

FIRE SAFETY EDUCATION COURSE

Office of Safety Health and Environment

COURSE OBJECTIVES

At the end of the course, participants will be able to :

- Understand their roles dealing with Fire Emergency Situation
- Identify fire safety hazards in their workplace
- State how fires can be prevented in their workplace
- Select and safely use appropriate fire fighting equipment
- State their individual responsibility in the workplace fire evacuation procedure.



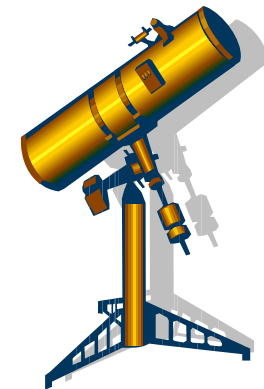
SCOPE

FIRE PREVENTION

- The Fire Triangle
- Identify fire hazards and potential hazards in the workplace
- Classes of Fire

EXTINGUISHMENT OF FIRE

- Content of extinguisher
- Identify differences in fire fighting equipment
- Fire extinguisher symbols
- Match correct equipment to type of fire
- Safe and effective use of fire extinguisher
- Fight or Flight



SCOPE

FIRE EVACUATION

- Action to take when you discover fire
- Action to take when you discover alarm
- Do's and Don't during fire evacuation
- Assisting the Fire Department and what information they require



What is Fire?

Fire is uncontrolled burning

or

Fire is a rapid self-sustaining combustion process accompanied by the evolution of heat and light of varying intensities

INTRODUCTION

- Explosion excepted, most fires have humble beginning
- Important to put off fire when they are small or during incipient stage
- Important to understand the combustion process and factors that determines the extinguishment of fire
- Fight the fire effectively and minimize the damage that may be caused by smoke, water and other factors



What does it take for a fire to burn?

- Fire requires three elements: **HEAT**, **FUEL** & **OXYGEN**
- **HEAT** is required to elevate a material's temperature to its ignition point.
- The second required element is **FUEL** (*material to be burned*).
- The third required element is **OXYGEN**

FIRE TRIANGLE



FIRE TRIANGLE

1. FUEL

- Fuel comes in many different forms:
 - Gases e.g. methane, propane
 - Liquid e.g. petrol, diesel
 - Solid e.g. wood, coal
- To be in vapor state to burn



CLASSES OF FIRE



Class A

- Ordinary combustibles materials like wood, paper, cloth, furnishing, plastics and rubber



Class B

- Flammable liquids, solvents, oils, paints, thinner and flammable gases
- Combustible liquids such as kerosene



Class C

- Live electrical equipment like electrical mains, transformers and electrical appliances (extinguishing medium must be electrically non-conductive)



Class D

- Combustible metals e.g. potassium, magnesium, titanium, sodium, lithium and zirconium

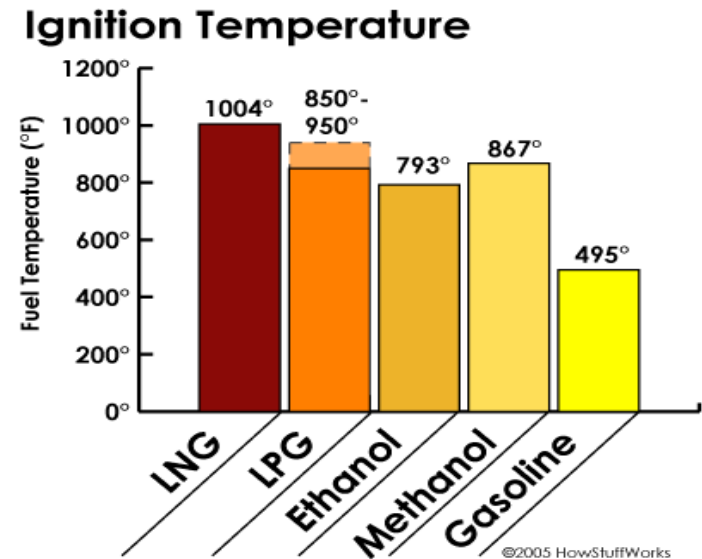
FIRE TRIANGLE

2. HEAT

The energy needed to increase the fuel temperature to a point where sufficient vapors are produced for ignition to occur.



Ignition Temperature : The minimum temperature at which vapor fuel must be heated to start self sustain combustion without a separate ignition source.



FIRE TRIANGLE

2. HEAT (source of ignition)

- Open Flame
- Welding
- Faulty Electricity
- Hot Surfaces
- Friction
- Chemical Reaction

How does heat move around?

a. **CONDUCTION**

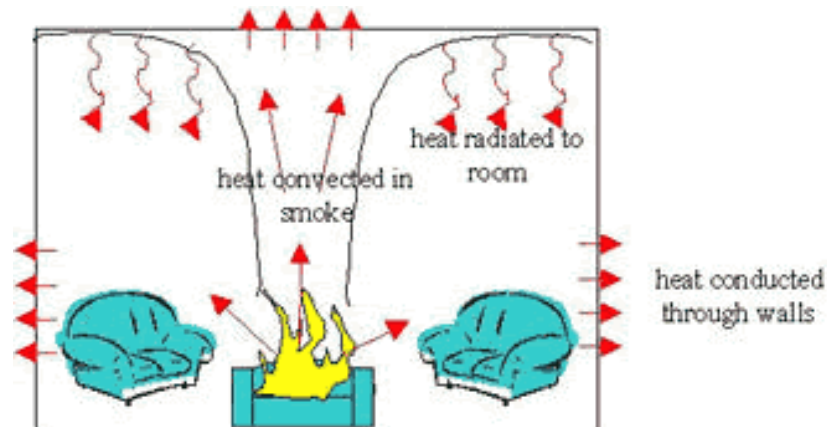
The transfer of heat through solid. Moved from a source to an exposure resulting the two materials reaching same temperature over a period of time

b. **CONVECTION**

The transfer of heat from one location to another in upward direction through liquids or gases.

c. **RADIATION**

The transfer of heat by infra-red electromagnetic radiation.



FIRE TRIANGLE

3. OXYGEN

- constitutes **21%** in the atmosphere
- will intensify the burning when \geq **21%**
- will begin to diminish when reaches \approx **16%**
- will extinguish completely when reaches **13%**

**FIRE, LIKE HUMAN BODY,
REQUIRES AT LEAST 16%
OXYGEN TO LIVE**

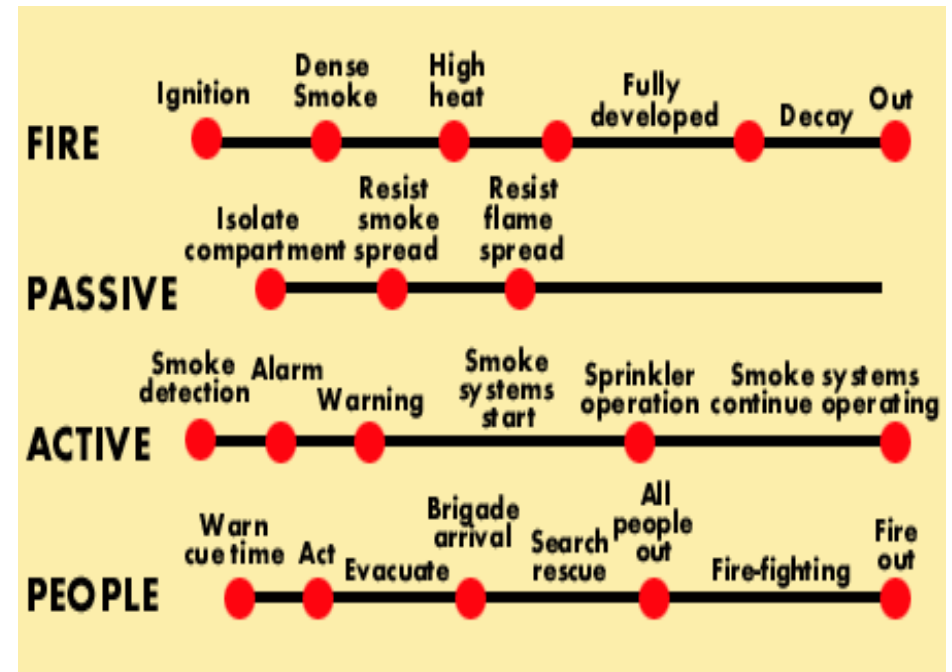
Fire Prevention

- **PASSIVE SYSTEMS**

- Passive systems include the
 - fire rated floor, ceilings, walls
 - fire-isolated exits and columns

- **ACTIVE SYSTEMS**

- Active systems include the
 - exit signs
 - emergency lighting, hydrants
 - hose-reels
 - smoke detectors and sprinklers



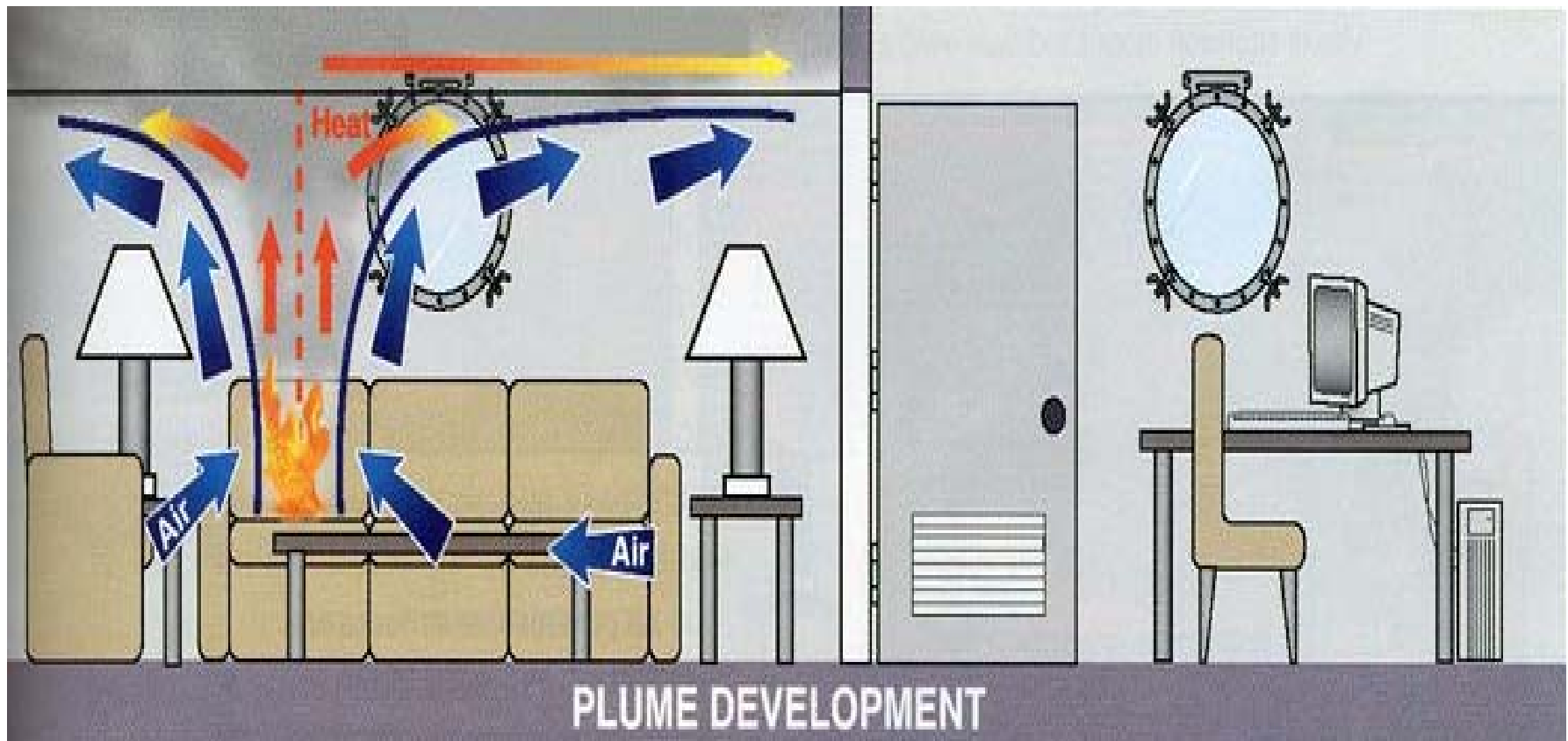
HOW FIRE SPREADS THROUGH YOUR WORKPLACE

Fire in enclosed space behave differently to fires in the open air:

- Smoke rising from fire gets trapped by ceiling
- Smoke spreads in all directions to form a layer over the entire room
- Smoke will pass through any holes/gaps in the walls, ceilings or floor and finally other parts
- Heat also get trapped, increasing the temperature

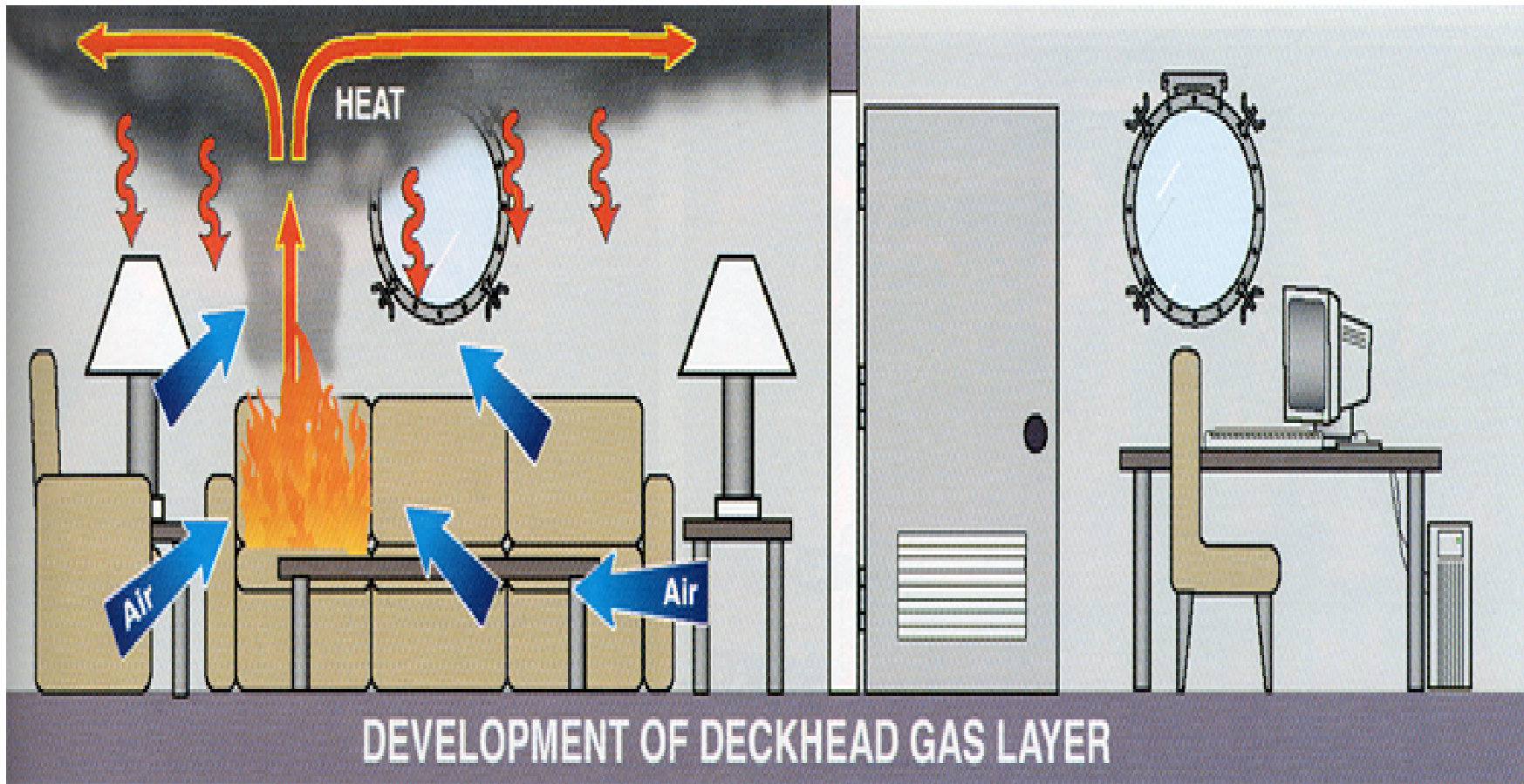
BASIC STAGES OF FIRE DEVELOPMENT

INITIAL STAGE (fire develops from its point of fire origin)



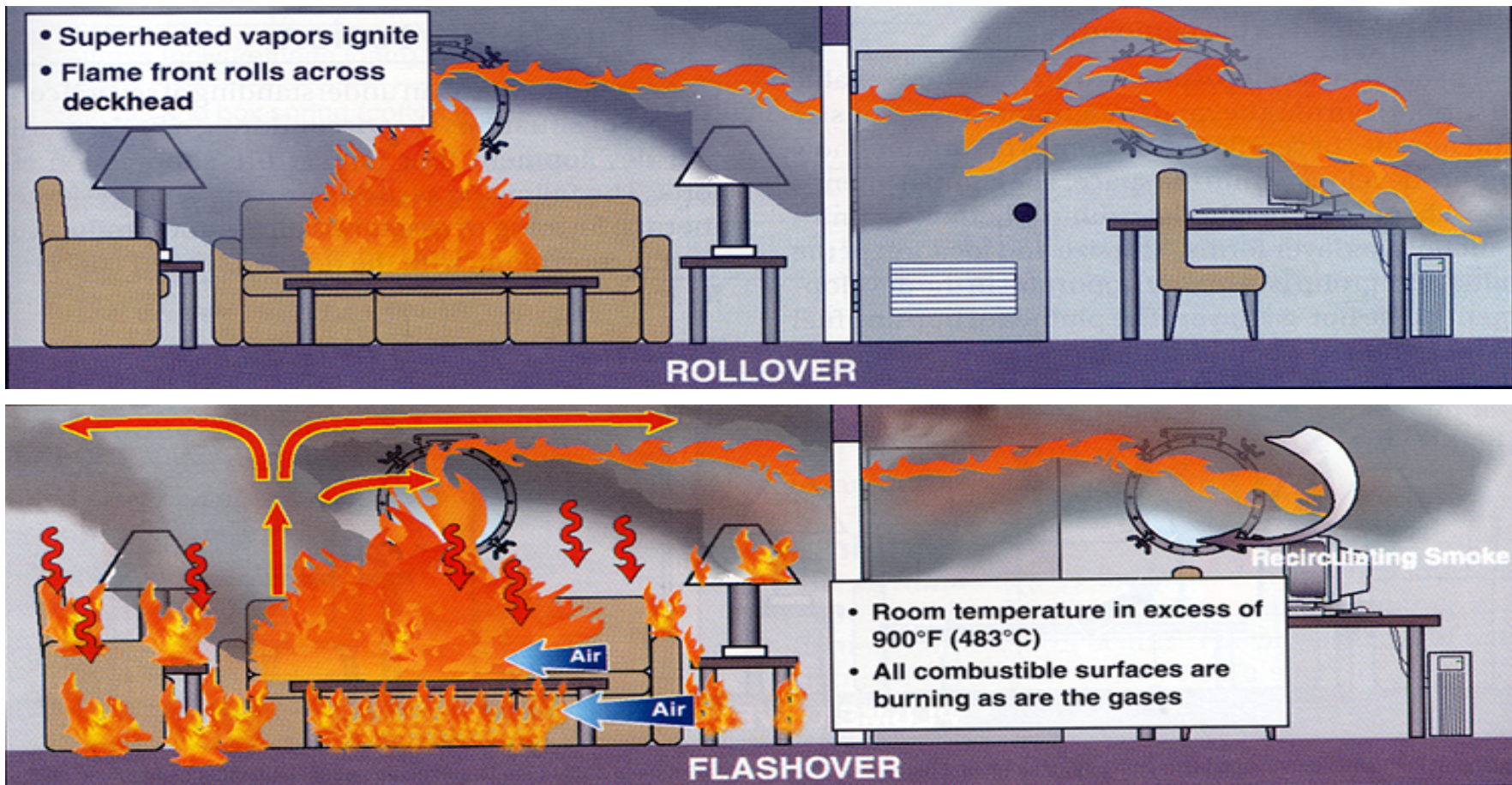
BASIC STAGES OF FIRE DEVELOPMENT

INITIAL STAGE (propagation of combustion)

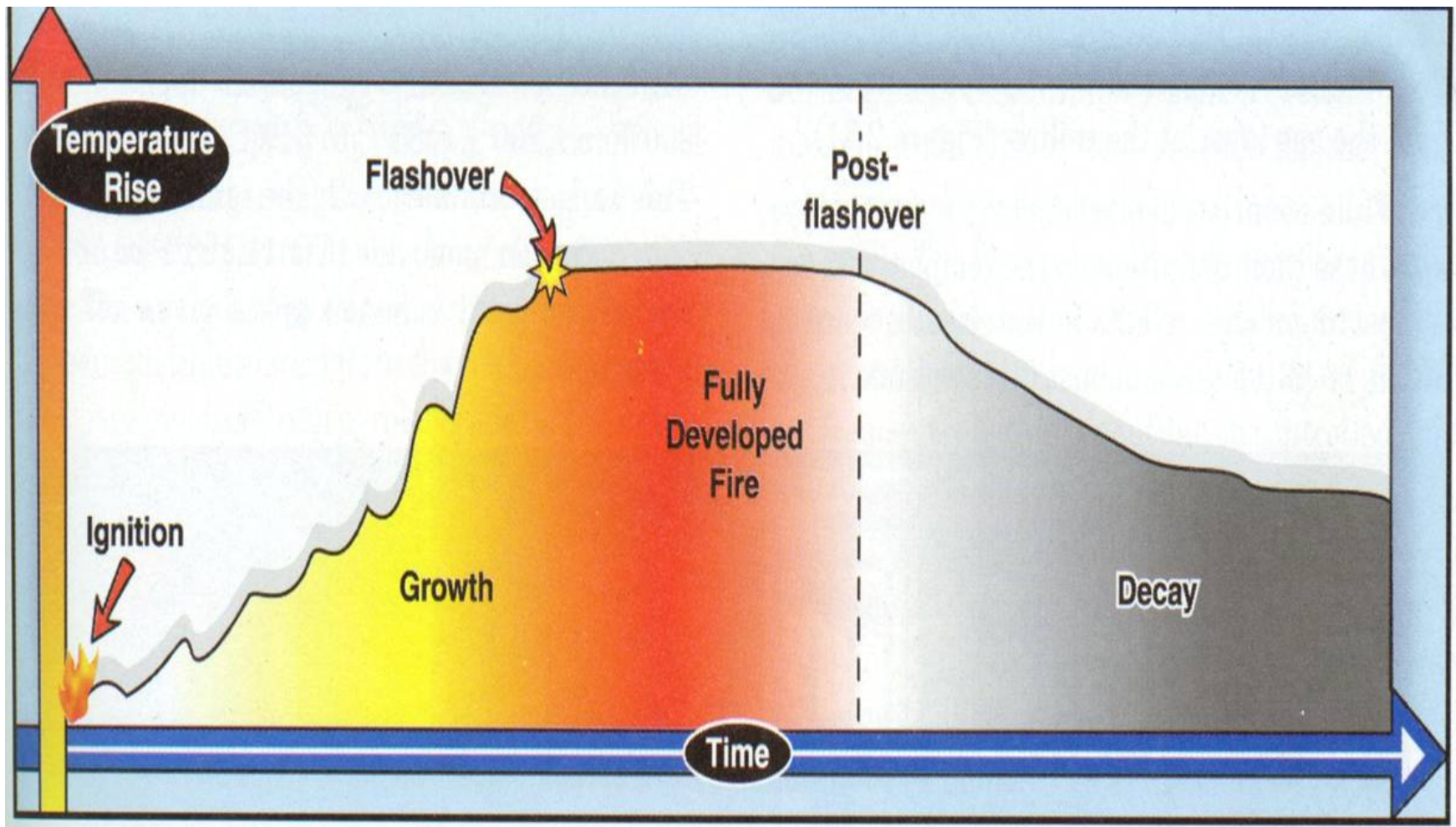


BASIC STAGES OF FIRE DEVELOPMENT

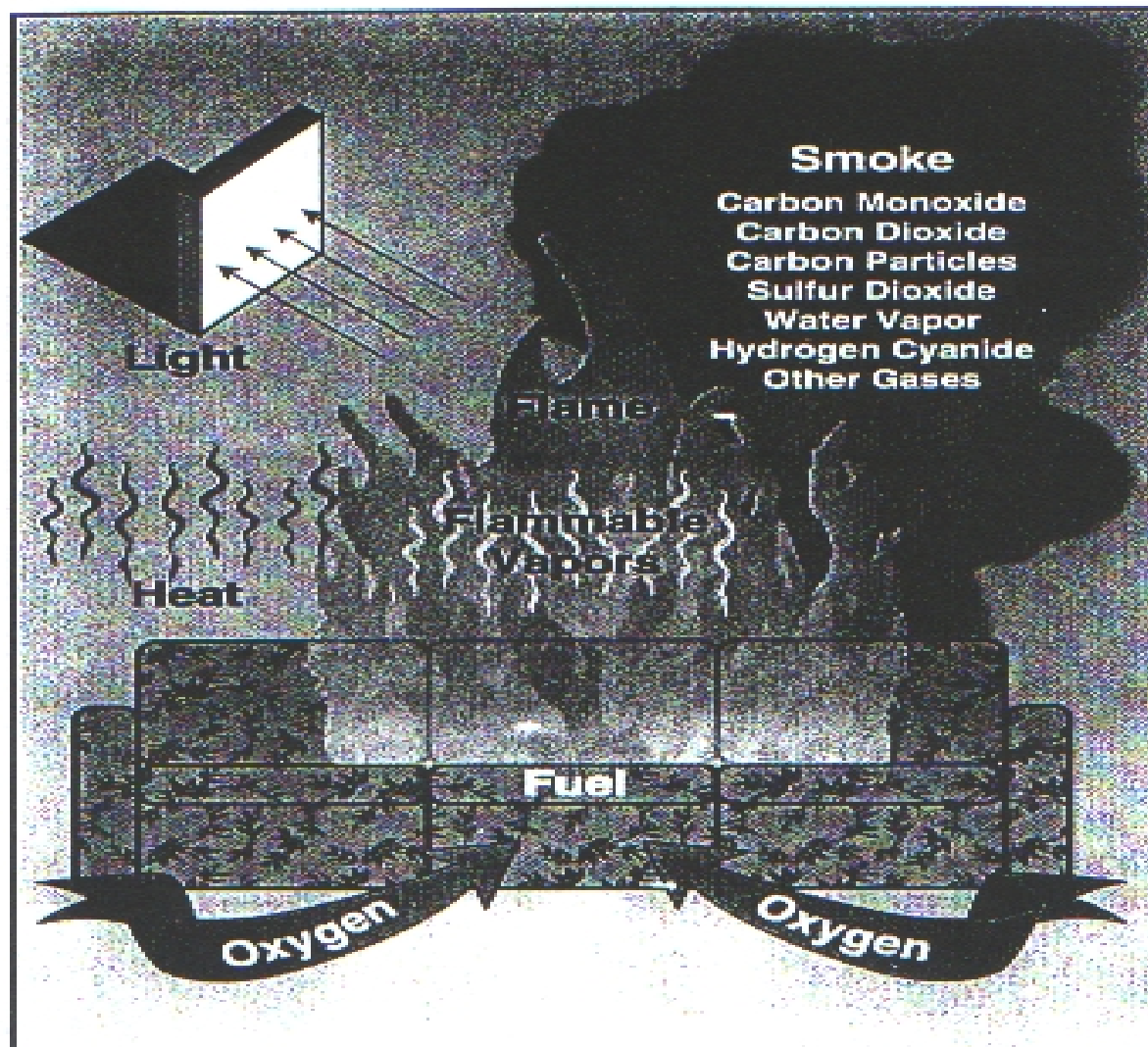
FLASHOVER (transition stage between initial and full development stage)



FIRE GROWTH



PRODUCTS OF COMBUSTION



COMMON CAUSES OF FIRE

- Electrical short circuit and overloading
- Overheating of electrical appliances
- Smouldering cigarette
- Mishandling and storage of chemicals
- Renovation
- "Hot Work"
- Human errors



ARE YOU OVERLOADING YOUR CIRCUIT?

1. Check office/laboratory equipment for a manufacturer's rating label that indicates total watts or amps.

2. Convert watt rating to amp.

$$\text{Amp} = \text{Watt} \div 240 \text{ V}$$

Example:

Typical power consumption for
Desktop Computer + CRT Monitor = 150 Watt
Circuit Load = $150 \text{ Watt} \div 240 \text{ V} = < 1 \text{ amp}$


3. Total the amp for each circuit

4. If the total equal or exceed 13 amp, you may be overloading the circuit. Move enough equipment to other circuit to reduce the load



INPUT: AC 100V-240V~ 1.0A 50 / 60 Hz

FIRE PREVENTIVE MEASURES

- A copy of Fire Emergency Plan is communicated and reviewed
- Observe the lobby, corridors, staircases are clear of obstructions
- Exits, fire alarms, smoke detectors, manual call-points, fire extinguishers, fire hose reels are working and clear of obstruction at all times
- Inspect your own area for
 - Overloaded circuits
 - Appliances without "SAFETY Mark" 
 - Wiring. Check all wiring for frayed ends or worn insulation
 - Non approved plugs

FIRE PREVENTIVE MEASURES

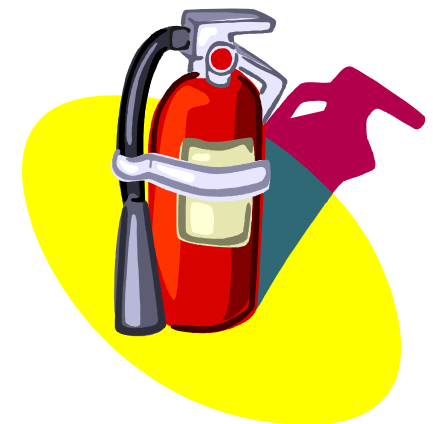
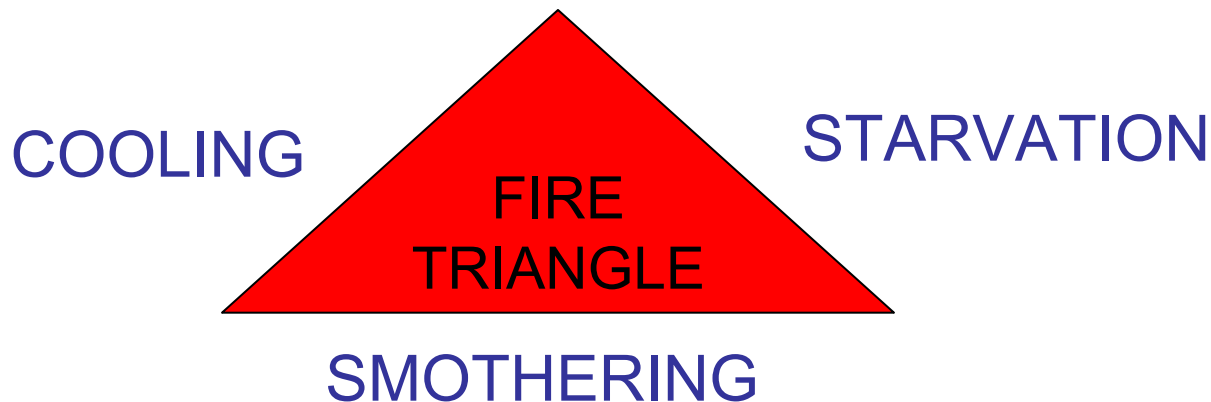
- No candles in the office
- No smoking policy
- Good Housekeeping
- Exposed heating elements should not be left unattended
- Participate in the fire drill conducted by your Department
- Stacking storage
 - Minimal stacking towards the ceiling, at least 50 cm away
 - Non-combustible materials used in the construction of storage racks
 - No obstruction of sprinkler heads, at least 50 cm away



Extinguishment of Fire

FIRE EXTINGUISHMENT THEORY

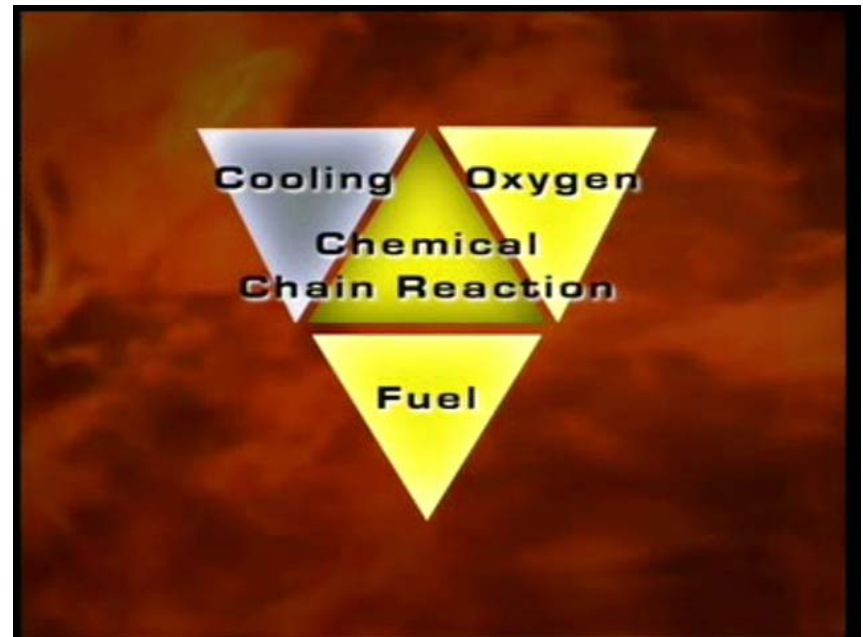
- Extinguish fire by limiting or interrupting one or more elements in the fire tetrahedron
- Either by the following:
 - Cooling = Reducing its temperature
 - Starvation = Eliminating available fuel
 - Smothering = Exclusion of oxygen



FIRE EXTINGUISHMENT THEORY

TEMPERATURE REDUCTION (COOLING)

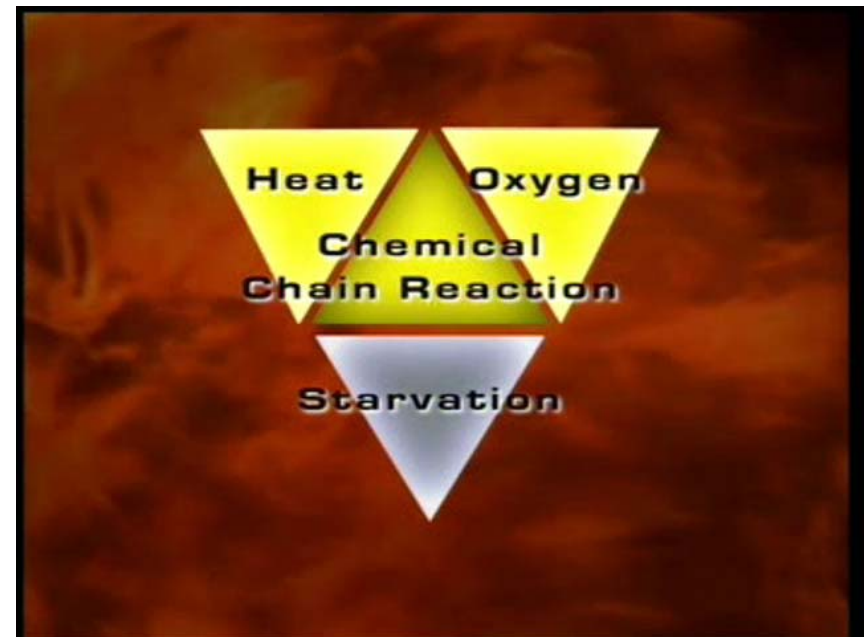
- Common method is cooling with water
- Reduce temperature of fuel where it does not produce sufficient vapor to burn



FIRE EXTINGUISHMENT THEORY

FUEL REMOVAL (STARVATION)

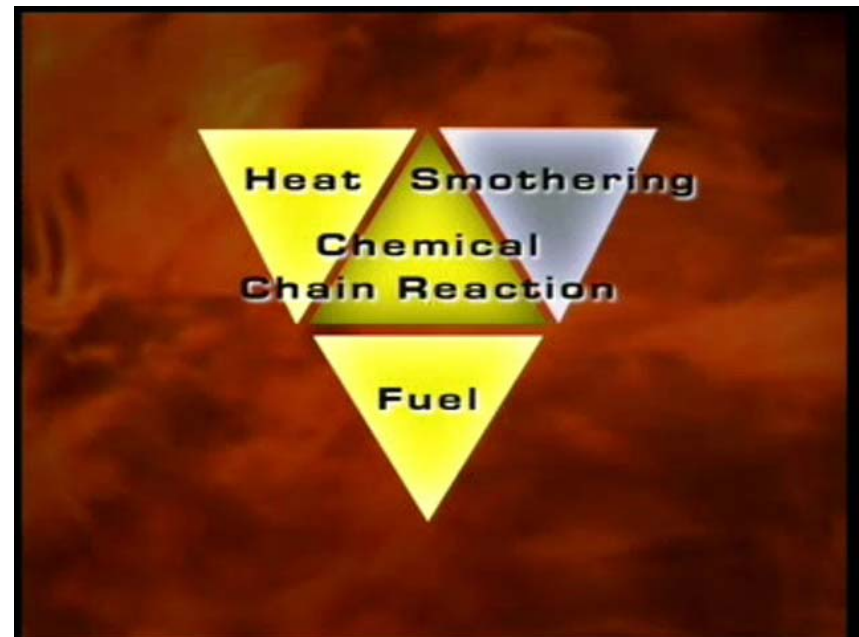
- Means remove the fuel source
- Either remove by physically stopping the flow of liquid or gaseous fuel or removing solid fuel in the path of fire
- Remove by allowing a fire to burn until all fuel is consumed



FIRE EXTINGUISHMENT THEORY

OXYGEN EXCLUSION (SMOTHERING)

- Reduce oxygen available to the combustion process reduces fire's growth and may extinguish over time
- Oxygen content can be reduced by flooding area with inert gas such CO₂ or FM200 which displaces oxygen
- Can also be separated from fuel by blanketing the fire with foam



FIRE EXTINGUISHER: METHOD OF OPERATION

- Stored pressure
- When lever of an extinguisher is compressed, it opens an inner canister of high pressure gas (Nitrogen / CO²)
- The high pressure gas forces the extinguishing agent from main cylinder through siphon tube and out the nozzle



The common extinguishing agents:

- WATER
- CARBON DIOXIDE
- DRY POWDER

TYPES OF PORTABLE FIRE EXTINGUISHER

WATER EXTINGUISHER

- Used on Class A fires
- 6 or 9 litres, pressurized gas is air or nitrogen
- Operating pressure is 10 bar
- Use caution to avoid scattering lightweight materials with pressurized water and spreading the fire



FIRE EXTINGUISHING AGENT

WATER

- Principles of extinguishment of fire by water:
 - Cooling
 - Smothering

Advantages

- Good latent heat of vaporization
- Relatively cheap
- Easily available

Disadvantages

- Good conductivity of electricity
- Cannot be used on fires involving combustible (burning) metal as an explosion may occur
- May cause damages to goods and properties if used in excess

TYPES OF PORTABLE FIRE EXTINGUISHER

DRY CHEMICAL (ABC)

- Uses small particles of chemicals to smother fire
- Powder forms a barrier to reduce the oxygen during combustion
- Crust formed over burning material by the action of heat on the powder, thus enable material to cool and retard burning.
- 1 to 12 kg, pressurized gas is air or nitrogen
- Operating pressure is 14 bar



FIRE EXTINGUISHING AGENT

DRY POWDER

Advantages

- Effective for fire involving plastics and burning metal
- Gives quick knock down
- When applied, cloud screens flame, enables close attack

Disadvantages

- Very messy, not suitable for electronic equipment
- Inhalation of chemical may be detrimental to one's health

TYPES OF PORTABLE FIRE EXTINGUISHER

CARBON DIOXIDE

- Used for Class B and C fires
- Filled with liquid CO₂ to two-thirds, one-third is evaporated gas
- Comes with discharge horn to stop entrainment of air with CO₂.



FIRE EXTINGUISHING AGENT

CARBON DIOXIDE

- Principles of extinguishment of fire by CO₂:
 - Reduces the oxygen content of the atmosphere
 - When discharged, carbon dioxide vaporizes off rapidly as a gas, thus extracting heat from the surrounding atmosphere.

Advantages

- Non conductivity of electricity
- Does not react with most substances
- Non toxic
- Non residue
- Easily liquefied and bottle under pressure

Disadvantages

- Incapable of retaining extinguishing atmosphere
- Require high concentration and long holding time for deep seated fire
- May cause suffocating atmosphere

CHOOSING THE RIGHT TYPE OF FIRE EXTINGUISHER

In suppressing fires, it is essential that you use the right tool for the job. The chart below summarizes the types of extinguishers that can be used for each class of fire and the methods used by each device

Fire Types, Extinguishing Agents and Methods		
Fire Type	Extinguishing	
	Agent	Method
Class A	Water	Removes Heat
	Dry Chemical	Breaks chain reaction
Class B	CO2	Removes air
	Dry Chemical	Breaks chain reaction
Class C	CO2	Removes air
	Dry Chemical	Breaks chain reaction
Class D	Special agents like Class D powder	Removes air

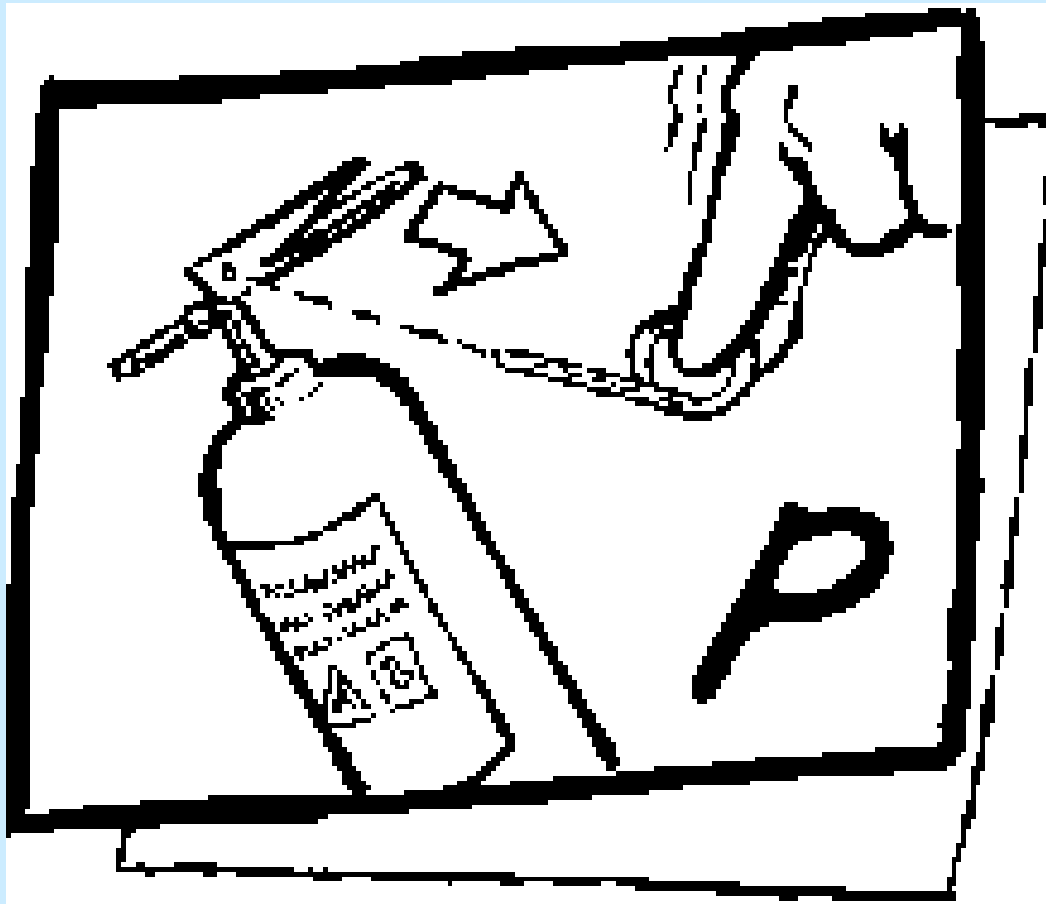
HOW TO OPERATE A FIRE EXTINGUISHER

- ❖ Has four main components: A hose or nozzle, a carrying handle and lever, a pressure gauge and the cylinder
- ❖ Use a simple procedure called

P - Pull
A - Aim
S - Squeeze
S - Sweep



Using a Fire Extinguisher: P.A.S.S.



“P”

Pull the Pin

This will allow you to squeeze the lever in order to discharge the extinguisher

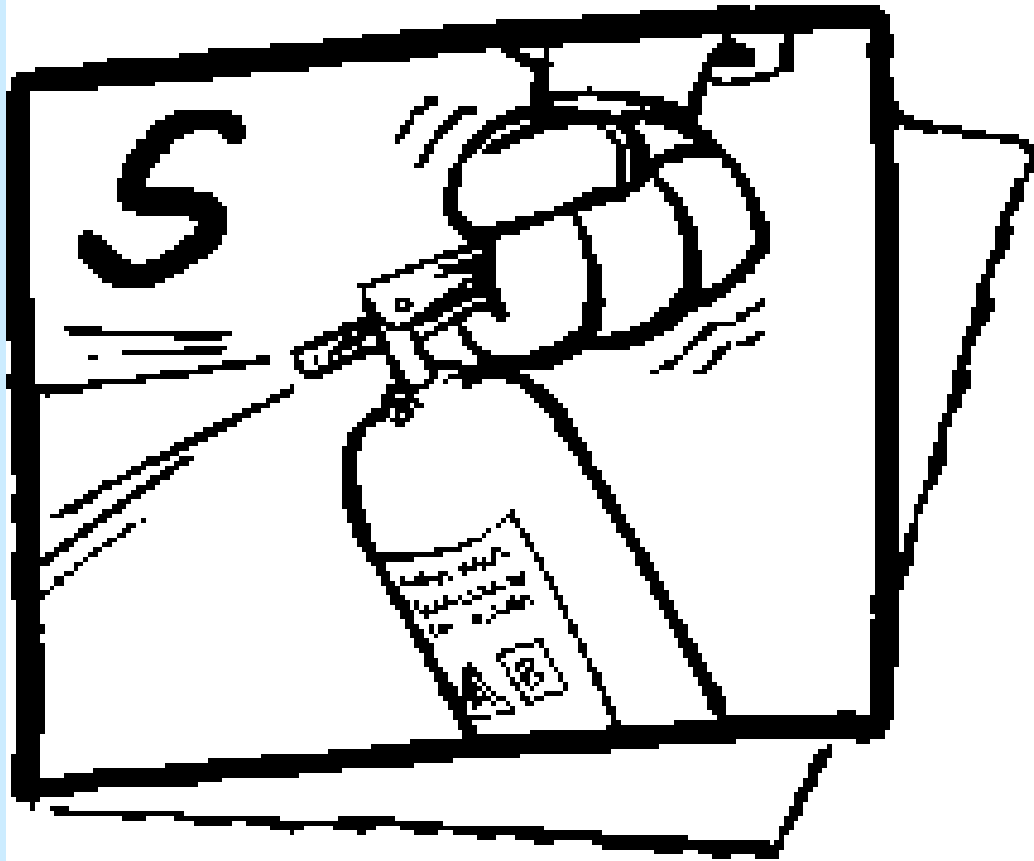
Using a Fire Extinguisher: P.A.S.S.

“A”

Aim Extinguisher
at Base of Fire



Using a Fire Extinguisher: P.A.S.S.



“S”

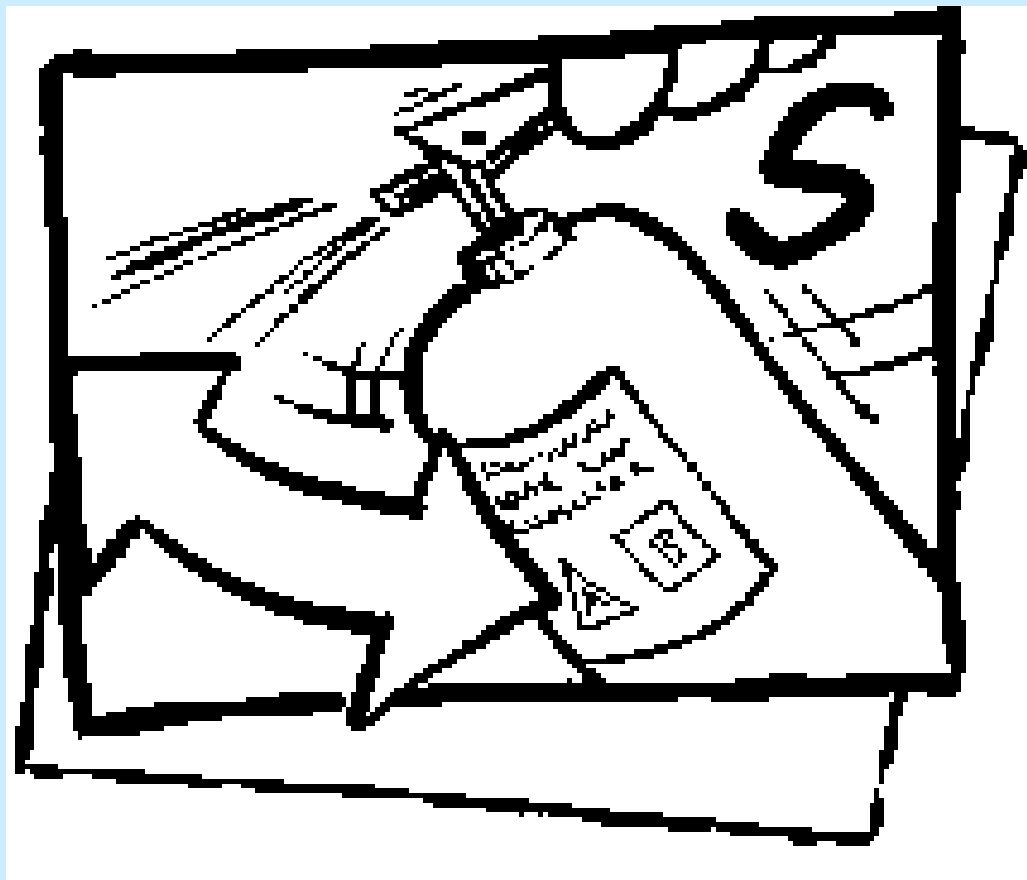
Squeeze Handle

Using a Fire Extinguisher: P.A.S.S.

“S”

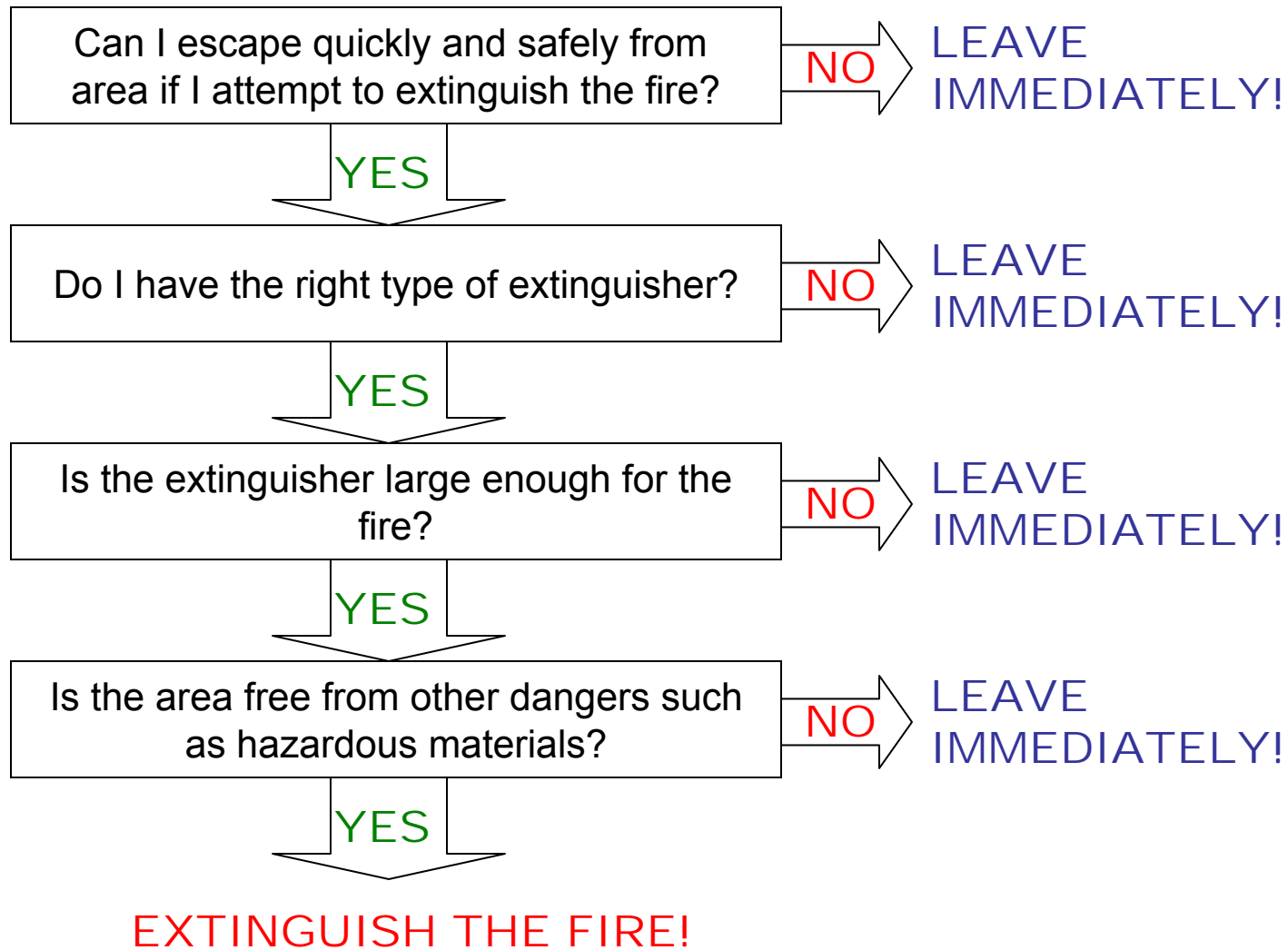
Sweep

from side to side



FIGHT OR FLIGHT

Before attempting to fight any fire with an extinguisher, ask yourself the following questions



Fire Evacuation

FIRE EMERGENCY PROCEDURES



FIRE ACTION

ACTION IN THE EVENT OF FIRE

1. Raise the alarm by breaking the glass at the nearest fire alarm point

Near Pantry

2. Dial 995 on the nearest telephone and give details to SCDF including location:
 - i. Location of the fire
 - ii. Some indication of its extent
 - iii. Whether the occupant of the building are in danger
3. Dial 8741616 and inform Campus Security so that they can lead SCDF/ SPF to the location of fire.
4. If possible, attack the fire with extinguishing equipment provided but do not put yourself at risk

FIRE EMERGENCY PROCEDURES

FIRE ACTION

ACTION TO TAKE ON HEARING THE ALARM

1. Stop all work, keep all documents, shut off electrical equipment etc
2. Remain alert and wait to be guided by Fire Warden
3. Leave the building immediately using the nearest safe exit route and report to the assembly area

Carpark 10

Do not stop to collect your personal belongings
Do not use lifts
Do not re-enter the building unless authorized to do so

4. Wait at the assembly area for further instructions



THE END