



INSTRUCT-O-GRAM

THE HANDS-ON TRAINING GUIDE FOR THE FIRE INSTRUCTOR

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PORTABLE FIRE EXTINGUISHERS

TIME REQUIRED

2 hours

MOTIVATION

Portable fire extinguishers are a "first aid" measure to stop incipient fires before they get out of hand. Ask for experiences of using or witnessing the use of extinguishers. Have the class discuss the pros and cons of extinguisher use by the general public.

OBJECTIVES

1. Given a reading assignment, lecture and demonstration, the student will define four classes of fire, with 100% accuracy.
2. Given a reading assignment, lecture and demonstration, the student will explain the rating system for Class A and B portable fire extinguishers, with 100% accuracy.
3. Given a reading assignment, lecture and demonstration, the student will list 6 agents used in portable fire extinguishers, with 100% accuracy.
4. Given a reading assignment, lecture and demonstration, the student will cite an instance when A, BC, ABC and D extinguishers should each be used, with 100% accuracy.
5. Given a choice of extinguishers and a controlled fire, the student will choose the

correct extinguisher and extinguish the fire using proper techniques.

PRESENTATION

Interactive Lecture and Demonstration

INTRODUCTION

Portable fire extinguishers are an invaluable piece of the fire protection picture. But in order for a portable fire extinguisher to be effective several things must be true:

- ◆ The extinguisher must be readily available.
- ◆ It must be located in a place that is accessible and is either known to the user or found in little or no time.
- ◆ The extinguisher must be in working order. The extinguisher must contain enough fire extinguishing agent and it must have enough pressure to expel the agent onto the fire.
- ◆ The extinguisher must be suitable for the hazard being protected. Research must be done by the occupant to ensure that the proper extinguishers are located near target hazards.
- ◆ The fire must be small enough to be controlled with an extinguisher. A fire that is too large to control with an extinguisher can get beyond the ability of a quick knockdown by

the fire department if time is wasted by attempts to extinguish it with a portable extinguisher.

- ◆ The person using the extinguisher must know how to operate it. Without a properly trained operator an extinguisher can be ineffective or even dangerous. All persons who may be expected to use a portable fire extinguisher should be trained in the proper techniques for attacking a fire.
- ◆ Fire fighters are considered the experts on fire extinguishers. People often call the local fire station for information on choosing the correct extinguisher. Many businesses ask the fire department to assist with employee extinguisher training. Fire fighters should be familiar with the use and selection of extinguishers not only to help those people, but also to be able to use an extinguisher when it is appropriate to do so.

I. Classifications of fire

A. Class A

Class A fires are fires in ordinary combustibles such as wood, paper or textiles.

B. Class B

Class B fires are fires in flammable or combustible liquids such as gasoline, diesel fuel, and animal or vegetable oils.

C. Class C

Class C fires are fires in charged electrical equipment.

D. Class D

Class D fires are fires in combustible metals such as sodium or magnesium.

II. Extinguisher symbols

Show actual extinguishers

A. Letter symbol

Extinguishers need to be label for their intended use. Extinguishers are labeled A, BC, ABC or D, depending on the type of agent and application. Each letter has a corresponding geometric symbol and color code: Class A is a green triangle, Class B is a red square, Class C is a blue circle and Class D is a yellow star. Care should always

be taken to use the correct extinguisher for the job at hand.

B. Pictorial

In addition to Letters, each extinguisher has a pictorial representation also.

III. Extinguisher rating

A. Class A

1. Numerical

Class A extinguishers each have a number assigned (1A, 2A, 5A). A 2A extinguisher can put out twice as big a fire as a 1A extinguisher. A 5A extinguisher can put out five times as big a fire as a 1A extinguisher.

2. For each 1¼ gallons of water

Class A extinguishers number rating is based on the fire extinguishing properties of 1¼ gallon of water. A 1A extinguisher can put out the same fire as 1¼ gallons of water. A 4A extinguisher can put out the same fire as 5 gallons of water.

3. Criteria

UL and other testing laboratories have several tests to determine the Class A rating of an extinguishing agent.

a. Wood crib

The wood crib test uses spruce or fir with a moisture content between 9 and 13 percent. The crib is larger for each classification rating, ranging from 10 layers of five 2" x 2" x 20" boards for a 1A rating to 10 layers of 2½" x 4" x 87" for a 40A rating. The crib is ignited by a pan of heptane and allowed to burn for several minutes before an attempt to extinguish the fire. For ratings above 10A this is the only test used.

b. Wood panel

The wood panel test uses a solid wood panel with furring strips applied. The panel sprinkled with fuel oil and ignited and is allowed to burn until the furring strips fall

away. The fire is then attacked from a beginning distance of 10 feet.

c. Excelsior

In the excelsior Test excelsior is spread over a steel or concrete floor. It is ignited by pouring 2 to 4 ounces of heptane along one edge and igniting it. When the fire reaches the center of the excelsior it is attacked from a distance of 15 feet.

d. Water capacity

Extinguishers which contain only water are rated based on the volume of water in the extinguisher.

4. Ratings from 1A to 40A

Class A extinguishers have ratings of 1A, 2A, 3A, 4A, 6A, 10A, 20A, 30A, and 40A.

B. Class B

1. Numerical

Class B extinguishers also are given a numerical rating.

2. Based on square foot

The rating is based on the square foot area of a 2" deep layer of heptane. A fire in a 1 foot by 1 foot pan of heptane should be extinguished by a 1B extinguisher. However, an expert should be able to extinguish 2½ times as much area as a non-expert. For example, a novice with a 40B should be able to extinguish a flammable liquid fire in a pan 4' by 10', while an expert with the same extinguisher should be able to extinguish a fire in a 10' by 10' pan.

3. 1B to 640B

Class B extinguishers have ratings of: 1B, 2B, 5B, 10B, 20B, 30B, 40B, 60B, 80B, 120B, 240B, 320B, 480B & 640B.

C. Class C

Class C extinguishers do not have a numerical rating. They receive a Class C rating because of the non-conductive properties of the agent.

D. Class D

Class D extinguishers do not have a numerical rating. They receive a Class D rating because of the ability of the agent to extinguish a fire in a particular metal. Class D extinguishers are specific to a particular metal and should not be used on a metal for which they are not designated, as they would not be effective. Class D extinguishers are usually selected because of a particular target hazard in the area, for instance, an occupancy using sodium in a manufacturing process would select Sodium extinguishers for the area where sodium is used.

1. Magnesium

a. Area fire test

The Area Fire Test simulates a fire in magnesium chips or dust. It is ignited by directing a gas flame at the center of the surface of the bed of magnesium. The fire is attacked when half of the bed is burning from a distance of 8 feet.

b. Pallet transfer

The Pallet Transfer Test involves a fire in a wood pallet that transfers to magnesium chips. The burning chips are then transferred by a shovel to a one inch bed of extinguishing agent over a wood panel. Additional agent is then used to extinguish the material.

c. Premix

In a Premix test magnesium is mixed with agent to test the ability of the agent to inhibit spread through a pile of chips.

d. Casting

In the Casting Test a 25 pound casting of magnesium is placed on a steel plate and ignited. When a pool of molten metal develops beneath the casting the fire is attacked, either with an extinguisher or manually.

2. Sodium and Potassium

Sodium and Potassium agents are tested when the metals are in a liquid state.

a. Spill fire

Three pounds of metal is melted and heated to 1050o at which point it self ignites. The burning fuel is poured into a square steel pan with an area of 4 square feet. The fire is then attacked.

b. Pan fire

The Pan Fire test consists of two fires. One involves a 7 pound of molten metal, one inch deep. The other involved 35 pounds of molten metal, 3.5 inches deep. Often the deeper pan is harder to extinguish.

E. Other criteria

Portable Fire Extinguishers must also meet other criteria.

1. Discharge volume

A portable Fire Extinguisher that uses dry chemical or dry powder must discharge 80% of its contents when it is activated. A portable fire extinguisher that uses any other agent (such as water, Carbon Dioxide or Halon 1211) must be able to discharge 95% of its contents.

2. Discharge duration

A pressurized water extinguisher must be able to discharge water for a minimum of 45 to 65 seconds, depending on the rating. A Class B extinguisher must be able to discharge agent for 8 to 75 seconds, again depending on the rating. (See page 122 of *Private Fire Protection*.)

3. Discharge range

Water extinguishers must have a minimum effective discharge range of 30 feet for 40 seconds. Dry Chemical and Dry Powder extinguishers must have a minimum horizontal discharge range of 10 feet.

4. Hydrostatic testing

Before being placed into service,

extinguishers must pass a hydrostatic test at 5 times the rated capacity for 5 seconds.

ACTIVITY

The students should be broken into small groups. Each group should find three extinguishers in the building and report on type, size, rating, location and operational readiness of the extinguisher.

PRESENTATION

Interactive Lecture and Demonstration

IV. Extinguisher agents

A. Water

Water extinguishes fire by its cooling effect. Water is inexpensive and is widely available. But water is ineffective on Class B fires and it may not be used on Class C fires because of its electrical conductive properties. Additionally, 5 gallons of water is about the maximum that can be effectively carried and used by one person.

B. Carbon Dioxide

Carbon Dioxide is a colorless, odorless, heavier than air gas. It extinguishes fires by smothering, or removing oxygen. It is suitable for Class C and B fires, but it has only very limited ability to extinguish class A fires because they can rekindle after the Carbon Dioxide dissipates. Carbon Dioxide is stored as a liquid under pressure (usually about 840psi).

C. AFFF

AFFF is often added to water to allow it to be used on Class B fires. The AFFF is usually premixed with the water and discharged through a special nozzle. AFFF extinguishers are good for Class A fires (cooling) and for Class B fires (smothering and separation of fuel from the fire). A new innovation is a solid concentrate of AFFF in the nozzle. As the water passes through the nozzle it dissolves the AFFF. These type extinguishers are not yet in wide use.

D. Halogenated agents

Halogenated agents have cumbersome names so a numeric system has been

developed based on the number of Halogen atoms in the compound. For instance, Halon 1211 has one Carbon, two Fluorine, one chlorine and one Bromine atoms. Many halogenated agents have been developed for fire fighting, including:

- ◆ Carbon Tetrachloride (Halon 104)
- ◆ Methyl Bromide (Halon 1001)
- ◆ Bromochloromethane (Halon 1011)
- ◆ Bromotrifluoromethane (Halon 1301)
- ◆ Bromochlorodifluoromethane (Halon 1211)

The last two, Halon 1301 and Halon 1211 are the only ones used in portable fire extinguishers. Halon 1211 is the only one in wide use. Halon 1301 is used primarily in fixed systems. Halons extinguish a fire by the interruption of the uninhibited chain reaction. One disadvantage to Halon agents is that they are toxic. Seven percent Halon 1301 in air and 3% Halon 1211 in air have serious physical effects.

E. Dry Chemical

Dry chemical agents are very useful in putting out fires. Since they are solids they can be projected farther than gasses such as Carbon Dioxide or Halon 1211. Dry chemical extinguishers should always be filled with only the agent for which they were designed. And Dry Chemical agents should never be mixed.

1. Sodium Bicarbonate (Ordinary dry chemical)

Sodium Bicarbonate was the first commercially produced dry chem agent and is still the most widely used. It is most effective on Class B and C fires. It also has limited application for Class A fires. It is usually color coded either blue or white to distinguish it from other dry chem agents.
2. Potassium Bicarbonate (Purple K)

Potassium Bicarbonate is similar to Sodium Bicarbonate, but is, pound per pound, about twice as effective. It is color coded violet.

3. Monoammonium Phosphate (Multipurpose or ABC)

Monoammonium Phosphate is effective on Class A, B and C fires. It inhibits the chain reaction and separates fuel from fire on B and C fires and forms a sticky residue which smothers Class A fires.

4. Potassium Chloride (Super K)

Potassium Chloride is more effective on B:C fires than Potassium Bicarbonate.
5. Urea-Potassium Bicarbonate (Monnex)

Monnex is a recently developed product that is even more effective against B:C fires than Potassium Chloride.

F. Dry Powders

Dry Powder agents are designed to extinguish fires in combustible metals such as aluminum, magnesium, potassium and sodium. Other agents are often ineffective in controlling or extinguishing a fire in a combustible metal. Water often reacts violently with combustible metals, releasing hydrogen gas. Halons also often react violently with burning metals. Some metals can even burn in high concentrations of carbon dioxide. Dry Powder extinguishing agents were created to solve the problem of fires in combustible metals that are often otherwise uncontrollable.

1. NA-X

NA-X is designed for Sodium, Potassium and Sodium-Potassium alloys. It forms a crust on the burning metal, depriving it of oxygen. It is based on sodium carbonate.
2. MET-L-X

MET-L-X is based on Sodium chloride. It is intended for use on sodium, potassium and magnesium fires. It also forms a crust over the burning metal. It should be applied quickly to control the fire, then more slowly to form a deeper layer to extinguish it.
3. LITH-X

LITH-X was developed to extinguish fires in burning lithium, but it is also effective against fires in magnesium,

zirconium and sodium. LITH-X is based on graphite and works by conducting heat away from the burning metal after a layer has been applied. It does not form a crust over the fuel.

V. Distribution of Extinguishers

A. Class A

The minimum travel distance to a Class A extinguisher is 75 feet.

B. Class B

The distribution of Class B extinguishers is based on the size of the extinguisher and the hazard. It varies from 30 to 50 feet.

C. Class C & D

There is no minimum spacing distance for Class C & D extinguishers. NFPA 10 recommends that the minimum travel distance to a Class D extinguisher be 75 feet. Of course if no combustible metal hazard exists a Class D extinguisher would not be necessary.

VI. Installation and Inspection

Extinguishers should be mounted near the normal paths of travel. Access to the extinguisher should not be blocked by storage. The extinguisher should be readily visible. If the extinguisher weighs less than 40 pounds the top should not be higher than 5 feet above the floor. If the extinguisher weighs more than 40 pounds the top should not be higher than 3 feet above the floor. Regardless of size, the clearance between the bottom of the extinguisher should not be less than 4 inches.

VII. Choice of extinguishers

A. Class A

- ◆ Air-pressurized water
- ◆ Halon 1211

- ◆ Multipurpose Dry Chemical (Monoammonium phosphate)

B. Class A & Class B

- ◆ AFFF
- ◆ Halon 1211
- ◆ Multipurpose Dry Chemical (Monoammonium phosphate)

C. Class B & Class C

- ◆ Carbon Dioxide
- ◆ Halon 1211
- ◆ Halon 1301
- ◆ Multipurpose Dry Chemical (Monoammonium phosphate)

D. Class D

- ◆ Graphite
- ◆ Sodium Carbonate
- ◆ Sodium Chloride

VII. Use of extinguishers

ACTIVITY

The class should break and reconvene outside in an area where live fire training can occur. Fires should be set in flammable liquid pans and in wood pallets. The instructors should demonstrate proper safety practices to be used during the activity. Students should select the proper extinguisher and extinguish the fire. It is essential that the instructors closely monitor the students to ensure safety at all times.

REFERENCES

IFSTA Manuals: *Private Fire Protection, Fire Inspection and Code Enforcement*; Course Guide for NFA/OLFSP class, *Fire Protection Structures and Systems Design*, NFPA 1001, 1031, 10.

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