Overview of Portable Fire Extinguishers

An Online Continuing Education Course for Engineers

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Abstract

Portable fire extinguishers are designed to put out small fires in their incipient stage. A small fire, if not checked immediately, will soon spread out of control. The portable fire extinguisher is one of the most valuable fire-protection appliances in use today.

For a fire extinguisher to be effective, the following conditions must be met:

- The extinguisher must be right for the type of fire;
- It must be located where it can be easily reached;
- It must be in good working order;
- The fire must be discovered while it is still small;
- The person using the extinguisher must be trained to use it properly.

The provisions of fire protection extinguishers requirement's are subject to certain statutory requirements of Occupational Health and Safety Act (OSHA) and in accordance with the recommendations of National Fire Protection Association (NFPA). The National Fire Protection Association (NFPA) has established the requirements for the number, size, placement, performance, and maintenance of portable fire extinguishers. These requirements are contained in *NFPA 10®*, "Standard for Portable Fire Extinguishers". Within this Standard it is stated that the selection of fire extinguishers for a given situation is determined by the character of the fires anticipated to be encountered, the construction and occupancy of the property to be protected, the ambient temperature of the area where the extinguisher will be located, and other factors that may dictate the selection of a particular type of extinguisher.

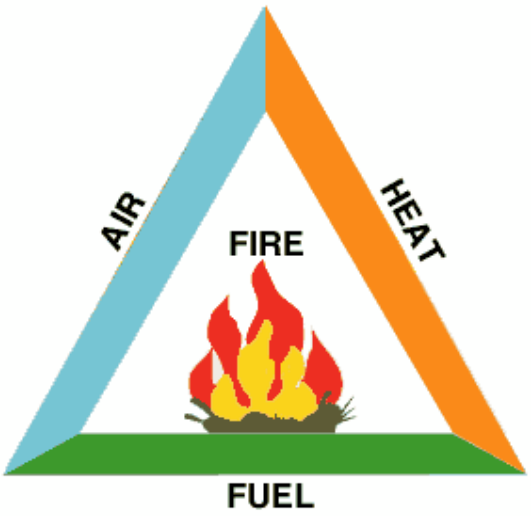
This course is derived from the extract information of *NFPA 10®* and is meant to help you with proper selection, proper use, and proper identification of fire extinguishers. It is not intended to abrogate the specific requirements of *NFPA 10®* and other standards.

OVERVIEW OF PORTABLE FIRE EXTINGUISHERS

For a fire to occur, all three of the following statements must be true:

- Flammable or combustible material is present (Fuel).
- The material is mixed with air in the proportions required to produce an ignitable mixture (oxygen - 16% or more).
- The release of energy is sufficient to ignite the mixture (Heat).

The above conditions constitute the well-known "fire triangle" (Figure below).



Remove any of these factors and the fire cannot occur or will extinguish itself if it is already burning.

FIRE EXTINGUISHING METHODS

Fires can be extinguished in one of four ways:

1. **By cooling:** Water is used to cool the burning material below the temperature at which it starts to burn
2. **By smothering:** Carbon dioxide ($C0_2$) or foaming agents are used to smother the burning material so that air is excluded
3. **By removing the fuel:** Fuel can be any combustible material-solid, liquid or gas. In place of usage you require these elements but definitely in event of fire a means to cut the fuel must be considered for instance "turning off a fuel line."
4. **By disrupting:** Interrupting the chemical chain reaction can extinguish the fire. Portable fire extinguishers are intended as a first line of defense to cope with fires of limited size. The fire extinguishers work by either removing one of the three elements needed to sustain combustion or by interrupting the reaction between the elements. The minimum percentage of oxygen in the atmosphere required to sustain a fire is 16%.

CLASSIFICATION OF FIRES

To select the proper fire extinguisher, you must first become familiar with the different classes of fires.

NFPA classify fires into four basic categories - designated Class - A, B, C, and D as described below.

TYPES OF FIRES	
CLASS · A	Ordinary combustible materials such as wood, paper, cloth, rubber, trash, many plastics including FRP and other ordinary materials.
CLASS · B	Flammable / combustible* liquids and gases such as petroleum greases, tars, oils, paints, gasoline, solvents, lacquers, alcohols and flammable gases.
CLASS · C	Fires involving energized electrical equipment such as appliances, wiring, switches, panel boxes, outlets, lamps and power supplies.
CLASS · D	Combustible metals such as magnesium, titanium, zirconium, sodium, lithium and potassium. (Normally not for household use)
CLASS · K	Fires in cooking appliances that involve combustible cooking media such as vegetable or animal oils and fats.

Note that Class - A, B, and C categories are not subdivided any further, so it may be easier to think of them as (A) solids, (B) liquids, and (C) electrical fires.

*The difference between flammable and combustible is the temperature at which they give off vapors, their flashpoint. A flammable liquid will give off vapors at or below 100°F. A combustible liquid will give off vapors when over 100°F.

FIRE EXTINGUISHER TYPES & USES

It is vital to know what type of extinguisher you are using. Using the wrong type of extinguisher for the wrong type of fire can be life-threatening. For example, you spray water on a grease fire, the water will cause the grease to splatter and the fire may spread; similarly, if you dowse live electrical equipment with water, you are putting yourself in danger of electrical shock.
Turning off the electricity will change the status of a Class - C fire to a Class - A and/or B fire.

The effectiveness of a fire extinguisher on a particular fire depends on the amount and type of agent in the extinguisher. Matching the agent to the fire begins with an understanding of how fires are classified.

There are **six** different types of fire extinguishers and are classified by the type of fire on which they can be used. Each extinguisher and extinguishing agent has certain advantages and disadvantages associated with its use and limitations on what it can accomplish.

Type of Extinguisher: Stored-pressure water Extinguishers

Suitability: Class - A fires

Features: Stored pressure water type extinguishers contain water under pressure and are usually quite large and heavy. Use this type is recommended when burning combustibles require a cooling and wetting action. Water extinguishers are effective against fires involving: wood, paper, plastic, rubber or textiles.

You cannot use a water extinguisher for a Class -B fire, (flammable liquids), as flammable liquids are lighter than water and will float on the surface of the water. This will simply aid in the spread of the fire.

You cannot use a water extinguisher on a Class - C fire, (electrical fire), because you run the risk of receiving an electrical shock. Water is an electrical conductor so as the water spreads out, the chance of electrocution increases. A stored pressure distilled water mist extinguisher is safe to use around energized electrical fires provided that you do not place any portion of the extinguisher within ten inches (10") of the electrical source. The misting nozzle provides safety from electric shock and reduces the scattering of burning materials.

Type of Extinguisher: Carbon-dioxide ($C0_2$) Extinguishers

Suitability: Class - B & C fires

Features: The use of $C0_2$ as an extinguishing agent is based on the principle of lowering the percentage of oxygen within the fire area. The fire is extinguished by a reduction of the oxygen content from the normal 21 percent to 15 percent. Since $C0_2$ is heavier than air, it has the ability to penetrate into loose material and confined spaces.

The rapid expansion of the gas on discharging produces a refrigerating effect, as indicated by the $C0_2$ snow, which has a temperature of minus 79°C (-110°F). This snow turns into gas and in the process absorbs heat from the surrounding atmosphere.

Uses: Carbon Dioxide ($C0_2$) extinguishers are used for Class - B and C fires. $C0_2$ extinguishers have an advantage over other extinguishers (e.g. dry chemical type) since they don't leave a harmful residue - a good choice for electrical machinery and apparatus, and any situation where water would be damaging to the material after the fire is extinguished. It is however not as effective outdoors as it is indoors due to the effect of wind on the agent.

Precautions in Using $C0_2$: The characteristics of carbon dioxide are such that certain precautionary measures are necessary:

- So far as safety to life is concerned, $C0_2$, if not breathed in excessive amounts, is not dangerous; however, a concentrated atmosphere inhaled for several minutes will produce suffocation. Inhaling $C0_2$ at concentration above 9 percent can render a person helpless almost immediately. As $C0_2$ design concentrations for fire extinguishing generally exceed 25 percent, it is potentially dangerous for personnel to be in an area protected by a $C0_2$ system.
- When carbon dioxide is discharged from a fire extinguisher, to its vapour state, static electricity is generated. The hose and horn assembly of the extinguisher provides a path to dissipate this static charge to prevent harm to the operator from an electrical spark. The spark will take place if the operator touches the horn during discharge operation; that is, if you place the horn against an object during discharge of the unit or if you come into contact with the discharge while operating the unit. The preferred way to operate this unit is to keep your body out of the fire area while discharging and to hold the horn by the insulated handle at all time.
- $C0_2$ is stored as a liquid under high pressure. Therefore, when discharged, the rapid expansion produces a cooling effect. One may obtain a "burn," or frostbite from touching the horn or the discharge from which the gas has passed. The discharge may contain small particles or bits of dry ice to shoot out the nozzle. These particles are dangerous because they may not be able to displace enough air around them to re-ignite.

Type of Extinguishe

Suitability: Class -

Features: Dry-chemical extinguishers expel a finely powdered dry chemical which, on striking flame, releases many times its volume in nontoxic fire- extinguishing gases similar to $C0_2$. The powder consists principally of bicarbonate of soda which has been chemically processed to make it free-flowing. The extinguishers contain a cartridge of $C0_2$ or nitrogen (depending on size) to expel the dry chemical. These extinguishers can be used for electrical fires, both in rotating machinery and other equipment. However, the powder remaining after the fire is extinguished is difficult to clean from motor or generator windings.

These extinguishers are effective on fires of flammable liquids in vats and pools, spilled fires on floors, or in any situation where the compound stream can be swept across the burning surface.

Dry chemical extinguishers have an advantage over $C0_2$ extinguishers since they leave a non-flammable substance on the extinguished material, reducing the likelihood of re-ignition.