

# Fire Extinguisher Safety in the School Laboratory



A portable, hand-held, fire extinguisher is a basic and required safety tool in the school science facility. It is the science teacher's first line of defense in the event of a fire, either in the laboratory or in the chemical storage area. This article will discuss the selection, location, maintenance, and use of fire extinguishers.

## Fire Background

The National Fire Protection Association (NFPA), fire professionals, and other standard-setting groups have established four categories or "classes of fire."

- Class A fire: Involves ordinary combustibles such as paper, wood, cardboard, cloth, rubber and plastics.
- Class B fire: Involves flammable or combustible liquids and gases such as gasoline, kerosene, alcohols, common organic solvents, and hydrogen gas.
- Class C fire: Involves energized (plugged in) electrical equipment such as hot plates, stirrers, lights, ovens, computers, appliances, and electrical switches.
- Class D fire: Involves combustible water-reactive metals such as lithium, sodium, and potassium, and flammable metals such as magnesium.

Should the science teacher even consider fighting a fire? This subject seems controversial. We have encountered fire professionals who vigorously suggest that the teacher, upon discovery of a fire, immediately notify the fire department, close all doors and windows in the affected areas, and vacate the premises at once. The issue of when to fight a fire should be established by the school district and be clearly explained in the school's Chemical Hygiene Plan. What everyone does agree on is to immediately sound the alarm. The alarm should not depend on your success (or lack of success) in fighting the fire.

You are not required to fight a fire. If you have the slightest doubt about your safety, the safety of your students, or your ability to fight the fire—do not fight the fire—simply get out, start an evacuation of the building, and notify the fire department. Unfortunately, you have only a few seconds to make the *Fight* or *Flight* decision. Only fight the fire if the following mental checklist is followed:

- F** Find the fire and evaluate what is causing the fire and the source of the fuel. How large can it get? What danger does it present to you and your students?
- I** Inform the school and fire department. Pull the fire alarm or have a student pull the fire alarm to start the evacuation of the school and to notify the fire department. No fire is too small to evacuate the building.
- R** Restrict the fire. Use a readily available fire extinguisher or fire blanket to contain the fire. Another option is to remove the fuel source or potential new fuel sources. If all else fails, close the door (do not lock it) to restrict the air supply and contain the fire.
- E** Exit and evacuate. Always make sure an exit is easily accessible before attempting to put out the fire.

Other factors may also influence a science teacher's firefighting decision:

- Is an extinguisher present and in good working order?
- Is the extinguisher the proper type for the class of fire?
- Can the fire be controlled using a hand-held extinguisher?
- Are you, the science teacher, willing to use and knowledgeable in the use of a fire extinguisher?

The *Fight* or *Flight* decision must be made immediately. Firefighting training and keeping the proper fire extinguishers in good working order makes the decision a little easier. If you are unsure of your ability to safely and successfully fight the fire, then immediately withdrawing from the fire is your wisest course of action.

Science teachers should establish a fire emergency sequence or scenario as part of their Chemical Hygiene Plan and safety program. In the event of fire, one student might be instructed to immediately sound the alarm, while other students would be instructed to secure the doors and windows and organize the rest of the class for immediate evacuation. All of the above

should, of course, be under and as the result of direct teacher supervision. We repeat, the most important first step in the event of a fire is to immediately sound the alarm.

### Fire Extinguisher Descriptions

There are many different types of fire extinguishers and all are available in various sizes. The important features are the type and size of the fire extinguisher. The type and size of the fire extinguisher will determine the types of fires that can be extinguished, the horizontal stream, and the approximate time of discharge. Fire extinguishers are usually available in sizes from 1 to 45 pounds of extinguishing material. Extinguishers have varying horizontal streams (how far the extinguishant will shoot) that range from 3 to 20 feet. Approximate time of discharge (how many seconds the extinguishing agent will shoot) is also an important factor. Science teachers who have used a hand-held extinguisher to fight a fire have commented, “The extinguisher lasted only a few seconds.” Yes, that’s true—a 10-lb CO<sub>2</sub> fire extinguisher will most likely be exhausted in 10 seconds or less.

Let’s examine the two most common types of fire extinguishers found in school environments.

#### ABC, Dry Chemical Fire Extinguisher

The dry chemical extinguisher is the science teacher’s best choice (see Figure 1). The ABC, dry chemical fire extinguisher can put out all three common fires (paper, solvents, and electrical). It has excellent fire extinguishing capabilities and leaves a blanket of non-flammable material which reduces the likelihood of reignition. Most ABC, dry chemical fire extinguishers contain ammonium phosphate as the extinguishing agent and pressurized nitrogen gas as the expellant. An average 10- to 20-lb ABC dry chemical fire extinguisher will shoot 5–20 feet and will discharge extinguishing agent for 10–25 seconds.

One disadvantage of using the ABC, dry chemical fire extinguisher is the enormous dust problem that will be created when used. However, the superior fire extinguishing capability of the dry chemical extinguisher far outweighs the undesirable dust problem.

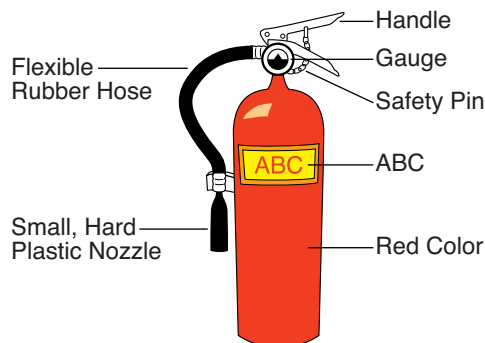


Figure 1.

#### CO<sub>2</sub> Fire Extinguishers

CO<sub>2</sub> fire extinguishers can be used on Class B and C fires. A CO<sub>2</sub> fire extinguisher contains compressed CO<sub>2</sub> and the CO<sub>2</sub> is used as both the expellant and extinguishing agent (see Figure 2). It works on the principle of cooling the fire and removing oxygen from the fire. CO<sub>2</sub> fire extinguishers work best on Class C (electrical) fires. They offer some extinguishing capabilities on Class B (solvents) but very little for Class A fires (paper). While CO<sub>2</sub> is a “clean” extinguishing agent, it exhibits poor extinguishing or fire “knock down” characteristics. It also evaporates immediately so there is little protection from reignition. In areas of the school science facility where optical equipment, balances, computers, and other dust sensitive equipment are located, CO<sub>2</sub> extinguishers might be a better choice than dry chemical extinguishers simply to avoid the dust problem.

The horizontal stream range of a CO<sub>2</sub> extinguisher is considerably less (about 3–8 ft) than that of a dry chemical extinguisher. The discharge time is 8–30 seconds, about the same as other fire extinguishers.

When involved in horseplay, students have been known to aim a CO<sub>2</sub> extinguisher at other students. The expelled gas is so cold that body and facial parts have been frozen. Never, ever allow fire extinguishers to be used for anything other than putting out fires.

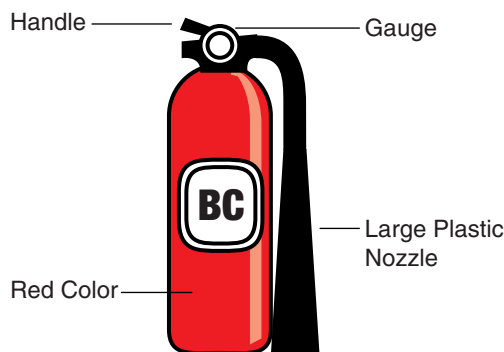


Figure 2.

### Other Fire Extinguishers

Water fire extinguishers are sometimes found in older schools. They are only suitable for Class A fires. In many cases, the water will make a Class B, C, or D fire worse by spreading the fire or reacting with the flammable metal. Water fire extinguishers should not be used in any science laboratory.

ABC, gas discharge fire extinguishers contain halogenated gases and have names such as Halon or Halotron. These fire extinguishers are suitable for Class A, B, and C fires but are very expensive. Because the extinguishant is a gas or rapidly evaporating liquid, they leave no powder residue and are preferred around electrical equipment. Their expense, however, prevents their widespread use.

### Class D Fire Extinguisher

ABC, dry chemical and CO<sub>2</sub> fire extinguishers should not be used to put out a Class D (flammable metals) fire. Flammable metals present the greatest risk when the metals are in a finely divided form (powder, dust, shavings, turnings, etc.). Once ignited, the flammable metals are particularly dangerous and are very difficult to extinguish. Frequently, these fires erupt on a combustible surface such as wooden lab bench or storage shelves and the entire scenario quickly takes on very serious consequences.

Special Class D fire extinguishing materials have been developed specifically to extinguish flammable metals fires. These extinguishing agents are powder-like substances that are scooped or shoveled onto the fire to smother and extinguish the fire. Many science teachers keep a supply of clean, dry sand on hand when demonstrating flammable water-reactive alkali metals. If the quantity of flammable metal is small, sand is an effective fire extinguisher. If large quantities of flammable metals are used, Flinn suggests a product called MET-L-X. MET-L-X has been specifically designed to extinguish Class D fires and may be found in the fire extinguisher section of the *Flinn Scientific Catalog/Reference Manual*. The science teacher's concern for using these flammable metals on school premises should be greatly reduced if the quantity of material is limited and properly stored.

## Selecting a Fire Extinguisher

The physical size of the extinguisher is an important consideration. Most school science departments (even small middle schools with limited science programs) require at least one small ( $\geq 10$ -lb) ABC, dry chemical fire extinguisher per room for sufficient protection. It is important to make sure there is enough fire protection to ensure safety in life threatening situations. Flinn Scientific recommends at least one 10- to 20-lb ABC, dry chemical fire extinguisher for all middle and high school science laboratories and store rooms. It provides the science teacher with the best overall protection.

The quantity of hazards present and the size of the laboratory or store room will dictate if additional fire extinguishers are needed. The actual size of the fire extinguisher should be determined by the teacher's ability to handle the fire extinguisher. It is far better to have two 10-lb fire extinguishers that a teacher can handle than one 20-lb fire extinguisher that is too heavy to use. Local fire regulations may also dictate the size and type of fire extinguishers in your science laboratories.

## Extinguisher Location

Location and availability are two key factors when discussing fire protection. Before getting into location specifics, let's discuss visibility and the need for the conspicuous location of fire extinguishers. Experts suggest that extinguishers be mounted no higher than 5 feet above floor level. Furthermore, the extinguisher location should be conspicuous and its location visible

from every location in the room. It must never be obscured nor obstructed. In a large area like a school science laboratory, signs and placards may be required to clearly indicate the extinguisher location(s).

The maximum travel distance to a fire extinguisher should only be 30–50 ft. This approximation is the maximum distance a teacher should travel to get to a fire extinguisher. The lab configuration and the amount of flammable materials used will also influence the

location of the fire extinguishers and the travel distance. Remember, a flammable liquid fire will reach “maturity” in seconds. There will not be time to travel a great distance.

The science teacher may wish to make a crude floor plan of all science areas. This floor plan will enable the teacher to strategically place the right type and size fire extinguishers in the correct locations (see Figure 3). If the science teacher draws a floor plan, a coverage or location plan can be created to ensure maximum fire extinguisher protection.

The chemical storage area—the home of the largest quantity and the most flammable materials—deserves your special attention, in terms of the extinguisher type, size, and quantity. If the storeroom is a long, narrow room with only one entrance/exit, then the fire extinguisher should be placed at the far inside wall of the room. Should a fire develop between you and the exit, this fire extinguisher will provide you with the means to fight your way to safety. If a solution prep area is located in the chemical storeroom, place a fire extinguisher within reach of the prep area. Again, ABC, dry chemical fire extinguishers are recommended for every chemical storeroom.

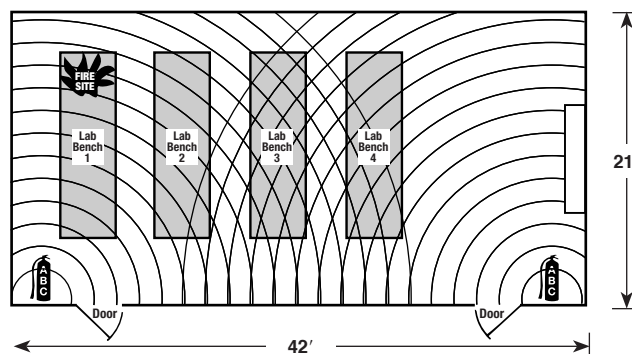


Figure 3.

## Fire Extinguisher Maintenance and Inspection

The science teacher will probably not be involved in actual extinguisher maintenance or inspections. Various state and local regulatory agencies have specific maintenance regulations that apply to your school. Most schools will contract out this service to a professional fire extinguisher maintenance company. Flinn Scientific does recommend a regular “quick-check” method to be sure the fire extinguisher is ready to assist you in a time of crisis. Some ingredients of a “quick check” are:

- Is it an ABC, dry chemical fire extinguisher?
- Is it visible from all areas of the room and unobstructed?
- Is it a size I feel comfortable using?
- Is it in a good location?
- Is the extinguisher fully charged (look at the dial)?
- Is the extinguisher undamaged and does it still have a plastic safety pull-tag on it?
- Is there an inspection tag on the extinguisher and does it appear to have been inspected within the last year?

If any of these questions are not answered to your satisfaction, consult with your administration or building supervisor.

## How to Use a Fire Extinguisher

Learn how and when to use a fire extinguisher before fighting a real fire. Annual science department safety training should include putting out a controlled fire with a hand-held fire. To fight a fire, remember the word PASS.

**P** Pull the pin. Most fire extinguishers have a simple metal pin that prevents the fire extinguisher from accidentally being discharged. This pin is usually held on with a small plastic tie. Firmly grasp the pin loop and pull to remove the pin.

**A** Aim. Always aim low, at the base or front of the fire—the edge of the fire closest to you. This will allow the extinguishing material to flow over the fire and smother it. If you aim at the middle of the fire or the back of the fire, much of your extinguishing material will be wasted and the fire may be pushed closer to you.

**S** Squeeze the handle. This releases the extinguishing agent. Short bursts are much better than one long continuous squeeze. A little bit of extinguishing agent goes a long way. Always keep the fire extinguisher upright.

**S** Sweep. Sweep the fire extinguisher from side to side at the base of the fire. Better yet, apply short bursts of the fire extinguishing material to each outer edge of the fire.

Move towards the fire, but always make sure an exit is easily accessible.

This *SafetyFax* contains only guidelines and recommendations and is not a comprehensive guide to choosing and using fire extinguishers. Flinn Scientific highly recommends that all science teachers be properly trained by a firefighting professional on when and how to use a fire extinguisher.

### Summary

An ABC, dry chemical fire extinguisher is the science teacher's first line of defense in the event of a fire. At least one fire extinguisher must be located in every science classroom, laboratory, and storeroom. In the event of a fire, the most important first step is to sound the alarm. After this step, a *Flight* or *Fight* decision must be made by the science teacher.

Science departments should establish fire extinguisher requirements, fire emergency sequence, and fire safety training as part of their Chemical Hygiene Plan and safety program.

### References

*Flinn Scientific Catalog/Reference Manual*

*CRC Handbook of Laboratory Safety*, 4th ed.; Furr, A. K., Ed.: CRC: Boca Raton, 1995.

Fire Protection Guide to Hazardous Materials, 12th ed.: NFPA: Quincy, MA, 1997.

**Materials for *Fire Extinguisher Safety in the School Laboratory* are available from Flinn Scientific, Inc.**

Catalog No.	Description
SE1034	Fire Extinguisher, ABC Dry Chemical, 5-lb
SE3001	Fire Extinguisher, ABC Dry Chemical, 10-lb
SE1033	Fire Extinguisher, Halotron, ABC
SE3004	Fire Extinguisher, Powder, Class D
SE320	Fire Extinguisher Sign, 24"× 4"
SE1916	Fire Extinguisher Sign, 7"× 17"

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.