University of Technology, Jamaica
CEEC

Electrical installation

Noel Sinclair M.Sc., P.G.Dip.Ed,CEM

Email: nosinclair@utech.edu.jm

Ext: 2240

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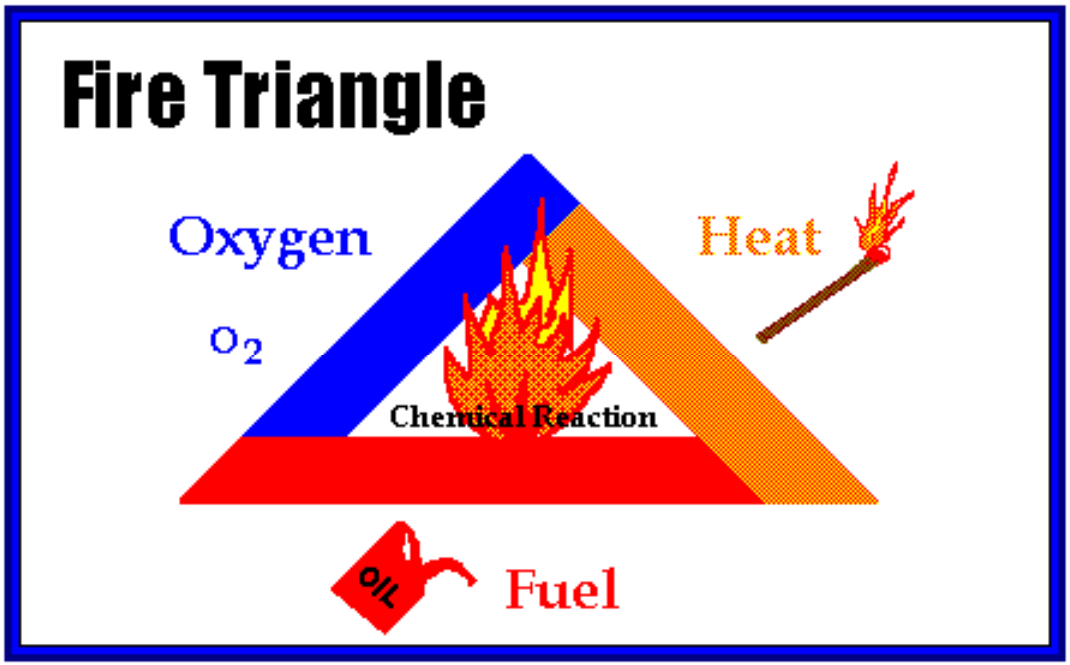
The Fire Triangle



Fire Safety, at its most basic, is based upon the principle of keeping fuel sources and ignition sources separate.

The Fire Triangle

Three things must be present at the same time to produce fire:

1. **Enough OXYGEN to sustain combustion**
2. **Enough HEAT to reach ignition temperature**
3. **Some FUEL or combustible material**

Together, they produce the CHEMICAL REACTION that is fire

Take away any of these things and the fire will be extinguished

Fuel Classifications

- Fires are classified according to the type of fuel that is burning.
- If you use the wrong type of fire extinguisher on the wrong class of fire, you might make matters worse.
- Its very important to understand the four different fire (fuel) classifications…

Fuel Classifications

Class A: Wood, paper, cloth, trash, plastics—solids that are not metals.

Class B: Flammable liquids—gasoline, oil, grease, acetone. Includes flammable gases.

Class C: Electrical—energized electrical equipment. As long as it's "plugged in."

Class D: Metals—potassium, sodium, aluminum, magnesium. Requires Metal-X, foam, and other special extinguishing agents.

Fuel Classifications

Most fire extinguishers will have a pictograph label telling you which types of fire the extinguisher is designed to fight.

For example, a simple water extinguisher might have a label like this…

…which means it should only be used on Class A fires.

Types of Fire Extinguishers

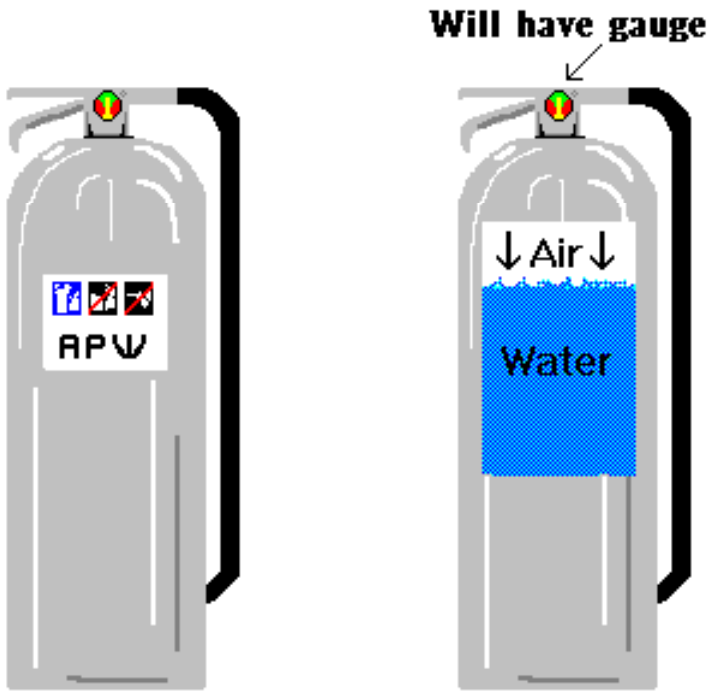
Different types of fire extinguishers are designed to fight different classes of fire.

The 3 most common types of fire extinguishers are:

1. Water (APW)
2. Carbon Dioxide (CO_2)
3. Dry Chemical (ABC, BC, DC)

Types of Fire Extinguishers

1. Water (APW) Fire Extinguishers



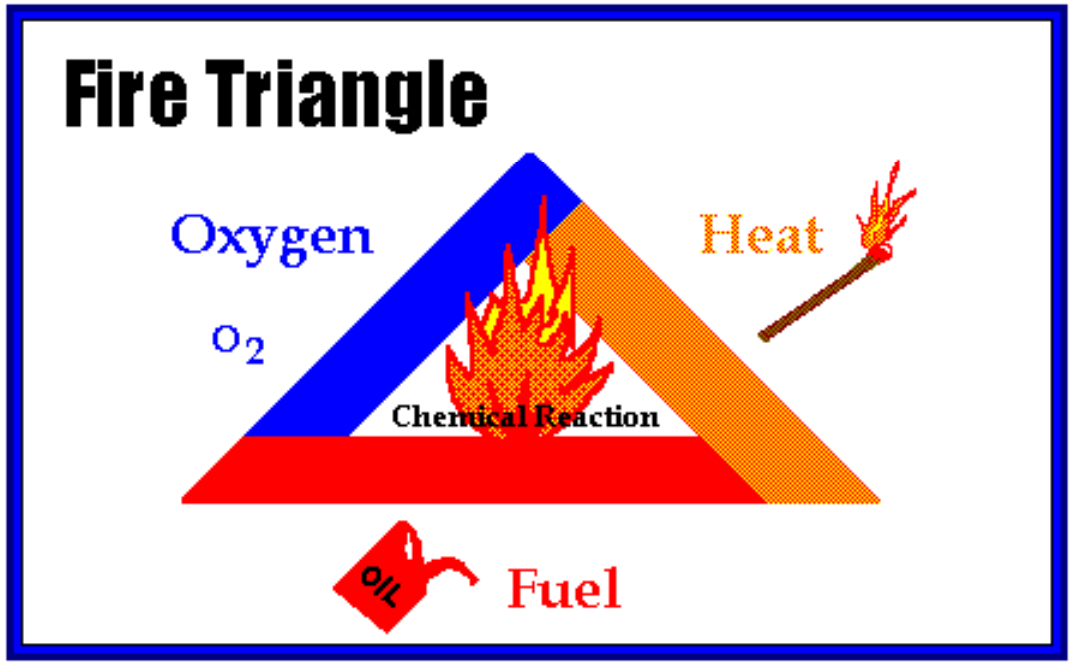
Large silver fire extinguishers that stand about 2 feet tall and weigh about 25 pounds when full.

APW stands for “Air-Pressurized Water.”

Filled with ordinary tap water and pressurized air, they are essentially large squirt guns.

Types of Fire Extinguishers

1. Water (APW) Fire Extinguishers



APW's extinguish fire by taking away the "heat" element of the Fire Triangle.

Types of Fire Extinguishers

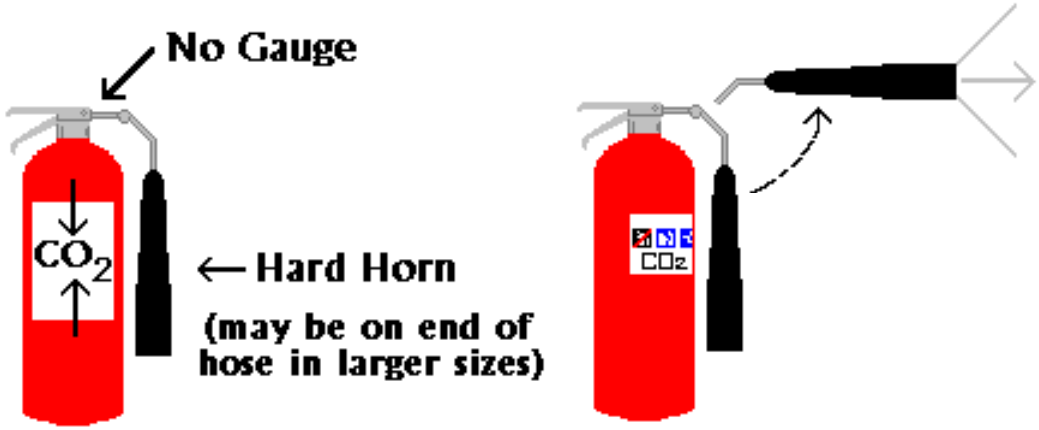
1. Water (APW) Fire Extinguishers

APW's are designed for Class A fires **only**:
Wood, paper, cloth.

- Using water on a flammable liquid fire could cause the fire to spread.
- Using water on an electrical fire increases the risk of electrocution. If you have no choice but to use an APW on an electrical fire, make sure the electrical equipment is un-plugged or de-energized.

Types of Fire Extinguishers

2. Carbon Dioxide Fire Extinguishers



The pressure in a CO_2 extinguisher is so great, bits of dry ice may shoot out of the horn!

CO_2 cylinders are red. They range in size from 5 lbs to 100 lbs or larger. On larger sizes, the horn will be at the end of a long, flexible hose.

Types of Fire Extinguishers

2. Carbon Dioxide Fire Extinguishers

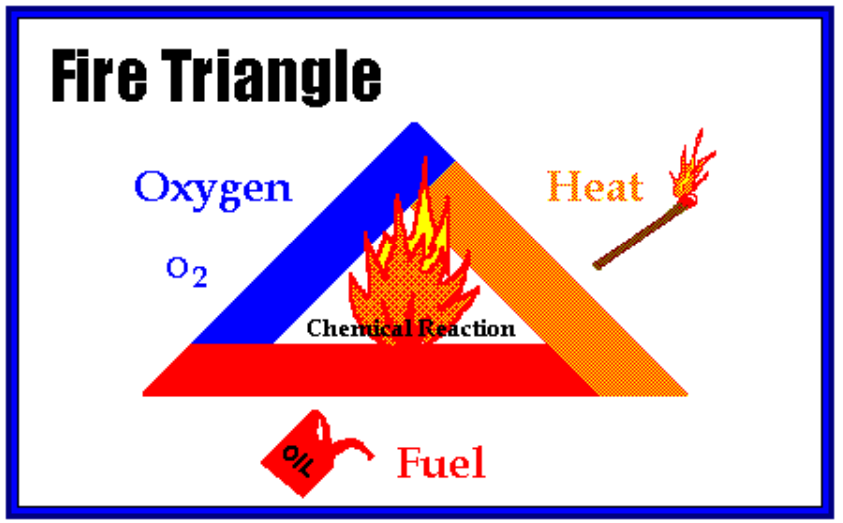
CO_2's are designed for Class B and C (Flammable Liquids and Electrical Sources) fires only!

CO_2s will frequently be found in laboratories, mechanical rooms, kitchens, and flammable liquid storage areas.

Types of Fire Extinguishers

2. Carbon Dioxide Fire Extinguishers

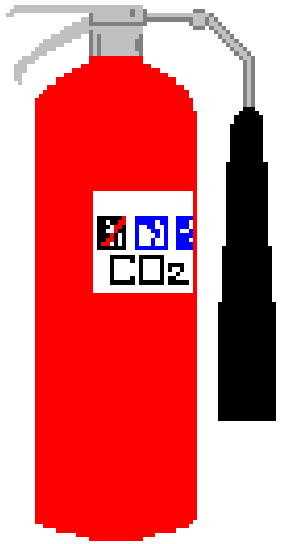
Carbon dioxide is a non-flammable gas that takes away the oxygen element of the fire triangle. Without oxygen, there is no fire.



CO_2 is very cold as it comes out of the extinguisher, so it cools the fuel as well.

Types of Fire Extinguishers

2. Carbon Dioxide Fire Extinguishers

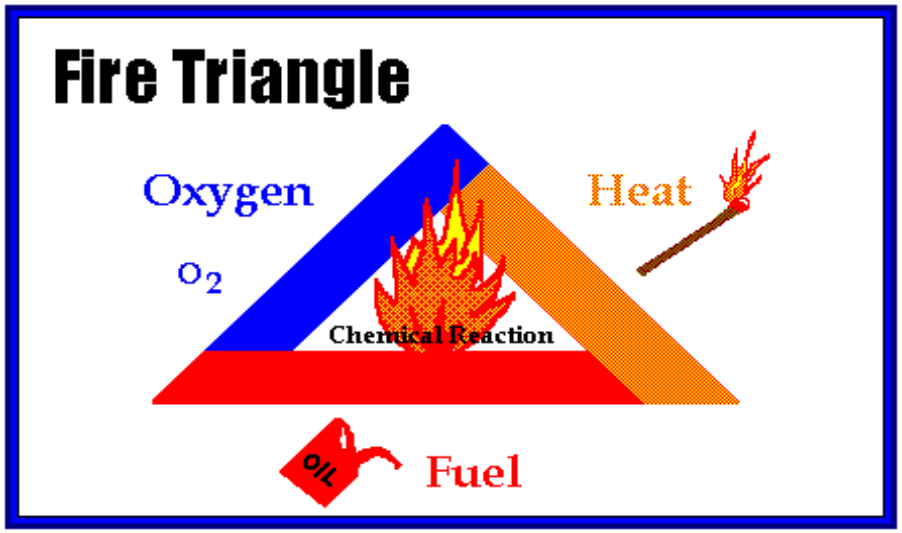


A CO_2 may be ineffective in extinguishing a Class A fire because it may not be able to displace enough oxygen to successfully put the fire out.

Class A materials may also smolder and re-ignite.

Types of Fire Extinguishers

3. Dry Chemical (ABC) Fire Extinguishers

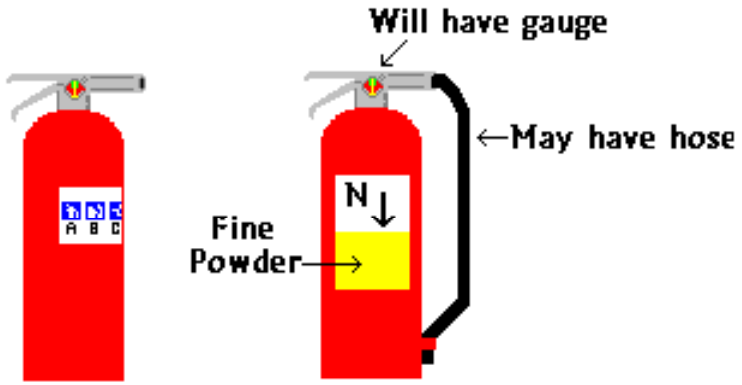


Dry chemical extinguishers put out fire by coating the fuel with a thin layer of dust. This separates the fuel from the oxygen in the air.

The powder also works to interrupt the chemical reaction of fire. These extinguishers are very effective at putting out fire.

Types of Fire Extinguishers

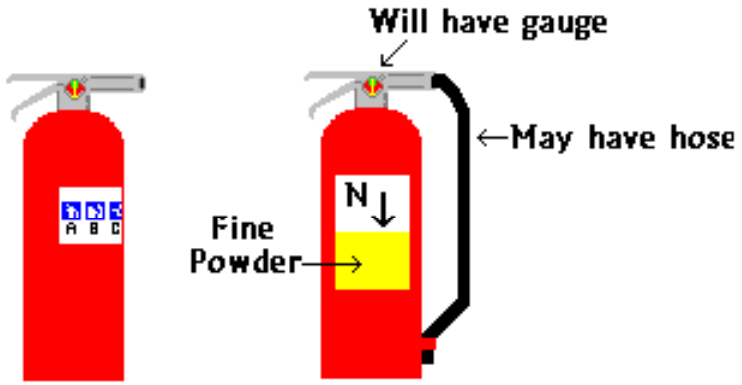
3. Dry Chemical (ABC) Fire Extinguishers



"ABC" fire extinguishers are filled with a fine yellow powder. The greatest portion of this powder is composed of monoammonium phosphate. The extinguishers are pressurized with nitrogen.

Types of Fire Extinguishers

3. Dry Chemical (ABC) Fire Extinguishers



Dry chemical extinguishers come in a variety of types…

You may see them labeled:

- DC (for “Dry Chemical”)
- ABC (can be used on Class A, B, or C fires)
- BC (designed for use on Class B and C fires)

Types of Fire Extinguishers

3. Dry Chemical (ABC) Fire Extinguishers

It is extremely important to identify which types of dry chemical extinguishers are located in your area!

An “ABC” extinguisher will have a label like this, indicating it may be used on Class A, B and C fires.

You don’t want to mistakenly use a “BC” extinguisher on a Class A fire thinking that it was an “ABC” extinguisher.

Types of Fire Extinguishers

3. Dry Chemical (ABC) Fire Extinguishers

Dry chemical extinguishers with powder designed for Class B and C fires ("BC" extinguishers) may be located in places such as commercial kitchens and areas with flammable liquids.

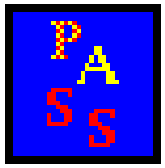
On campus, you will find ABC's in public hallways of new buildings, in laboratories,, offices, chemical storage areas, mechanical rooms, etc.

Fire Extinguishers

Type of fire extinguisher / Type of fire	(i) Water Signal red flash on red	(ii) Foam Pale cream flash on red	(iii) Carbon dioxide gas Black flash on red	(iv) Dry powder French blue flash on red	(v) Vapourizing foam Emerald green flash on red
Class A. Paper, wood and fabric	✓ Yes	✓ Yes	✗ No	✓ Yes	✓ Yes
Class B. Flammable liquids	✗ No	✓ Yes	✓ Yes	✓ Yes	✓ Yes
Class C. Flammable gases	✗ No	✗ No	✓ Yes	✓ Yes	✓ Yes
Electrical fires	✗ No	✗ No	✓ Yes	✓ Yes	✓ Yes
Motor vehicle protection	✗ No	✓ Yes	✗ No	✓ Yes	✓ Yes

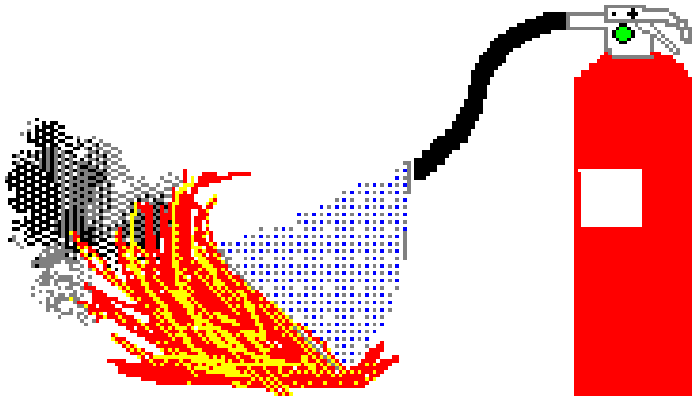
FIGURE 2.10
Fire extinguishers and their applications (colour codes to BS EN3:1996). The base colour of all fire extinguishers is red, with a different coloured flash to indicate the type.

How to Use a Fire Extinguisher

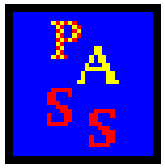


It's easy to remember how to use a fire extinguisher if you remember the acronym **PASS:**

- **P**ull
- **A**im
- **S**queeze
- **S**weep

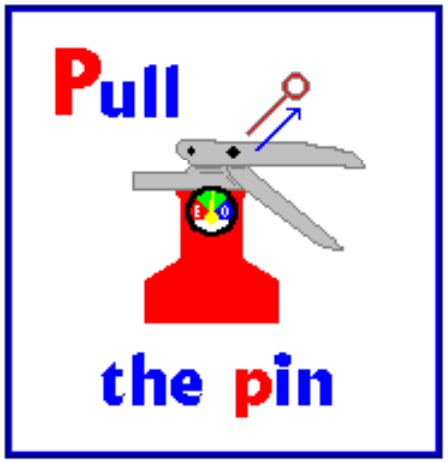


How to Use a Fire Extinguisher

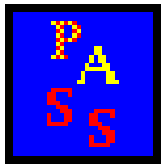


Pull the pin…

This will allow you to discharge the extinguisher



How to Use a Fire Extinguisher



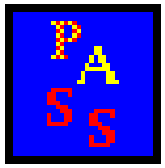
Aim at the base of the fire...

Hit the fuel.

If you aim at the flames...

... the extinguishing agent will fly right through and do no good.

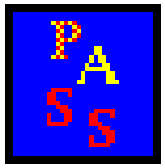
How to Use a Fire Extinguisher



Squeeze the top handle…

This depresses a button that releases the pressurized extinguishing agent.

How to Use a Fire Extinguisher



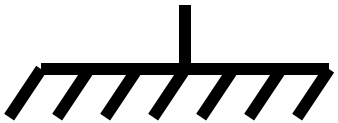
Sweep from side to side...

.. until the fire is completely out.

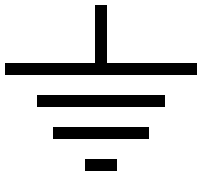
Start using the extinguisher from a safe distance away, then slowly move forward.

Once the fire is out, keep an eye on the area in case it re-ignites.

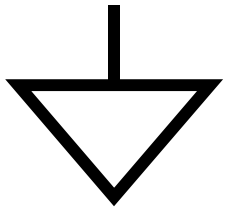
Three types of Ground Connections



Earth



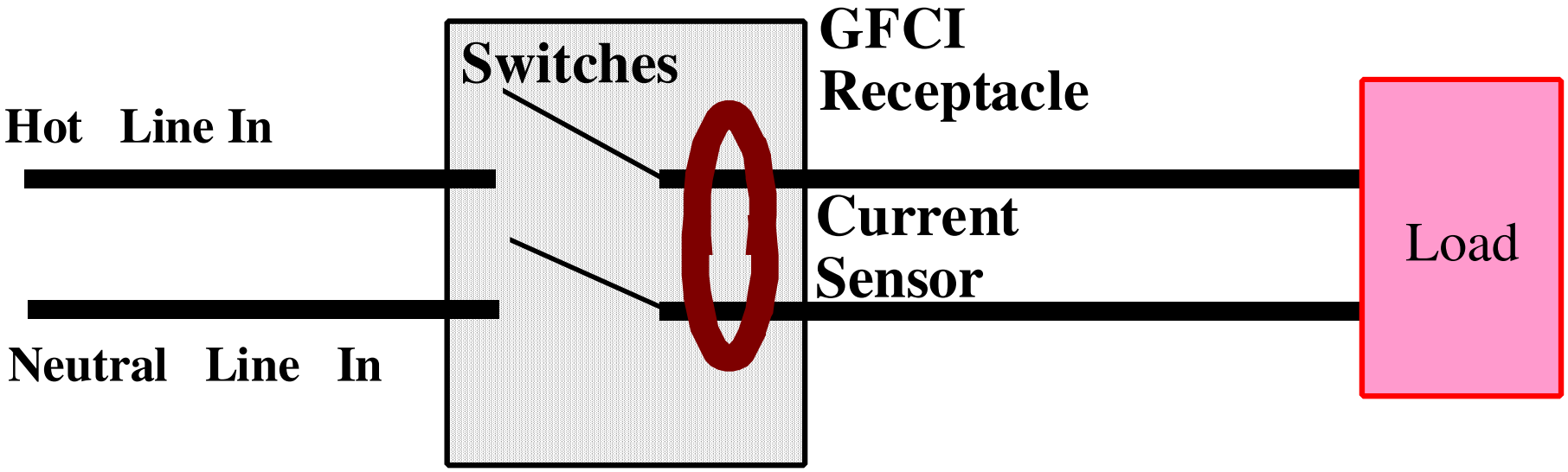
Equipment



Virtual

Three types of ground connections are commonly found. Virtual (also know as floating) grounds are not true grounds and may be energized. If a connection is made from an energized virtual ground to either an equipment or an earth ground, current will flow (shock potential).

Function of a Typical GFCI



A GFCI or ground fault circuit interrupter shuts off the flow of current upon sensing a fault condition such as an electrical shock. Switches quickly open in the GFCI device in order to prevent the shock victim from receiving a lethal amount of electricity.

GFCI Use

Typical GFCI Outlet

Receptacles containing a GFCI are noted by the test and reset buttons, and should be tested monthly to insure proper operation.

Any outlet within 6 feet of a sink or other source of plumbing should be equipped with a GFCI. Recalling Ohm's law, V=IR, very low resistances such as an earth ground (plumbing etc.) allow for very high levels of current flow.

GFCI device may be located at a circuit breaker instead of an outlet. This arrangement allows several outlets to be protected with a single GFCI device.

Fundamentals of Electrical Hazards

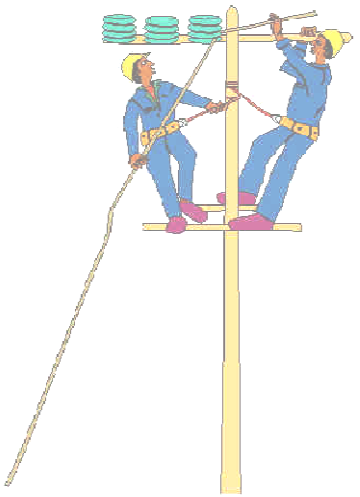
- To flow electricity must have a complete path.
- Electricity flows through *conductors*
  - water, metal, the human body
- Insulators are non-conductors
- The human body is a conductor.

Fundamentals of Electrical Hazards

Have You Ever Been Shocked?

THE BASICS

Fundamentals of Electrical Hazards



- √ **More than 3 ma**
  painful shock
- √ **More than 10 ma**
  muscle contraction “no-let-go” danger
- √ **More than 30 ma**
  lung paralysis- usually temporary
- √ **More than 50 ma**
  possible ventricular fib. (heart dysfunction, usually fatal)
- √ **100 ma to 4 amps**
  certain ventricular fibrillation, fatal
- √ **Over 4 amps**
  heart paralysis; severe burns. Usually caused by >600 volts

Fundamentals of Electrical Hazards

- Hazards of Electricity
  - Electrocution/Shock/Burns/Death
- Minimum distance from overhead lines 10 ft.
- Inspect all electrical tools and equipment

Frayed, cut, broken wires
grounding prong missing
Improper use of cube taps
improperly applied or missing strain relief

Electrical Protection

- **Circuit Breakers**
  - Provided to protect EQUIPMENT not people
  - Do not reset breakers with a line voltage higher than 120V and only reset if you know why it tripped

Lockout and Tagging of Circuits

- Apply locks to power source after de-energizing
- Tag deactivated controls
- Tag de-energized equipment and circuits at all points where they can be energized
- Tags must identify equipment or circuits being worked on

Thank you
for Listening