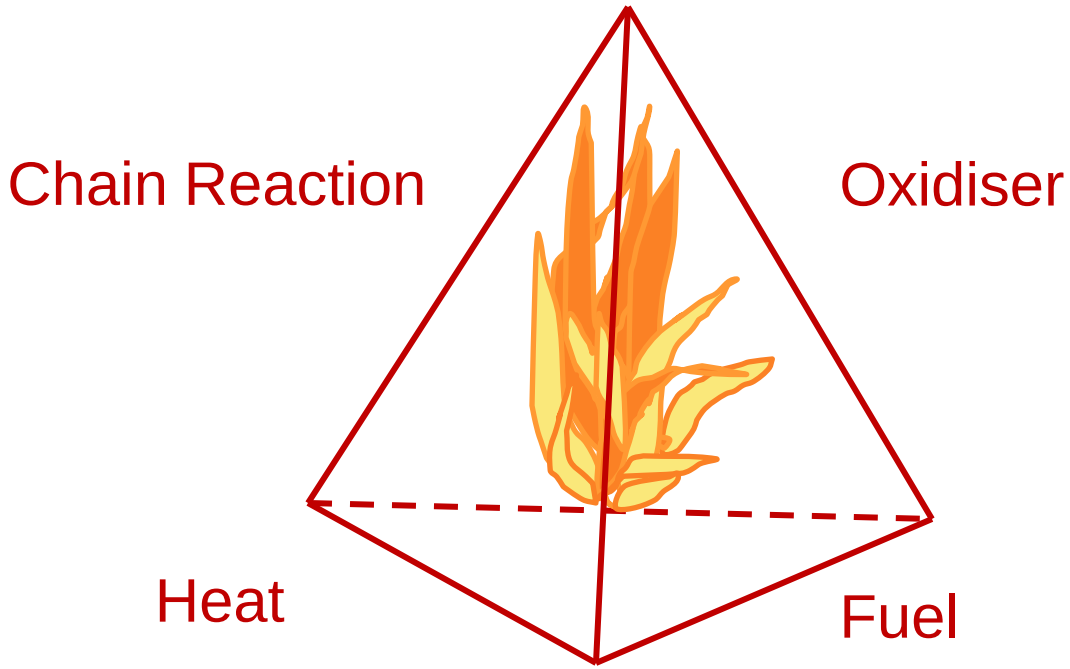
FIRE SAFETY

Fire

Fire is a rapid chemical reaction of oxidant with fuel accompanied by the release of energy, indicated by incandescence or flame.



Fire Tetrahedron

Combustion Characersitics

For a fire to happen, the following elements are essential

- Oxidiser to sustain combustion.
- Heat to reach ignition temperature.
- Fuel or combustible material.

This results in a chemical chain reaction which starts a fire.

Removing any of these elements will extinguish the fire.

Heat Transfer

During a fire heat transfer occurs by

- Conduction - transfer of heat within the material itself.
- Convection - transfer of heat by the physical movement of hot masses of air.
- Radiation - refers to the emission of heat in the form of electromagnetic waves.

Ignition

- Ignition is the process of initiating self sustained combustion.

- The ignition temperature of a substance is the minimum temperature to which it must be heated for it to ignite.

Sources of Ignition

Ignition can occur by

- Electrically powered equipment- Arcing, damaged wiring, over heating of cables due to excess loads, loose electrical connections, heat from electric bulbs etc.
- Open flame
- Hot surfaces
- Sparks from welding operations
- Chemical reaction between incompatible chemicals
- Smoking
- Batteries

Flash Point

In a flammable liquid fire, it is the vapours released from the surface of the liquid that burns.

Flash point is the lowest temperature at which a liquid produces enough vapor to form an ignitable mixture.
E.g., Diethyl ether (-45 ◦C)
Methyl alcohol (11.1 ◦C)

Lower the flash point of a flammable liquid, greater the hazard.

Classification of Fire

On the basis of the type of fuel, fires are classified into the following

Class A Fires — solid combustible materials of organic nature such as wood, paper, rubber, plastics, etc.

Class B Fires — flammable liquids

Classification of Fire

Class C Fires — flammable gases under pressure
including liquefied gases.

Class D Fires — combustible metals, such as magnesium, sodium, potassium, etc,

Extinguishing Fire

Fire can be extinguished by

- Cooling the fuel by removing heat (e.g., by applying water).

Extinguishing Fire

Fire can be extinguished by

- Smothering by cutting off oxygen supply (e.g., by applying foam, carbon dioxide).

Extinguishing Fire

Fire can be extinguished by

- Starving the fire by removing the fuel.(e.g., stopping gas flow during a pipeline fire).

- Inhibition by stopping the chain reaction.(e.g., by applying dry chemical powder).

Fire Extinguishers

Type of extinguishers and the classes of fire for which they can be used	
Water	Class A fire
Dry chemical powder	Class B & C fire
Foam	Class A & B fire
Carbon dioxide	Class B & C fire
Special dry powder	Class D fire

Water Extinguisher

- They are used for Class A fires.
- Water removes heat and extinguish the fire.
- Water must not be used on fires involving live electrical equipment as it can cause electrocution.
- Water must not be used on metal fires.

Carbon Dioxide Extinguisher

- CO_2 extinguishers are mainly used for Class B and C fires.

- CO_2 extinguish the fire by displacing oxygen in the surrounding air.

Carbon Dioxide Extinguisher

- CO_2 is not suitable for fires involving metals.
- It's principal advantage is that it does not leave any residue.
- Can be used on electrical/electronic equipment.

AFF Foam Type Extinguishers

- The extinguishing agent is aqueous film forming concentrate in water which forms air foams when discharged through an aspirating nozzle.
- It has a blanketing effect excluding oxygen from the surface of the fuel as it spreads on the fuel.
- Prevents vapour formation from the surface of the burning liquid.

AFF Foam Extinguishers

- It develops a floating aqueous film of solution under the foam on fuel surface and cool the burning surface.

- AFF extinguishers must not be used on electrical and metal fires.

Dry Chemical Powder(DCP) Extinguisher

- The main base chemicals used in DCP extinguishers are sodium bicarbonate and potassium bicarbonate.
- DCP extinguishers puts out fire by coating the fuel surface with chemical powder.
- This separates the fuel from the oxygen in the air and prevent vapor formation.

Dry Chemical Powder(DCP) Extinguisher

- The powder also interrupts the chemical chain reaction of fire.
- The disadvantage is that it leaves residue particularly making it difficult to clean up in case of sensitive equipment.

Special Dry Powder Extinguisher

- Special extinguishing agents are used for extinguishing metallic fires.
- Dry powders extinguish the fire by forming a crust on metal surface excluding air and also absorbs heat from the metal surface.
- E.g., Blended sodium chloride based dry powder, ternary eutectic chloride(TEC) powder, graphite etc.

Propellant for extinguishing media.

- The extinguishing media is expelled from the extinguisher by carbon dioxide gas contained in a cartridge inside the extinguisher.

- CO_2 extinguisher contains liquefied carbon dioxide. The gas present in the vapour space above the liquefied CO_2 itself acts as the propellant. So no separate cartridge is used in CO_2 extinguisher.

Extinguisher Operation

- Pull/remove the locking clip.
- Aim the nozzle at the base of the fire.
- Press the knob down.
- Starting from the edge of the fire sweep the nozzle from side to side advancing ahead.

Knob

Locking clip

Can be used for Class A & B fires

Air aspirating nozzle

Operating Foam type Extinguisher

- When using AFFF on a container of burning liquid the foam must be directed towards the back or side wall of the container and allowed to spread over the surface.

- Where the fire is in a liquid spill the foam must be allowed to drop slightly ahead of the fire and moved forward with a side to side movement of the nozzle.

Extinguisher Operation

- Pull/remove the locking pin.
- Aim the nozzle at the base of the fire.
- Press the lever down.
- Starting from the edge of the fire sweep the nozzle from side to side advancing ahead.

Operating a CO_2 extinguisher

- Remove the locking pin.
- Aim the horn at the base of the fire.
- Open the valve by turning it anticlockwise.
- Sweep the horn from side to side, gradually advancing ahead.

Locking pin

Valve

Can be used for Class B & C fires

Discharge horn

Extinguishing Fire

The successful use of a fire extinguisher depends on the following conditions:

- The extinguisher must be easily accessible and in good working order.
- The extinguisher must be the right type for the fire.
- The fire must be discovered in its incipient stage for the extinguisher to be effective.

Emergency Response

In case of a fire

- Actuate the manual fire alarm call point.

- Alert personnel nearby so that they can come to your help/inform security section.

Emergency Response

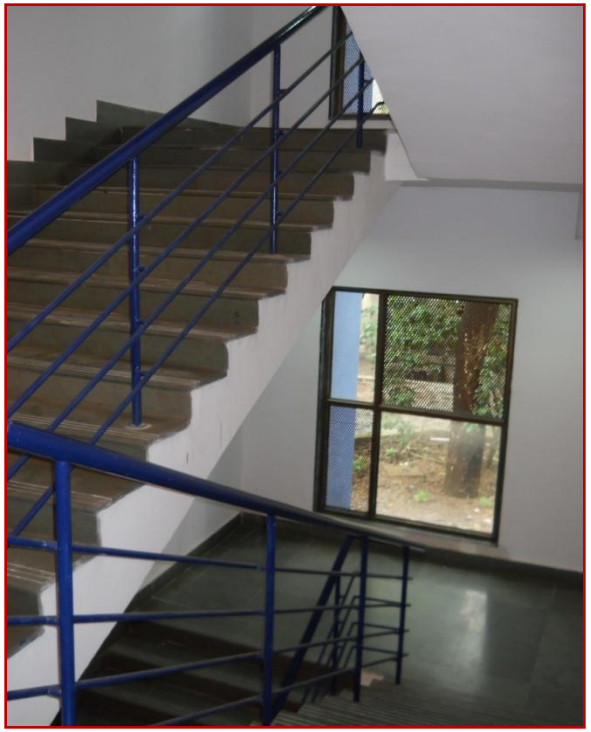
- Determine what is burning.
- Use the right type of extinguisher for fighting the fire. Use the fire extinguisher only if you have attended practical training.
- Always position yourself with an exit or means of escape behind you before you attempt to use an extinguisher to put out a fire.

Emergency Response

- If the person who notices the fire feels that it cannot be tackled by extinguishers, he can directly inform the fire station without delay.
- On hearing the alarm evacuate the building and assemble at the designated assembly point.
- As you evacuate close the doors of the rooms(do not lock) as this will slow down the spread of smoke and fire.

Emergency Response

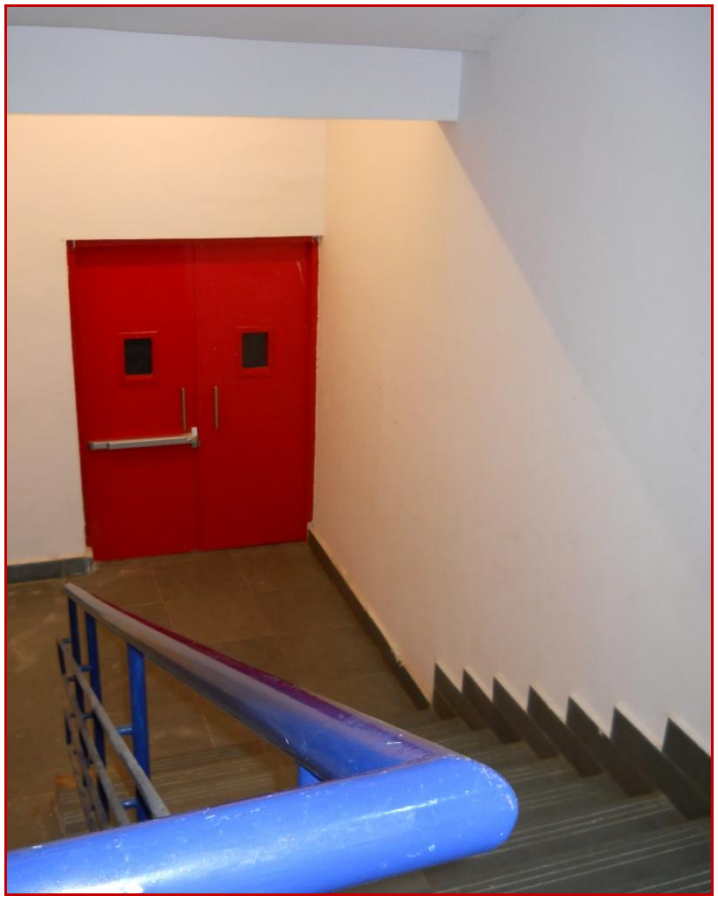
- While moving out of the building always use stairways.



- Do not use lifts, they may fail mid way trapping people inside.

Precautions

- Keep fire doors of the staircase closed. If kept open, heat and smoke will enter the staircase during fire and prevent escape of occupants.



Precautions

- Do not obstruct emergency equipment. Fire extinguishers must be easily accessible.
- Materials must not be stored in front of exits or along stairways blocking them.
- Know the exits in the laboratory and in the building.

- Display emergency contact numbers near the telephone.

THANK YOU