard, it must also comply with the "Fire Detection Systems" standard as depicted in 29 CFR 1910.164. If an OSHA standard specifically states that an employer must install a fire protection system, then the employer is required to follow this standard.

Click Box

2.1.2 Installation

Fire detectors should be selected based on the burning characteristics of the materials present and the nature of the location they will be used to protect. General installation guidelines include:

- Install at least one detector in each room, storage area, and hallway, with consideration for installing more than one in those rooms that exceed the manufacturer's spacing requirements
- Place the detector as close to the center of the ceiling as possible when only one detector is required in a room or space
- Install at least one detector in each closet, elevator and dumbwaiter shaft, stairwell, and other enclosed spaces
- Place a detector at the top of each flight of stairs
- Install detectors in the path of the air flow toward the return air duct when air supply or return ducts are present in a room or space
- Place all smoke detectors at least three feet from ceiling fans

Click Box

2.1.2 Installation

Special installation consideration should be given for the following detectors:

- **Smoke Detectors:** Ionization or photoelectric smoke detectors are designed to identify a fire during its smoldering or early flame stages and will meet the needs of most areas containing primarily wood, paper, fabric, and plastic materials. During combustion, these materials produce a mixture of smoke types with detectable levels of both large and small smoke particles. Smoke detectors are suitable for indoor areas with low ceilings such as offices, closets, and restrooms, areas that are relatively clean with minimal amounts of dust and dirt, and areas that contain solid fuels like wood, paper, fabric, and plastic materials. Some locations are unsuitable for smoke detectors due to the potential for unwanted alarms. These are kitchens, stairs, shafts, high air flow locations, areas that are dusty or dirty and outdoor areas.

Click Box

2.1.2 Installation

- **Heat Detectors:** Heat detectors are ideal for areas where flammable gasses and liquids are handled or any area where a fire will quickly cause a large change in the surrounding temperature. Heat detectors are also suitable for dirty, dusty or smoky environments, indoor areas without winds or drafts that can prevent heat from reaching the detector, manufacturing areas where large quantities of vapors, gases, or fumes may be present, and areas where particles of combustion are normally present, such as in kitchens, furnace rooms, utility rooms, and garages or where ovens, burners or vehicle exhaust gases are present.

- **Flame Detectors:** Flame detectors are best for protecting areas with high ceilings and open-spaces, such as warehouses and auditoriums, outdoor or semi-enclosed areas, where winds or draughts can prevent smoke from reaching a heat or smoke detector, areas where rapidly developing flaming fires can occur, such as petrochemical production, fuel storage areas, paint shops, and solvent areas, and environments that are unsuitable for other types of detectors.

Click Box

2.1.2 Installation

In order for the continued protection of detector devices that are installed in external environments, it is important to provide a canopy, hood, or other suitable protection (such as a non-corrosive coating) for this equipment. To maintain operability, detectors should be located away from or out of contact with materials or equipment which may cause physical damage, with protection by a cage or metal guard to protect against mechanical or physical impact.

Detectors should be securely mounted to a solid surface, such as screwed to a junction box with a mounting plate or other appropriate method that prevents them from putting pressure or stress on attached wires or tubing. Detectors should be supported independently of their attachment to wires or tubing.

The Fire Protection standard recommends that the number, spacing and location of fire detectors is based upon design data obtained from field experience, tests, engineering surveys, the manufacturer's recommendations, or a recognized testing laboratory listing.

2.1.2 Installation

Typically, fire detection equipment is installed for specific applications. The following guidelines apply to different types of fire detection system applications:

- When a fire detection system is installed for the purpose of activating a fire extinguishing or suppression system, it should be designed to respond in time to control or extinguish the potential fire. It is recommended that alarms or devices actuated by fire detectors not be delayed for more than 30 seconds unless the delay is necessary for the safety of employees. For example, if a fire suppression system uses a compressed gas that will flood an occupied area, it will be necessary to give employees time to escape. If such a delay is necessary, it must be addressed in an emergency action plan meeting the requirements of 29 CFR 1910.38.

- When a fire detection system is installed as an employee evacuation alarm, it must be designed and installed to provide a warning for emergency action and safe escape of employees.

Click Box

2.1.3 Maintenance

Over time, dust, dirt, and other foreign material can build up inside a detector's sensing elements, resulting in reduced sensitivity which can limit the amount of warning time given during a fire. Dirty or dusty detectors can also result in unwanted alarms that can desensitize occupants to the alarm system or produce more serious behavior, such as disconnecting the system altogether.

Click Box

2.1.3 Maintenance

To avoid malfunctions and unwanted alarms and to ensure that fire detection system will perform as expected in the event of a fire, an employer is required to:

- Operate and maintain a system in working condition, ensuring that sure it is always turned on, except during repairs or maintenance.
- Test and adjust fire detectors and fire detection systems often to ensure that they operate correctly and maintain reliability. Detectors found to be unreliable and/or with reduced sensitivity should be replaced or cleaned and recalibrated.
- Ensure that pneumatic and hydraulic operated detection systems are equipped with supervised systems.
- Employ a qualified person to service, maintain and test all fire detection systems, including cleaning and necessary sensitivity adjustments.

2.1.3 Maintenance

- Clean detectors of dust, dirt, or other particulates at periodic intervals to ensure their proper operation.
- Return all detection equipment to normal operation as soon as possible after being tested, used, or accidentally activated.
- Require that spare detection devices and components are readily available in the workplace or from a local supplier to ensure prompt restoration of the system.

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2.2 Employee Alarm Systems

The purpose of the Employee Alarm Systems standard (29 CFR 1910.165) is to reduce the severity of workplace accidents and injuries by ensuring that alarm systems operate properly, and procedures are in place to alert employees to workplace emergencies. The standard applies to all employers that use an alarm system to satisfy any OSHA standard that requires employers to provide an early warning for emergency action, or reaction time for employees to safely escape the workplace, the immediate work area, or both. This standard also applies to an employer if an OSHA standard specifically states that it must install an employee alarm system. For example, some standards that specifically require or reference alarm systems include:

- Maintenance, safeguards, and operational features for exit routes (29 CFR 1910.37)
- Emergency action plans (29 CFR 1910.38)
- Powered platforms for building maintenance (29 CFR 1910.66)
- Flammable and combustible liquids (29 CFR 1910.106)
- Hazardous waste operations and emergency response (29 CFR 1910.120)
- Portable fire extinguishers (29 CFR 1910.157)
- Fixed extinguishing systems, general (29 CFR 1910.160)

2.2 Employee Alarm Systems

- Portable fire extinguishers (29 CFR 1910.157)
- Fixed extinguishing systems, general (29 CFR 1910.160)
- Fixed extinguishing systems, dry chemical (29 CFR 1910.161)
- Fixed extinguishing systems, gaseous agent (29 CFR 1910.162)
- Fire detection systems (29 CFR 1910.164)

This employee alarm systems section applies to all emergency employee alarms installed to meet a particular OSHA standard. However, this section does not apply to those discharge or supervisory alarms required on various fixed extinguishing systems or to supervisory alarms on fire suppression, alarm, or detection systems, unless they are intended to be employee alarm systems.

Click Box

2.2.1 Types of Employee Alarm Systems

The employee alarm system is to provide warning for necessary emergency action as called for in the Emergency Action Plan, or for reaction time for safe escape of employees from the workplace or the immediate work area, or both. An employee alarm system can be any piece of equipment and/or device designed to inform employees that an emergency exists or to signal the presence of a hazard requiring urgent attention. National Fire Protection Association (NFPA) 72, National Fire Alarm Code, requires a fire alarm signal to be distinctive in sound from other signals and cannot be used for any other purpose.

The employee alarm should be capable of being perceived above ambient noise or light levels by all employees in the affected areas of the workplace. Tactile devices may be used to alert those employees who would not otherwise be able to recognize the audible or visual alarm.

2.2.1 Types of Employee Alarm Systems

Audible Alarms

Audible alarms include bells, horns, sirens, voice announcement systems, and other devices that can be distinguished above and apart from the normal sound level within the workplace. Of these, temporal and voice signals are the most effective means since audible notification devices such as horns, bells, or sirens are no longer recognized for new systems by NFPA 72, National Fire Alarm Code. Bells, horns, and sirens, are now only permitted in existing systems. Click on the audio icons to hear how each alarm sounds.

Temporal Coding is accomplished by interrupting a steady sound in the following manner: .5 sec ON, .5 sec OFF, .5 sec ON, and .5 sec OFF, in a repeating cycle.

- Standard audible emergency signal consists of a "three-pulse" temporal pattern. Three successive "on" phases, lasting .5 second each, are separated by .5 second of "off" time. Then, at the completion of the third "on" phase there must be 1.5 seconds of "off" time before the full cycle is repeated. Therefore, the total cycle lasts 4 seconds (.5 second "on," .5 second "off," .5 second "on," .5 second "off", .5 second "on," 1.5 seconds "off"). This universally-adopted standard is an American National Standard Institute (ANSI) standard.

- This signal pattern is only to be used to notify personnel of the need to immediately evacuate the building. Total evacuation is not always desirable or necessary during an emergency; therefore, there should be a different signal pattern assigned to signify the need for relocation of the occupants from the affected area to a safe area within the building or for a "shelter in place."

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2.2.1 Types of Employee Alarm Systems

Vibrating bells have been the most common signal device, commonly used in such organizations as schools for fire alarms.

Horns produce a very loud distinctive sound that immediately attracts attention. Horns have been useful to call attention to critical situations.

Sirens produce a loud piercing wail that makes them ideally suitable for initiating a site-wide evacuation.

Workplace announcement systems with speakers can be used to play a live or recorded voice message. They are often ideally suited for large workplaces where phased or guided evacuations are needed.

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2.2.1 Types of Employee Alarm Systems

Visual Alarms

Visual alarms use steady, flashing, or strobe lights to alert employees to an emergency situation in areas where noise levels are high, especially where ear protection must be worn, and audible signals may not be heard or may be misunderstood. Visual signals also provide an effective way to alert employees with hearing loss about an emergency. Strobe lights are recognized as the most effective means and only strobe lights are now recognized by NFPA 72 and the Americans with Disabilities Act (ADA).

Since it is not always possible to fix the occupancy of a room or space or anticipate its use by a person with a hearing impairment, visual alarms are particularly important in those common use spaces where a person may be alone. It is important to provide visible signals in restrooms, hallways, lobbies, cafeterias, and meeting rooms. Per the Americans with Disabilities Act Accessibility Guidelines, visual alarms should also be used in similar spaces that are not used solely as employee work areas.

Flashing lights or strobe lights use high intensity flash tubes that are ideally suited for areas where high ambient light levels make traditional rotating or flashing lights difficult to distinguish or where ambient noise makes audible signals difficult to hear.

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2.2.2 Testing and Maintenance

For the most effective testing and maintenance of employee alarm systems, the following guidelines are provided:

- Test the reliability and adequacy of non-supervised employee alarm systems every two months. Use a different actuation device in each test of a multi-actuation device system.
- Maintain or replace power supplies as often as necessary to ensure a fully operational condition. Provide a back-up means of alarm when systems are out of service, such as employee runners or other means of communication.
- Use properly trained personnel to service, maintain, and test employee alarms.
- Conduct a visual check to ensure that employee alarm devices are not obstructed or installed in a manner that would prevent sound or light from reaching or entering the protected areas.
- Restore all employee alarm systems to normal operating condition as soon as possible after each test or alarm. Spare alarm devices and components should be readily available in sufficient quantities and locations for prompt restoration of the system.

2.3 Training

Employees should understand the types of emergencies that may occur and what course of action they must take. Employees should also understand the function and elements of the emergency action plan, including types of potential emergencies, reporting procedures, alarm systems, evacuation plans, and shutdown procedures. During the training, it is important to review any special hazards at the workplace such as flammable materials, toxic chemicals, radioactive sources, and/or water-reactive substances.

The training on employee alarm systems should address the following:

- Individual roles and responsibilities
- Threats, hazards, and protective actions
- Location and operation of manually-activated pull stations and communication equipment
- Emergency response procedures
- Evacuation, shelter, and accountability procedures
- Location and use of common emergency equipment
- Emergency shutdown procedures

When employees know how to sound an alarm and/or notify emergency personnel at the first sign of an emergency, it may make the difference between life and death.

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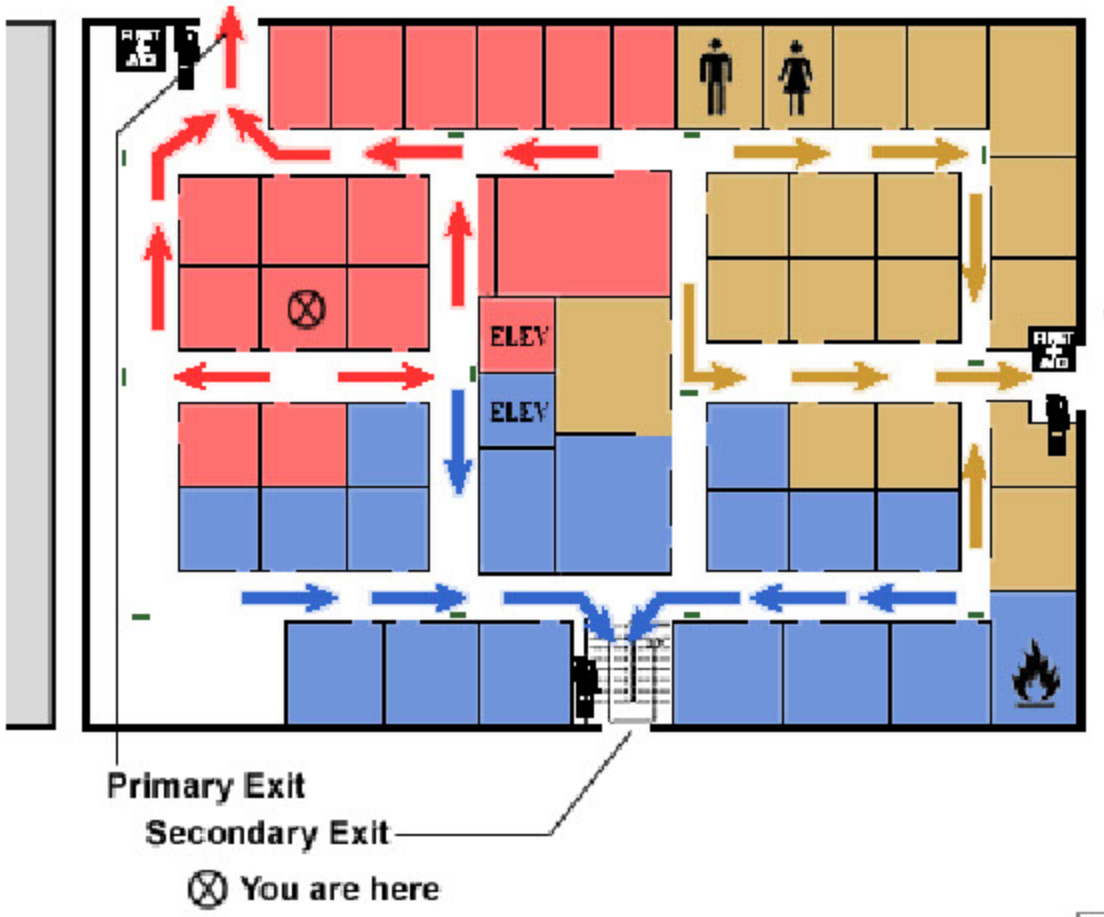
3.0 Exit Routes

A major key to safety in times of emergency is knowing your emergency exit routes. An exit route is a continuous and unobstructed path of exit travel from any point within a workplace to a place of safety. An exit route consists of three parts:

1. ***Exit access:*** The part of an exit route that leads to an exit.

2. ***Exit:*** The part of an exit route that is generally separated from other areas to provide a protected way of travel to the exit discharge.

3. ***Exit discharge:*** The part of the exit route that leads directly outside or to a street, walkway, refuge area, public way, or open space with access to the outside.



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3.1 Basic Requirements

Requirements for the design and construction of exit routes are varied and specific. This section describes a number of these requirements. It includes requirement such as their permanency, exit openings, number of routes, exit discharges, and exit route doors. It also addresses the capacity, height and width of exit routes, and sets forth requirements for exit routes that are outside a building.

1910.36 contains requirements for the design and construction of exit routes such as:

- An exit route must be a permanent part of the workplace.
- An exit must be separated by fire resistant materials. Construction materials used to separate an exit from other parts of the workplace must have a one-hour fire resistance-rating if the exit connects three or fewer stories and a two-hour fire resistance-rating if the exit connects four or more stories.
- Openings into an exit must be limited. An exit is permitted to have only those openings necessary to allow access to the exit from occupied areas of the workplace, or to the exit discharge. An opening into an exit must be protected by a self-closing fire door that remains closed or automatically closes in an emergency upon the sounding of a fire alarm or employee alarm system. Each fire door, including its frame and hardware, must be listed, or approved by a nationally recognized testing laboratory.

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3.1.1 Number of Exits Required

The number of exit routes must be adequate, with at least two exit routes available in a workplace to permit prompt evacuation of employees and other building occupants during an emergency, with exceptions noted in the standard. The exit routes should be located as far away as practical from each other so that if one exit route is blocked by fire or smoke, employees can evacuate using the second exit route.

More than two exit routes must be available in a workplace if the number of employees, the size of the building, its occupancy, or the arrangement of the workplace is such that all employees would not be able to evacuate safely during an emergency. Otherwise, a single exit route is permitted if all employees would be able to evacuate safely during an emergency. For assistance in determining the number of exit routes necessary for your workplace, consult NFPA 101, Life Safety Code.

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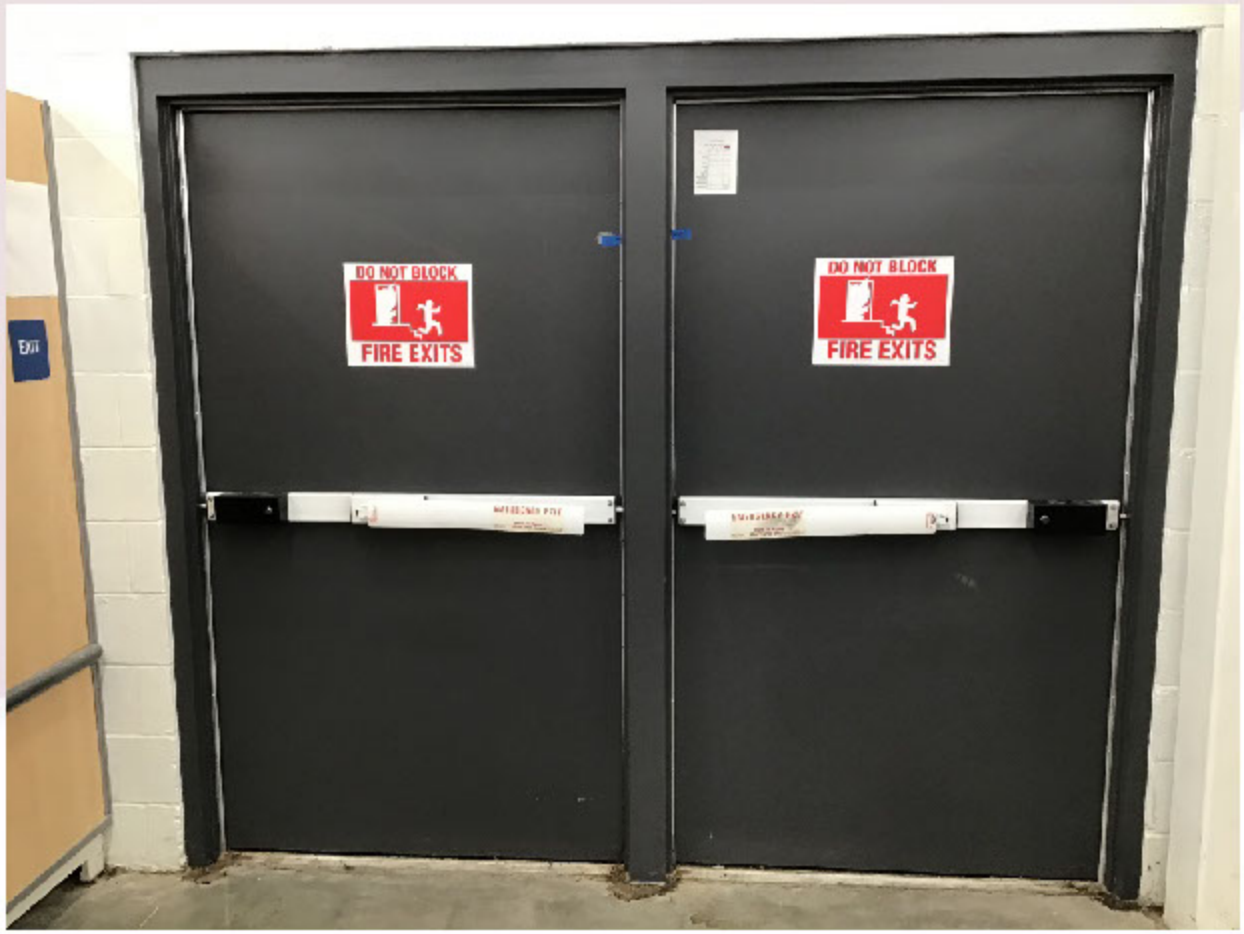
3.1.2 Exit Discharge

Each exit discharge must lead directly outside or to a street, walkway, refuge area, public way, or open space with access to the outside. The street, walkway, refuge area, public way, or open space must be large enough to accommodate the building occupants likely to use the exit route. Exit stairs that continue beyond the level on which the exit discharge is located must be interrupted at that level by doors, partitions, or other effective means that clearly indicate the direction of travel leading to the exit discharge.



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3.1.3 Locking

An exit door must be unlocked from the inside. Employees must be able to open an exit route door from the inside at all times without keys, tools, or special knowledge. A device such as a panic bar that locks only from the outside is permitted on exit discharge doors. Exit route doors must be free of any device or alarm that could restrict emergency use of the exit route if the device or alarm fails.

An exit route door may be locked from the inside only in mental, penal, or correctional facilities and then only if supervisory personnel are continuously on duty and the employer has a plan to remove occupants from the facility during an emergency.

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3.1.4 Door Swing

A side-hinged exit door must be used to connect any room to an exit route. The door that connects any room to an exit route must swing out in the direction of exit travel if the room is designed to be occupied by more than 50 people or if the room is a high hazard area (i.e., contains contents that are likely to burn with extreme rapidity or explode).

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3.1.5 Exit Route Capacity

The capacity of an exit route must be adequate, supporting the maximum permitted occupant load for each floor served. The capacity of an exit route may not decrease in the direction of exit route travel to the exit discharge. For further information regarding, "occupant load", refer to NFPA 101, Life Safety Code.

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3.1.6 Height and Width

An exit route must meet minimum height and width requirements. The ceiling of an exit route must be at least 7 feet 6 inches high. Any projection from the ceiling must not reach a point less than 6 feet 8 inches from the floor.

An exit access must be at least 28 inches wide at all points. Where there is only one exit access leading to an exit or exit discharge, the width of the exit and exit discharge must be at least equal to the width of the exit access. The width of an exit route must be sufficient to accommodate the maximum permitted occupant load of each floor served by the exit route. Lastly, objects that project into the exit route must not reduce the width of the exit route to less than the minimum width requirements for exit routes.

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3.1.7 Outdoor Exit Routes

An outdoor exit route is permitted. The outdoor exit route must have guardrails to protect unenclosed sides if a fall hazard exists. It must be covered if snow or ice are likely to accumulate along the route, unless the employer can demonstrate that any snow or ice accumulation will be removed before it presents a slipping hazard. The outdoor exit route must be reasonably straight and have smooth and solid level walkways. The outdoor exit route must not have a dead-end that is longer than 20 feet.

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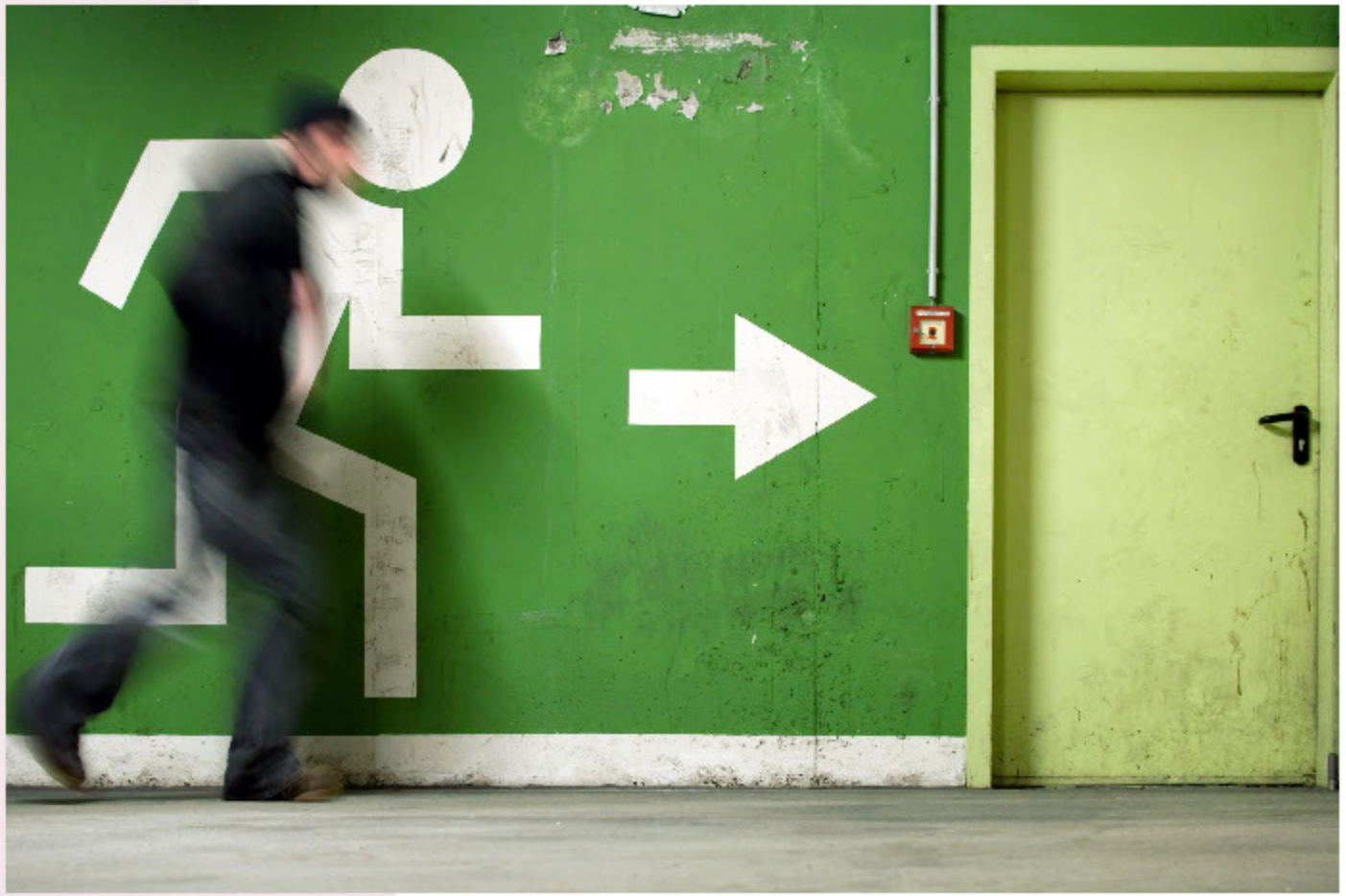
3.2 Maintenance, Safeguards, and Operational Features

1910.37 includes the safe use of exit routes during an emergency, lighting and marking exit routes, fire retardant paints, exit routes during construction, repairs or alterations, and employee alarm systems.



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3.2.1 Safe Use of Exit Routes

Exit routes must be kept free of explosive or highly flammable furnishings or other decorations. They should be arranged so that employees will not have to travel toward a high hazard area, unless the path of travel is effectively shielded from the high hazard area by suitable partitions or other physical barriers. Exit routes must be free and unobstructed, with no materials or equipment placed, either permanently or temporarily, within the exit route. The exit access must not go through a room that can be locked, such as a bathroom, to reach an exit or exit discharge, nor may it lead into a dead-end corridor. Stairs or a ramp must be provided where the exit route is not substantially level.

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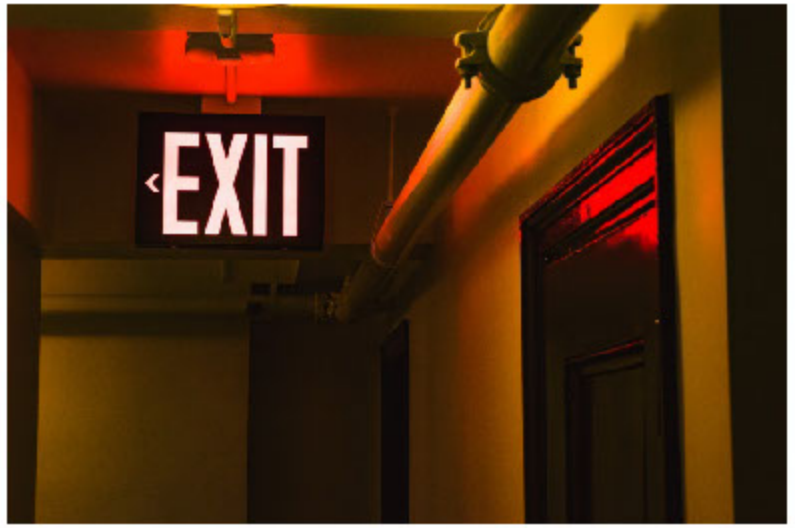
3.2.2 Lighting and Marking

Each exit route must be adequately lighted so that an employee with normal vision can see along the exit route. Each exit sign must be illuminated to a surface value of at least 5 foot- candles (54 lux) by a reliable light source and be distinctive in color. Self-luminous or electroluminescent signs that have a minimum luminance surface value of at least .06 footlamberts are permitted.

Each exit must be clearly visible and marked by a sign reading "Exit" in plainly legible letters not less than 6 inches high, with the principal strokes of the letters in the word "Exit" not less than 3/4 of an inch wide.

Each exit route door must be free of decorations or signs that obscure the visibility of the exit route door. If the direction of travel to the exit or exit discharge is not immediately apparent, signs must be posted along the exit access indicating the direction of travel to the nearest exit and exit discharge. Additionally, the line-of-sight to an exit sign must clearly be visible at all times. Each doorway or passage along an exit access that could be mistaken for an exit (such as a closet) must be marked, "Not an Exit" or similar designation, or be identified by a sign indicating its actual use.

Exit lighting and fire doors, like other safeguards designed to protect employees during an emergency such as sprinkler and alarm systems, must be in proper working order at all times.



3.2.3 Maintenance During Construction

During new construction, employees must not occupy a workplace until the exit routes required by this subpart are completed and ready for employee use for the portion of the workplace they occupy.

During repairs or alterations, employees must not occupy a workplace unless the exit routes required by this subpart are available and existing fire protections are maintained, or until alternate fire protection is furnished that provides an equivalent level of safety.

Employees must not be exposed to hazards of flammable or explosive substances or equipment used during construction, repairs, or alterations, that are beyond the normal permissible conditions in the workplace, or that would impede exiting the workplace.

4.0 Fire Safety Plans

Nobody expects an emergency or disaster – especially one that affects them, their employees, and their business personally. Yet the truth is that emergencies and disasters can strike anyone, anytime, and anywhere. You and your employees could be forced to evacuate your company when you least expect it.

Fire safety plans are often required by your local Fire Code, especially for certain buildings and occupancy rates. Check with your jurisdiction, municipality, or local fire department for further information. Some municipalities and/or fire departments may prefer that a template or standard format be used by all businesses in their area to help when they have to respond to emergencies.

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4.1 Emergency Action Plan (EAP)

Under 29 CFR Subpart E 1910.38, a written emergency action plan (EAP) is a requirement as defined by many OSHA standards. The purpose of an emergency action plan is to facilitate and organize employer and employee actions during workplace emergencies. Well-developed emergency plans and proper employee training (such that employees understand their roles and responsibilities within the plan) will result in fewer and less severe employee injuries and less structural damage to the facility during emergencies. A poorly prepared plan will likely lead to a disorganized evacuation or emergency response, resulting in confusion, injury, and property damage.

Writing an emergency action plan is simply not enough to ensure the safety of workplace employees. When an evacuation is necessary, responsible, and trained individuals who can supervise and coordinate activities to ensure a safe and successful evacuation will be required. An EAP will be useful only if its content is current and employees are sufficiently educated and trained before an actual evacuation takes place.

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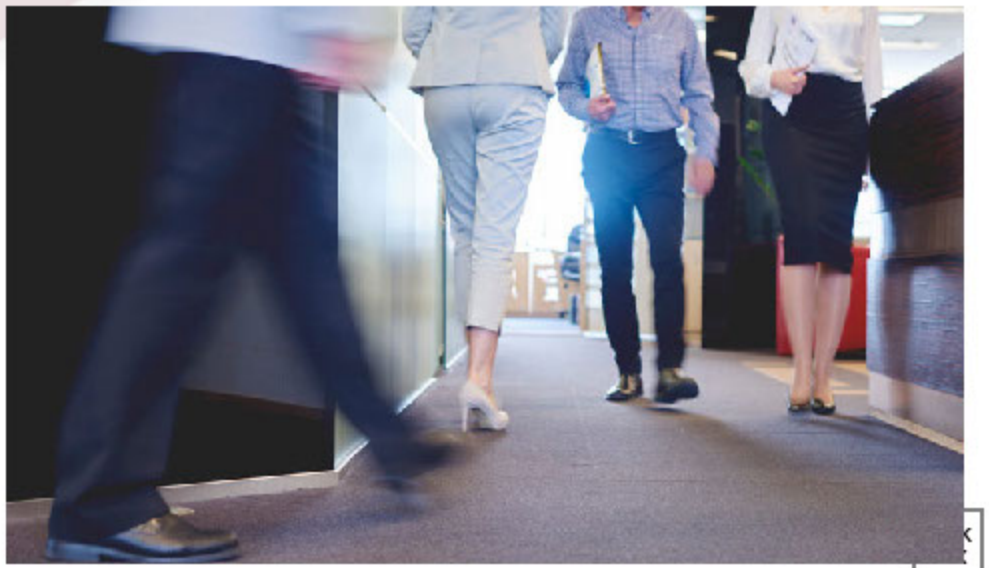
4.1 Emergency Action Plan (EAP)

It is essential that the emergency action plan developed be site-specific with respect to emergency conditions evaluated, evacuation policies and procedures, emergency reporting mechanisms, and alarm systems. Emergency action plans should include employees in the planning process, specify what employees should do during an emergency, and ensure that employees receive proper training for emergencies. For the most effective employee participation in the process, it is recommended that employees be encouraged to offer suggestions about potential hazards, worst-case scenarios, and proper emergency responses. After the plan is developed, it should be reviewed with employees to make sure everyone knows what to do before, during, and after an emergency. A copy of the emergency action plan should be made available in a convenient location where employees can get to it; otherwise, a copy of the plan should be provided to all employees.



4.1 Emergency Action Plan (EAP)

Developing a comprehensive emergency action plan that deals with the issues specific to the worksite is not difficult. It involves taking what was learned from the assessment of the workplace hazards and describing how employees will respond to different types of emergencies, taking into account specific worksite layout, structural features, and emergency systems. Most organizations find it beneficial to include a diverse group of representatives (management and employees) in this planning process that meet frequently to review progress and allocate development tasks. The commitment and support of all employees is critical to the plan's success in the event of an emergency by requesting their help in establishing and implementing the emergency action plan. For smaller organizations, the plan does not need to be written and may be communicated orally if there are 10 or fewer employees.

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4.1 Emergency Action Plan (EAP)

A disorganized evacuation can result in confusion, injury, and property damage. When developing an emergency action plan, it is important to first consider the following:

- Conditions under which an evacuation would be necessary
- Conditions under which it may be better to shelter-in-place
- A clear chain of command and designation of the person authorized to order an evacuation or shutdown
- Specific evacuation procedures, including routes and exits
- Procedures for assisting visitors and employees to evacuate, particularly those with disability challenges or language barriers
- Designation of any employees who will remain after the evacuation alarm to shut down critical operations or perform other duties before evacuating
- A means of accounting for employees after an evacuation

- Appropriate personal protective equipment or other special equipment to be made available to employees during the evacuation process

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4.1.1 Evacuation Elements

Before implementing the emergency action plan, an employer should designate and train enough people to assist in the safe and orderly emergency evacuation of employees. The plan should be reviewed with each employee when the initial plan is developed and when each employee is initially assigned to a job. Additionally, an employer should review the plan with each employee when his/her actions or responsibilities under the plan change or when the plan itself is revised or changed in any way.

Operations and personnel change frequently, and an outdated plan will be of little use in an emergency. With this, the plan should regularly be updated whenever an employee's emergency actions or responsibilities change, or when there is a change in the layout or design of the facility, new equipment, hazardous materials, or processes are introduced that affect evacuation routes, or new types of hazards are introduced that require special actions. The most common outdated item in plans is the facility and agency contact information. Consider placing this important information on a separate page in the front of the plan so that it can be readily updated.

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4.1.1 Evacuation Elements

After the final revisions of the plan have been made, it should be posted in an area where all employees will have access to it. The plans should also be reviewed with other companies or employee groups that may share occupancy of the building to ensure that fire safety efforts will be coordinated, enhancing the effectiveness of the plan. In addition, if the assistance from local emergency responders such as the fire department, local HAZMAT teams, or other outside responders is relied upon, it may be useful to review and coordinate the emergency plans with these organizations. This ensures that all who may participate in the plan are aware of the capabilities of these outside responders and that they know what is expected of them.

4.1.2 Training

Effective plans often call for retraining employees annually and include drills in which employees can practice evacuating their workplace and gathering in the assembly area. The size of the workplace and workforce, processes used, materials handled, and the availability of onsite or outside resources will determine the training requirements. All covered employees should understand the function and elements of the emergency action plan, including types of potential emergencies, reporting procedures, alarm systems, evacuation plans, and shutdown procedures. Any special hazards that exist onsite should be reviewed, such as flammable materials, toxic chemicals, radioactive sources, or water-reactive substances.

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4.1.2 Training

Specific workplace training for employees who are covered under the emergency action plan should address the following:

- Individual roles and responsibilities
- Threats, hazards, and protective actions
- Notification, warning, and communications procedures
- Means for locating family members in an emergency
- The location of first aid kits
- Emergency response procedures
- Evacuation, shelter, and accountability procedures
- Location and use of common emergency equipment
- The management of unauthorized access to the site
- Emergency shutdown procedures

4.2 Fire Prevention Plan

The purpose of the fire prevention plan is to prevent a fire from occurring in the workplace. It describes the fuel sources (hazardous or other materials) onsite that could initiate or contribute both to the spread of a fire, as well as the building systems, such as fixed fire extinguishing systems and alarm systems in place to control the ignition or spread of a fire. The plan requirements are depicted in 29 CFR Subpart E 1910.39. This plan may be combined with the emergency action plan as described in the previous section to create a comprehensive fire safety plan for the workplace.

An employer should inform their employees of the fire hazards to which they are exposed and review with each employee those parts of the fire prevention plan necessary for self-protection. It is important that the plan clearly communicates who will be in charge during an emergency to minimize confusion. The plan is to be in writing, kept in the workplace, and made available to employees for review. However, the plan may be communicated orally to employees for an employer with 10 or fewer employees.

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4.2 Fire Prevention Plan

At a minimum, the fire prevention plan must include:

- A list of all major fire hazards, proper handling and storage procedures for hazardous materials, potential ignition sources and their control, and the type of fire protection equipment necessary to control each major hazard
- Procedures to control accumulations of flammable and combustible waste materials
- Procedures for regular maintenance of safeguards installed on heat-producing equipment to prevent the accidental ignition of combustible materials
- The name or job title of employees responsible for maintaining equipment to prevent or control sources of ignition or fires
- The name or job title of employees responsible for the control of fuel source hazards

Upon initial assignment to a job and with any pertinent job change, an employer should inform employees of the fire hazards to which they are exposed. An employer should also review with each employee those parts of the fire prevention plan necessary for self-protection.