

STUDY MATERIAL FOR THE  
CERTIFICATE OF FITNESS EXAM  
FOR

**E-21**  
**USING POWDER**  
**ACTIVATED**  
**(AMMUNITION)**  
**TOOLS**

INSIDE THIS BOOKLET YOU WILL FIND  
THE FOLLOWING:

**NOTICE OF EXAMINATION (NOE)**

## NOTICE OF EXAMINATION FOR

**Title:** Examination for the Certificate of Fitness for Using Powder  
(Ammunition) Actuated Tools (E-21)

**Date of Test:** Written tests are conducted Monday through Friday (except legal holidays) 8:00 AM to 2:30 PM.

### QUALIFICATION REQUIREMENTS

1. Applicants must be at least 18 years of age.
2. Applicants must have a reasonable understanding of the English language.
3. Applicants must present a letter of recommendation from his/her employer. The letter must be on official letterhead and must state the applicant's full name, character, physical condition, experience, and address of premises where applicant will be employed.
4. Applicants must present two (2) forms of satisfactory identification i.e., driver's license and passport picture ID.
5. Applicants must have satisfactorily completed a training program in the safe use of powder actuated tools utilizing ammunition acceptable to the Fire Department.

### APPLICATION INFORMATION

**Application Fees:** \$25.00 for originals and \$15.00 for renewals. The fee may be paid in cash, money order, or personal check payable to New York City Fire Department. The \$25.00 fee must be payable by all applicants prior to taking the Certificate of Fitness test. Application forms are available at the Public Certification Unit, 1<sup>st</sup> floor, 9 MetroTech Center, Brooklyn, NY 11201.

### TEST INFORMATION

**Test:** The test will be of the written, multiple choice type. A passing score of at least 70% is required in order to secure a Certificate of Fitness. Call (718) 999-1988 for additional information and forms.

This study material will help you prepare for the examination for the Certificate of Fitness for Using Powder (Ammunition) Activated Tools. The study material includes information taken from the Fire Prevention Code and the Fire Prevention Directives of the Bureau of Fire Prevention, FDNY. The study material does not contain all of the information you need to know in order to work with powder activated tools at your work location. It is your responsibility to learn whatever else you need to know to do your job. You must also become familiar with all applicable rules and regulations of the City of New York, even if they are not covered in this material.

All questions on the Certificate of Fitness examination are multiple choice, with four alternative answers to each question. Only one answer is correct for each question. If you do not answer a question or mark more than one alternative your answer will be scored as incorrect. A score of 70% correct is required on the examination in order to qualify for the Certificate of Fitness. Read each question carefully before marking your answer. There is no penalty for guessing.

### Sample Questions

**1. Powder activated tools may only be used by:**

- (A) the construction foreman.
- (B) a Certificate of Fitness holder.
- (C) a male construction worker.
- (D) someone with a gun permit.

The correct answer is "**B**". You would press "**B**" on your touch screen computer monitor.

**2. Power activated tools can be used to fasten into:**

- (A) concrete.
- (B) masonry.
- (C) steel.
- (D) all answers are correct.

The correct answer is "**D**". You would press "**D**" on your touch screen computer monitor.

## POWDER ACTIVATED TOOLS

A powder (or ammunition) actuated fastening system is an acceptable method of making instantaneous forced entry fastenings into various construction materials. The tools are used to make fastenings to very hard materials such as concrete or steel. Although this system is simple to use, there are precautions and safeguards that must be observed. To become a qualified operator, additional training covering operation, maintenance and recommended practices for each manufacturer's tool is necessary. A qualified operator should also read and be familiar with any local and state regulations applicable to this system. Any powder actuated tools using ammunition must have a label stating that it has been approved by the Board of Standards and Appeals.

### Types and Classes of Tools

The illustration below shows a commonly used tool for drive pin and threaded stud fastenings. Although there are many different models, in all cases a fastener is forced rapidly down the barrel of the tool by an explosive charge.



### A Commonly Used Power Actuated Tool

Powder actuated tools are divided into types according to the principle of operation.

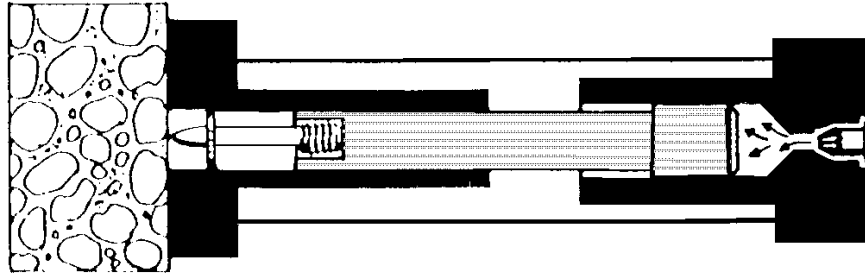
A tool uses the high velocity principle is when a fastener is shot down a barrel as a projectile to penetrate the work surface.

The coacting principle is when the piston and the fastener are pushed up the guide so that the piston is in contact with the fastener, but the fastener has a stand off from the work surface.

A tool using the impact principle has the piston pushed back in the guide of the tool but the fastener is against the work surface.

The contact principle tool has the piston in contact with the fastener and the fastener in contact with the work surface.

The illustration in the figure below is that of a tool using the contact principle.



### **Power Actuated Tool Using the Contact Principle**

Powder activated tools are also divided into classes according to the velocity with which the fastener travels. A low velocity class tool is one in which the average test velocity does not exceed 328 feet per second. A medium velocity class tool produces an average test velocity greater than 328 feet per second but not exceeding 492 feet per second. A high velocity class tool produces an average test velocity over 492 feet per second.

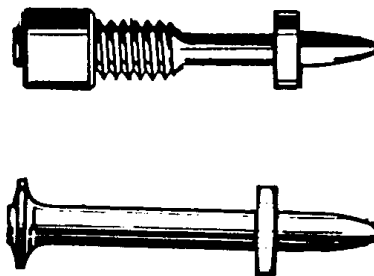
### **Fasteners**

The fasteners used in powder actuated tools are not common nails. They are manufactured from special steel and heat treated to produce a very hard, yet ductile fastener. These properties are necessary to permit the fastener to penetrate concrete or steel without breaking. The fastener is equipped with some type of tip, washer, eyelet or other guide member. This guide aligns the fastener in the tool as it is being driven and is usually used to retain the fastener in the tool. The more commonly used fasteners are drive pins and threaded studs.

A drive pin is special fastener designed to permanently attach one material to another such as wood to concrete or steel.

A threaded stud is a fastener comprised of a shank portion which is driven into the base material and a threaded portion to which an object can be attached with a nut.

The illustration below shows an example of each of these two kinds of fasteners. Note the guide near the end of the fastener that aligns the fastener in the barrel of the tool.



**Commonly Used Fasteners**

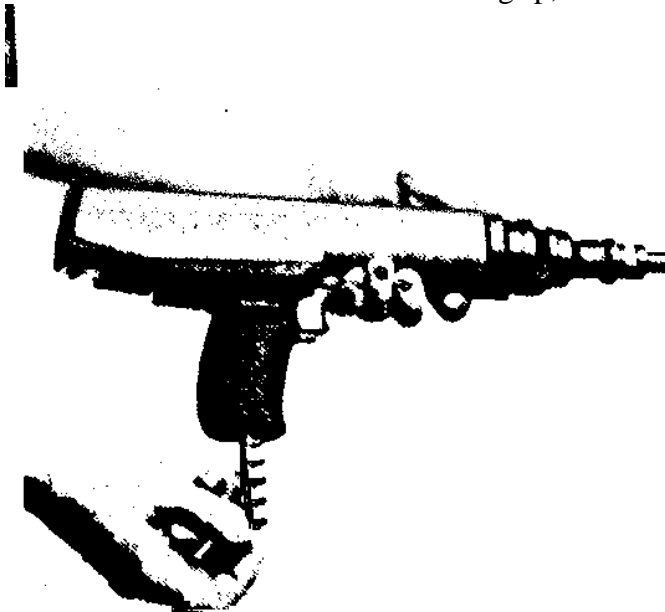
## Power Loads

The power load is a unique, portable, self contained energy source used in powder actuated tools. The power loads may come in cartridges in throw away magazines, as shown in the illustration below. Other power loads are provided only in single cartridges.



**Ten Cartridge Magazine**

The method of loading the tool will vary with the particular model being used. The kind of magazine shown above is often inserted into the base of the grip, as shown in the illustration below.



**Loading a Power Actuated Tool**

Regardless of the type, caliber, size or shape, there is a standard number and color code used to identify the power level or strength of all power loads.

Cased power loads used in all types and classes of tools cover a range of 12 power load levels. The power load levels are numbered 1 through 12, with #1 being the lightest load and #12 being the heaviest load.

Power loads #1 through #6 are in brass colored cases. Power loads #7 through #12 are in nickel colored cases. To further identify power load levels a basic six color code of gray, brown, green, yellow, red, and purple is used twice. The color codes for all of the power load levels is given in the Power Load Identification Chart.

## Power Load Identification Chart

Level	Case Color	Load Color
1.	Brass	Gray
2.	Brass	Brown
3.	Brass	Green
4.	Brass	Yellow
5.	Brass	Red
6.	Brass	Purple
7.	Nickel	Gray
8.	Nickel	Brown
9.	Nickel	Green
10.	Nickel	Yellow
11.	Nickel	Red
12.	Nickel	Purple

### Selecting a Power Load

Every tool has a recommended range of power levels. When selecting the proper power load to use in a particular application, it is important to start with the lightest power level recommended for the tool being used. Using the lightest load, if the first test fastener does not penetrate to the desired depth, the next higher power load should be tried. If necessary, continue increasing power levels by single steps until proper penetration is obtained.

For example, assume the tool for your job used power levels #1 through #4. Your first test fastening should be made with the #1 gray load (brass case). If the fastener is not fully driven, your next test fastening should be with a #2 brown load, and so forth. If your tool used power levels #3 through #6, you would start with the #3 power level.

### Shields and Special Fixtures

Shields and special fixtures are important parts of the powder actuated fastening system. The shields and fixtures are used for safety and to adapt the tool for a particular job. Low velocity class tools are supplied with a shield to confine flying particles. The shield should be used whenever fastening directly into a base material such as driving threaded studs or eye pins into steel or concrete. In addition to confining flying particles, the shield also helps hold the tool perpendicular to the work.

Medium and high velocity class tools are designed so that the tool cannot fire unless a shield or fixture is attached. Some standard shields are adjustable for fastening close to any obstruction. It is essential that these adjustable shields be used in their off center position only where the work provides safety equal to the full shield position. For other special applications, special fixtures should be used in place of the standard shield, for the purpose of additional safety and positive fastener location.

There are many other special tool accessories available for use with all tools. Examples of these are adapters which hold various types of clips, brackets or washers at the muzzle end of the tool. Power boosters are available for some tools. Special accessories and power boosters should be used only according to specific instructions by the tool manufacturer.

## **BASE MATERIALS**

In general, powder actuated tools are designed to be used in concrete and structural steel only. If the material is too hard, the fastener will not be able to penetrate and could possibly deflect or break. Some examples of materials that are too hard would be hardened tool steel, granite, spring steel, or natural rock. Other materials are too brittle, and will shatter or break. Examples of too brittle materials would be glass, glazed tile, brick or slate. Other base materials are too soft. Some examples of base materials that are too soft are wood, plaster, drywall or composition board.

### **Center Punch Test Procedure**

In all cases, the suitability of a base material may be tested by using the simple center punch test. This test procedure uses a fastener as punch. The fastener is struck with an average hammer blow.

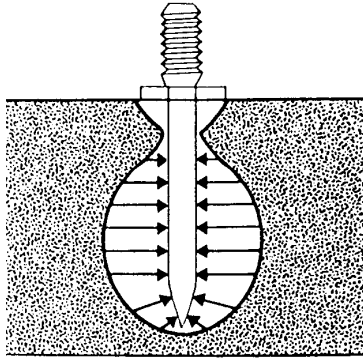
1. If the material shows a clear fastener point impression and the fastener point is not blunted, the material is suitable for power actuated fastening. You would now proceed with the first test fastening.
2. If the fastener point is blunted, the material is too hard.
3. If the material cracks or shatters, the material is too brittle.
4. If the fastener sinks into the material the material is too soft.

### **Masonry Materials**

Masonry materials suitable for fastening consist of the following:

- Poured concrete
- Pre-cast concrete
- Pre-stressed concrete
- Concrete block
- Mortar joints (horizontal)

The tool user should never fasten closer than three inches from the edge of the masonry. It is important to understand what happens when a fastener is driven into any masonry material and why the fastener holds. The holding power of the fastener results primarily from a compression bond of the masonry to the fastener shank. The fastener, on penetration, displaces the masonry which tries to return to its original form and exerts a squeezing effect. Compression of the masonry around the fastener shank takes place with the amount of compression increasing in relation to the depth of penetration and the compressive strength of the masonry. The figure below illustrates the compression effect on a threaded stud driven into concrete.

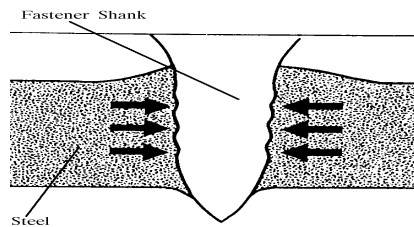


### Threaded Driven Into Concrete

### Steel

Practically all of the powder actuated fasteners driven into steel as the base material are driven into structural steel. Structural steel shapes in common usage include structural beams, angle iron, channel, tee, plate and strip. Where fasteners are to be driven into metal materials other than structural steel, it is necessary to determine the acceptability of the material for powder actuated fastenings either by consulting the supplier or by center punch testing for hardness.

A fastener driven into steel holds in the steel by the natural tendency of the steel to return to its original undisturbed condition. As the fastener is driven into steel it pushes the steel aside, compressing and displacing the steel. The tendency of the steel to flow back to its original position exerts a gripping or clamping force on the fastener shank. If the pointed portion of the shank does not extend through the steel, a part of the compressive force in the area of the point will act to force the fastener to back out. The illustration below shows the compressive effect on a fastener shank driven into steel.

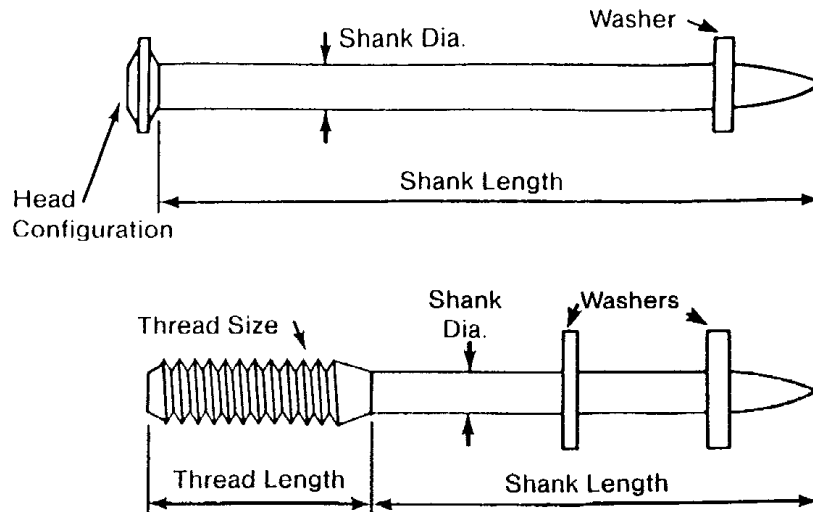


### Drive Pin Driven Into Steel

### FASTENING PROCEDURES

The selection of the proper fastener depends upon the thickness and hardness of the material into which the fastener is to be driven and the intended use for the application. If a permanent, nonreusable fastening is desired, a drive pin should be used. If a reusable installation is desired, use a threaded stud. For a light duty application, select a small shank diameter. For a heavy duty application, select a

large shank diameter. The illustration shows the dimensions that need to be considered.



### Dimensions Needed to Select Fastener

#### Fastening Into Steel

As a general rule, remember that when fastening into steel the point of the fastener should fully penetrate the opposite side. This factor should be considered when selecting shank lengths. Also remember, knurled shank fasteners hold better in steel compared to smooth shank fasteners.

**Drive Pins.** To select the proper shank length, determine the total thickness of the material to be fastened, the thickness of the steel into which the pin will be driven, plus the point length.

**Threaded Studs.** The proper shank length for threaded studs depends on the thickness of the steel plus the point length on the opposite side. Depending upon the thickness of the item to be fastened, different thread lengths are available. Generally, if the item to be fastened is sheet metal, a short thread length would be selected. If the item to be fastened is thick, a correspondingly long thread length should be chosen so that a nut, and perhaps a washer can be applied.

#### Fastening Into Masonry

It is important that the masonry be at least three (3) times as thick as the fastener penetration.

**Shank Diameter - Penetration Rule.** When fastening into average concrete, the fastener should penetrate 7 to 8 times the shank diameter. In hard concrete, 5 to 6 shank diameters penetration would normally be sufficient for proper holding power. In soft concrete, 9 to 10 shank diameters would be appropriate.

**Drive Pins.** In selecting the proper drive pin for concrete or masonry, determine the correct shank length by allowing for the thickness of the material through which the drive pin is to be driven, plus the depth of penetration required by using the shank diameter penetration rule.

**Threaded Studs.** The selection of the proper threaded stud shank length is determined by using the shank diameter penetration rule. Select a thread length to allow for the thickness of the material to be attached and a nut and washer.

An appearance problem that may occur when fastening into masonry is spall (breaking of the masonry on the surface) around the fastener shank. Spall is caused by the fastener's compression of the masonry and the initial impact. Spall does not greatly reduce holding power as it affects only the surface. If spall is an appearance problem, the appearance can be improved by fastening through a disc or by using a small reducing adapter. Surface spall may be reduced or eliminated as follows. Use a smaller shank diameter fastener which also permits a shorter shank length and less penetration. Since over penetration often causes excess spall, try a shorter shank length, a lighter power load, or both. Hold the tool perpendicular to the masonry surface. Any angular forces may cause spall. Utilize the tool shield for stability.

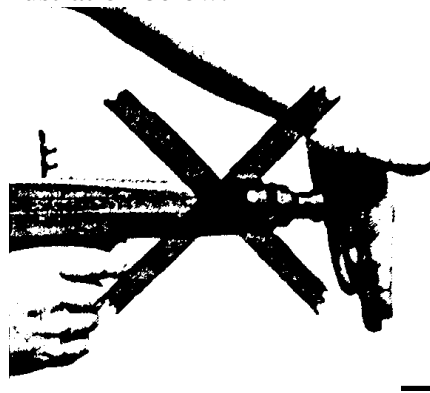
### **GENERAL SAFETY PRECAUTIONS**

Powder actuated tools are designed to operate safely. Unfortunately, they do not think for the operator. Safe operation of powder actuated tools requires knowledge and constant alertness by the operator.

#### **Operator**

Operators and coworkers should always wear safety goggles. Use of ear protection is recommended when making fastenings in confined areas such as small rooms, tanks, vaults or ship compartments. Never let bystanders gather around when you are using the tool.

When working on ladders and scaffolds, maintain good balance and properly brace yourself at all times. Never load the tool until ready to make a fastening. Never carry a loaded tool from job to job. Always keep the tool pointed in a safe direction. Never place your hand in front of the barrel of a loaded tool as shown in the illustration below.



#### **Incorrect Handling of a Power Actuated Tool**

No powder actuated tool utilizing ammunition shall be used unless the Certificate of Fitness holder establishes a safe zone behind the work area by the use of 1/2 inch steel back-up plate and/or maintenance of an area clear of all people.

## **Care and Servicing of Tools**

All tools should be cleaned and maintained in accordance with the tool manufacturer's specific instructions. Always check all tools prior to each day's use to be sure they are in proper working condition. Defective tools must be removed from service until they are repaired.

Have the tools inspected and serviced at regular intervals by the manufacturer's authorized service personnel. Do not alter any powder actuated tool or attempt to repair it with anything but factory replacement parts. Such action could destroy its safety features. Tools should be stored unloaded in a locked container when not in use.

## **Use and Limitations of Tools**

A tool should always be equipped with the proper shield or fixture for the job. Use special fixtures where the standard shield does not provide protection. Only use the off center positions of adjustable shields when fastening near obstructions, such as a wall, when the obstruction is utilized as a shield. Always operate a tool at right angles to the work surface. Always check the chamber for foreign matter before loading. Do not use the tool in an explosive or flammable atmosphere.

## **Power Loads**

Always check the color of each power load before inserting it into the tool chamber. Always make your first fastening with the lightest power load recommended for the tool. Never attempt to force a power load into a tool chamber.

In the event of a misfire hold the tool firmly against the work surface for a period of thirty seconds. Then follow the explicit procedures set forth in the manufacturer's operating instructions. Unfired power loads must not be thrown into trash containers or carelessly discarded. Never carry fasteners or other metal objects in the same container, apron pocket or pants pocket with power loads.

## **Base Materials and Materials to be Fastened**

Before fastening into any unidentified material, check it by using the center punch test. Always follow the rules for edge distance, fastener spacing and material thickness.

Do not attempt to install a fastener through an existing hole in steel or any other material unless a positive guide is used to assure accurate location. Doing so could cause the fastener to hit the edge of the hole and fish-hook or ricochet.

Never attempt to fasten into a spalled or cracked area in masonry or into any area where a previous fastener has failed. Doing so could cause the fastener to fish-hook or ricochet.

Never overdrive a fastener. Do not use a fastener to draw down a steel member. This could cause a springing action and over a period of time the fastener could be pulled loose. Never over tighten a nut on a threaded stud. This could cause the fastener to be backed ("jacked") out. Do not attempt to install fasteners into very hard or brittle materials.

Never fasten wood fiberboard, plaster or other soft materials unless backed by a material that will prevent the fastener from passing completely through. Always know the material you are fastening into, especially in older buildings where the base material may be concealed. Check continually to avoid fastening into unsuitable material. Do not fasten closer than 3" from the edge of masonry. Do not fasten closer than 1/2" from the edge of steel.

### **STORAGE OF POWER LOADS**

A permit is necessary to store or sell 200 or more shells of small arms ammunition. The main supply of ammunition shall be kept in a locked metal box lined with noncombustible insulating material. The storage and distribution of ammunition shall be supervised by a competent person holding an FDNY Certificate of Fitness. They must keep the key to the storage box in their possession.

The ammunition storage box must be kept away from heat and must not be stored in the same compartment or shanty in which compressed gases, or inflammable liquids are kept. It must also be kept away from heat.

The compartment or shanty in which the locked ammunition box is stored shall bear a permanent sign with the words "DANGER - AMMUNITION" in 2" white letters on a red background.

One 2 1/2 gallon water type fire extinguisher or equivalent must be provided where ammunition is stored. "No Smoking" signs must be posted in the area where ammunition is stored.

### **FIRE EXTINGUISHERS**

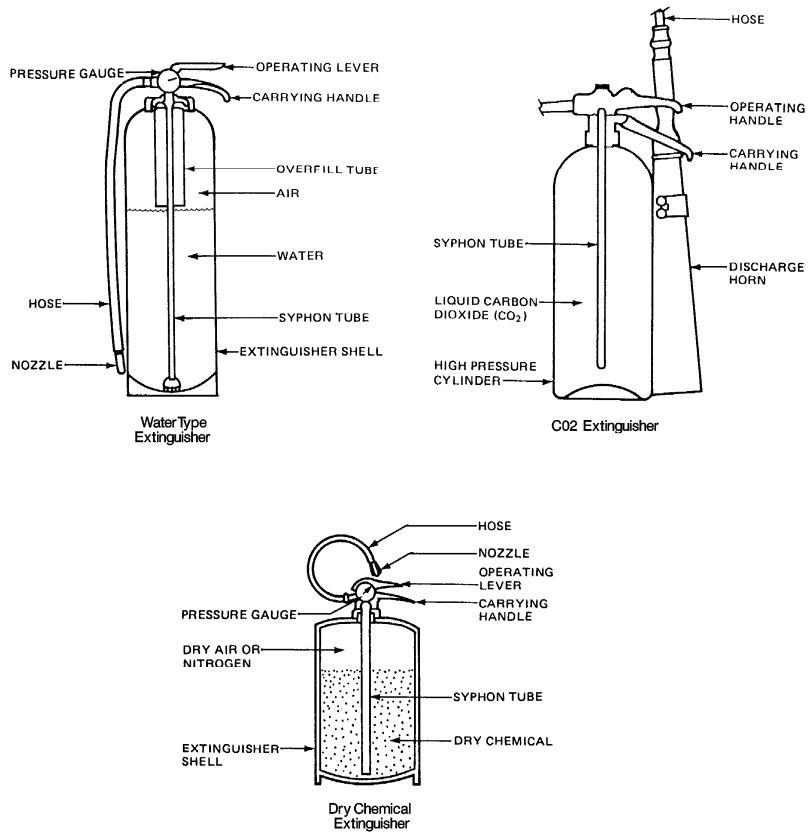
The fire guard must be familiar with the different types of fire extinguishers that are present. The fire guard must know how to operate the extinguishers in a safe and efficient manner. He/she must know the difference between the various types of extinguishers and when they should be used. A description of the three classes of fires and the appropriate extinguishers are described below.

Class A fires occur when ordinary combustible materials are ignited. For example, wood and paper fires are classified as class A fires. Water type extinguishers should be used to extinguish these fires. The water type extinguishers cool the fire while quenching the flame.

Class B fires occur when flammable liquids or greases are ignited. These fires must be extinguished by smothering the flame. The flame may be smothered using CO<sub>2</sub>, dry chemical or foam extinguishers. Water type extinguishers are not effective for class B fires.

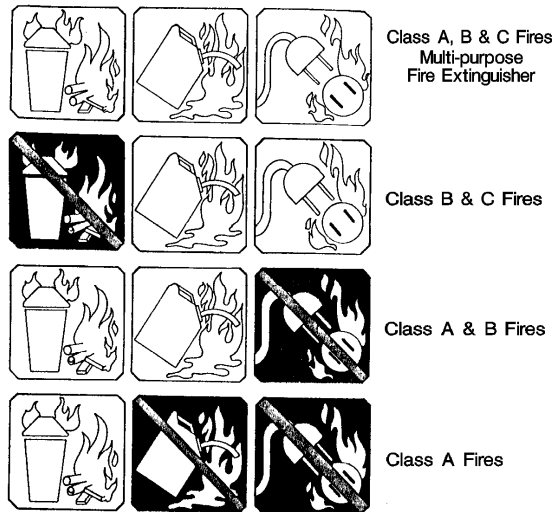
Class C fires occur when electrical equipment catches fire. These fires must be fought with fire extinguishers that do not conduct electricity. CO<sub>2</sub> and dry chemical extinguishers must be used to extinguish electrical fires. Foam and water type extinguishers must not be used to extinguish electrical fires.

Examples of Water type, CO<sub>2</sub> and Dry Chemical extinguishers are shown below.



### Typical Fire Extinguishers

Symbols may also be painted on the extinguisher. The symbols indicate what kind of fires the extinguishers may be used on. Examples of these symbols are shown below.



### Typical Symbols Painted on Fire Extinguishers

The symbol with the shaded background and the slash indicate that when the extinguisher must not be used. The fire guard must understand these symbols. The fire guard must make sure that the fire extinguishers are kept in good working order at all times.

Generally, operation instructions are clearly painted on the side of the fire extinguisher. They clearly describe how to use the extinguisher in case of an emergency. An example of these instructions are shown below.



**Operation Instructions for a Fire Extinguisher**