FIRE SAFETY

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What is Fire??

Fire is an exothermic combustion reaction which liberates large amounts of heat, smoke & light as main products of combustion.

Consequences of Fire:

- Death, Personal injury, loss of business and jobs
- Heat causes the burning of items and property and smoke causes suffocation and disables visibility.
- Environmental pollution, Global warming
- Loss of Land and Infrastructure (Property damage)
- Loss of Biodiversity (Flora and Fauna damage)
- Water Contamination
- Transport disruption

Common Causes of Fire

1. **Carelessness:**

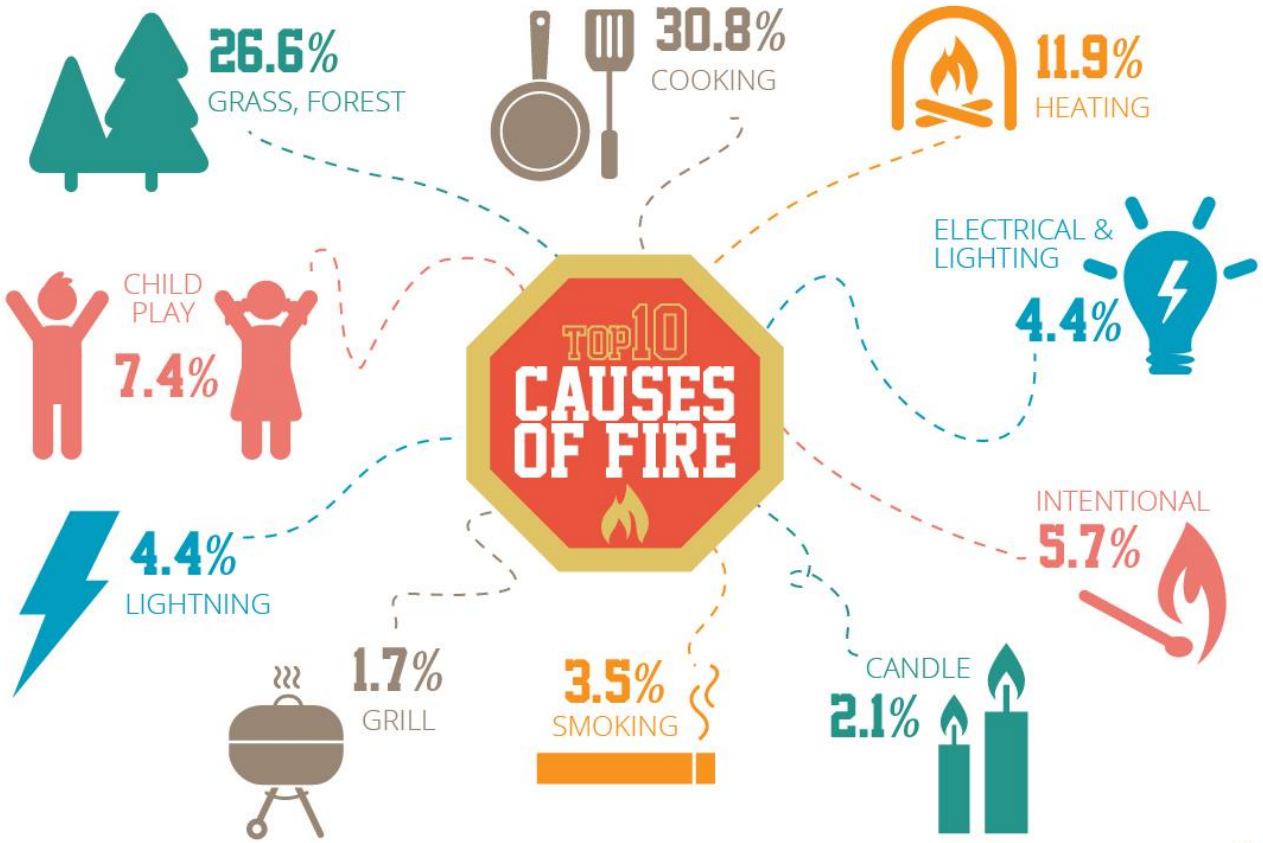
- Disposal of cigarette butts in a trash bag.
- Smoking in bed at night.
- Leaving cigarettes burning in ashtrays.
- Careless handling of fire or hot substances

2. **Accidental:**

- Electrical Short circuits etc.
- Faulty appliances and leads
- Faulty fuel supplies
- Misuse of equipment

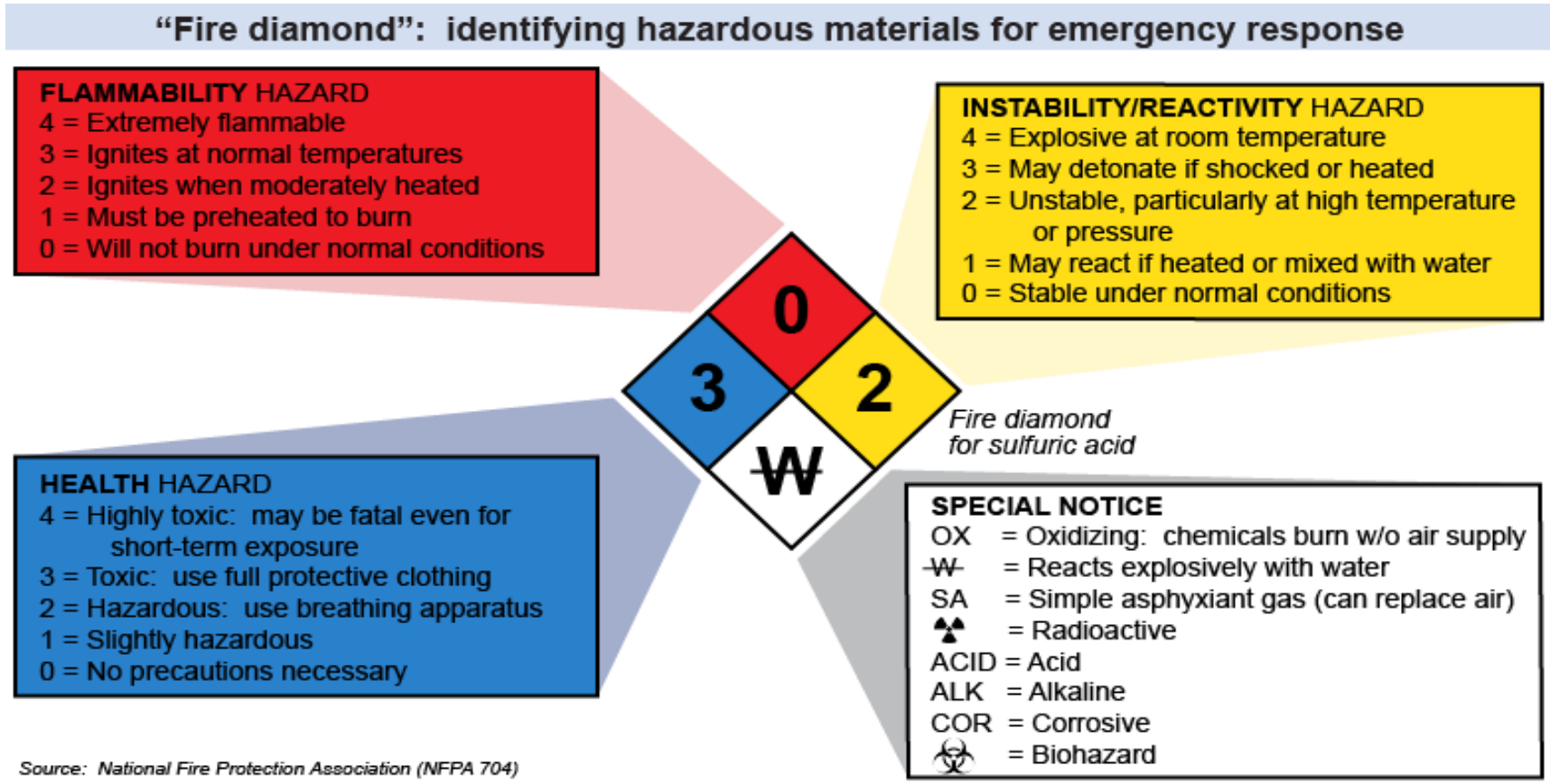
3. **Ignorance**: Inadequate fire prevention Knowledge

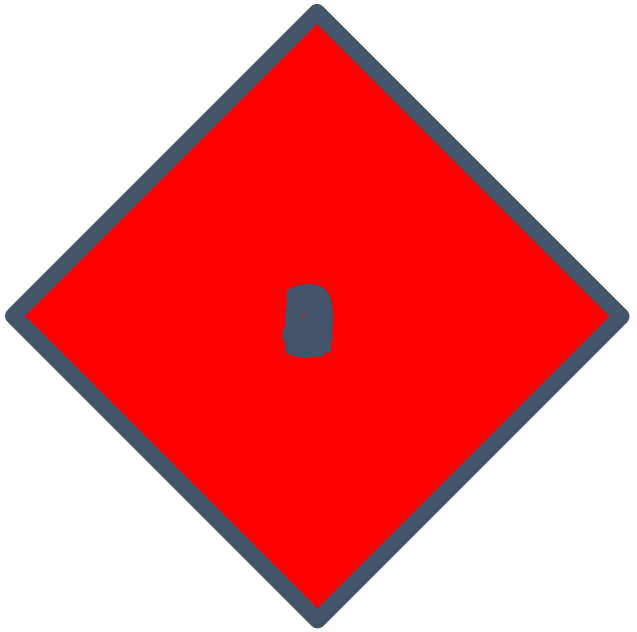
4. **Sabotage:** deliberately destroying something



National Fire Protection Association (NFPA); Sign for Hazard

Fire diamond for Sulfuric Acid





Fire Hazard Red Diamond

Flash Points
4-Below 73°F
3-Below 100°F
2-Above 100°F not exceeding 200°F
1-Above 200°F
0-Will not burn

Flash Point: ***The temperature at which a particular organic compound gives off sufficient vapor to ignite in air.***

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

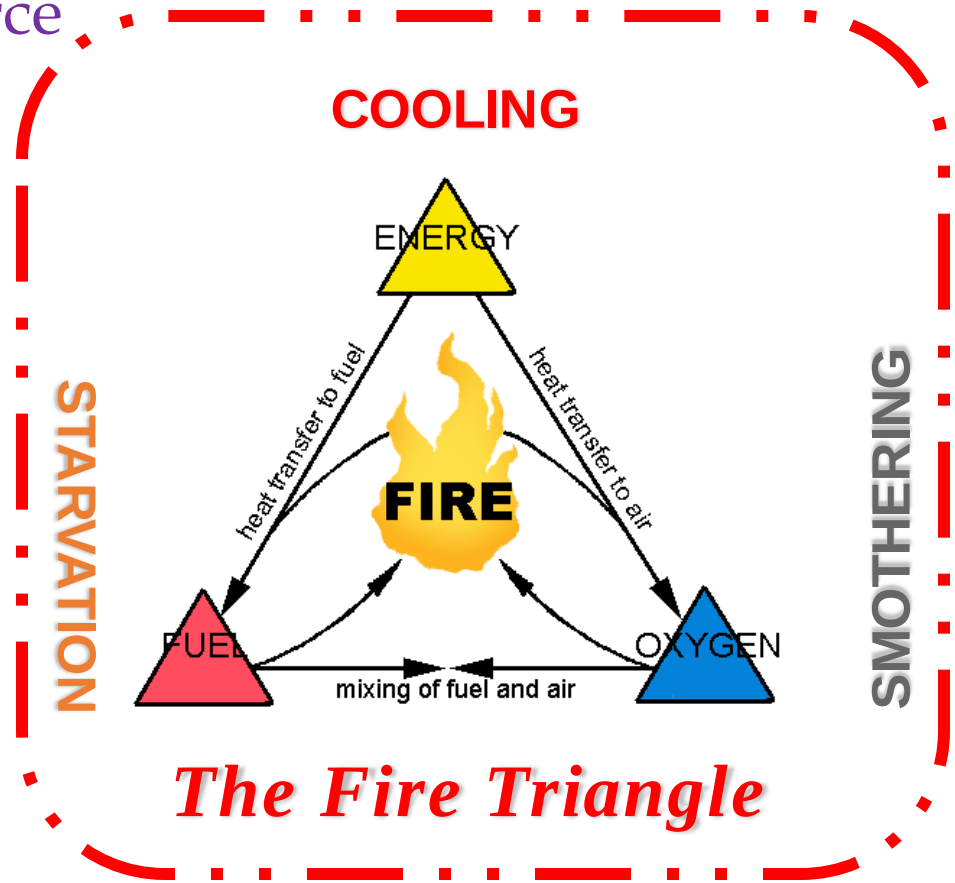
Basic Principles of Fire

Fire Triangle:

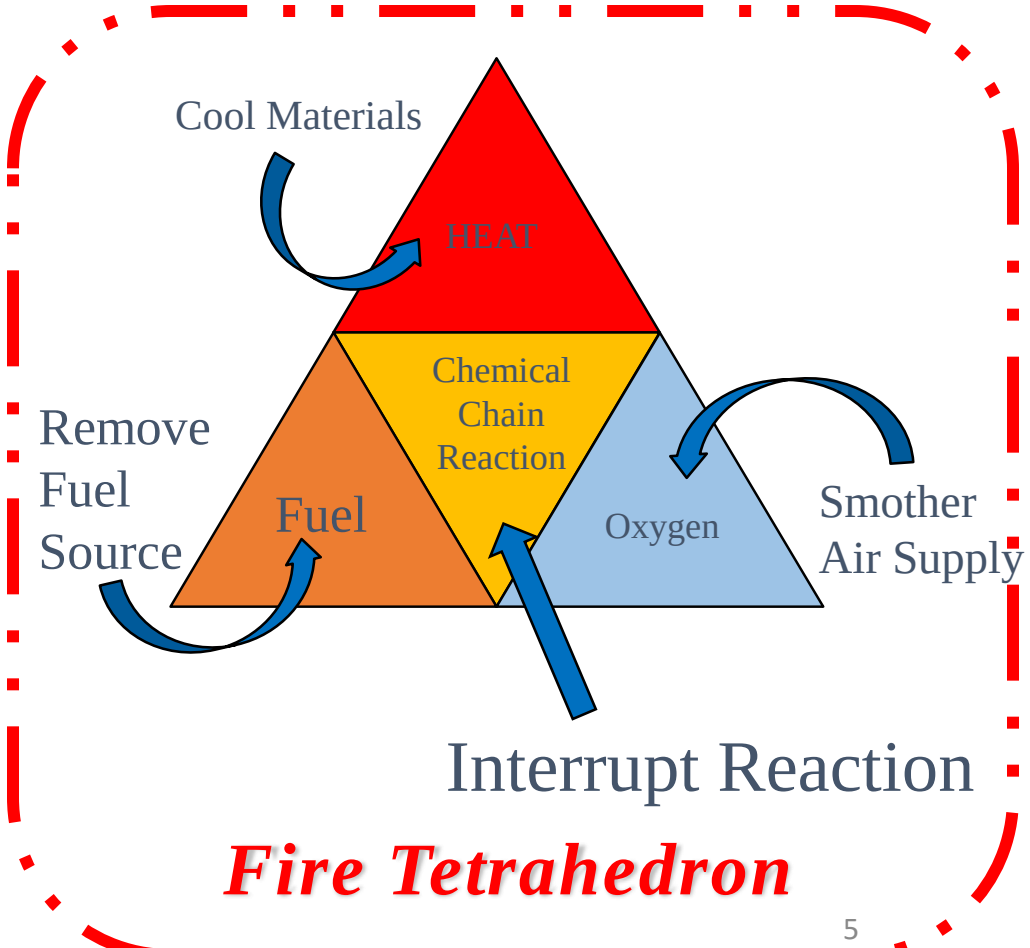
Fire cannot take place unless three things are present:

1. Fuel
2. Ignition source
3. Oxygen

Fire cannot exist without all these elements in place and in the right proportions.



The Fire Triangle

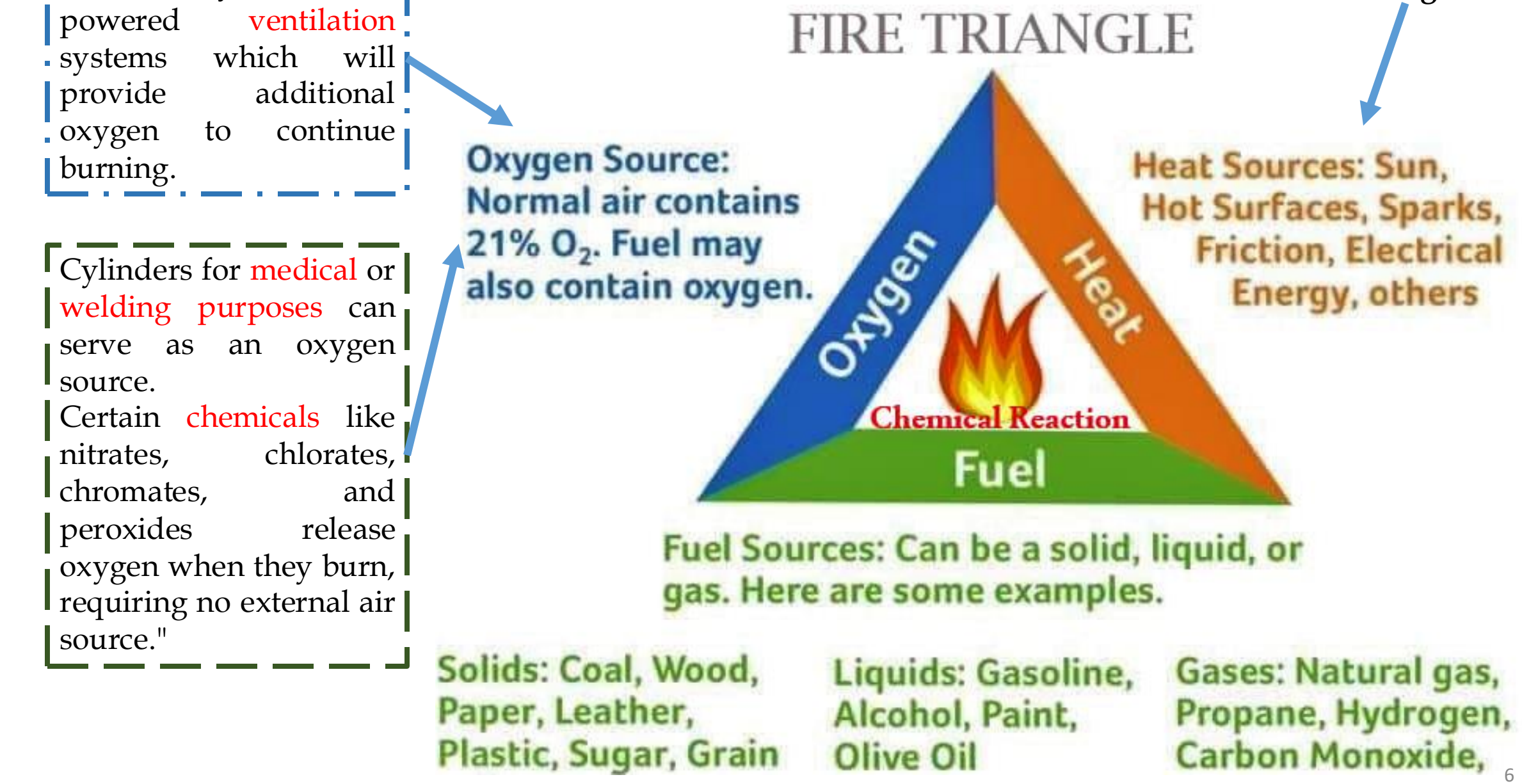


Fire Tetrahedron

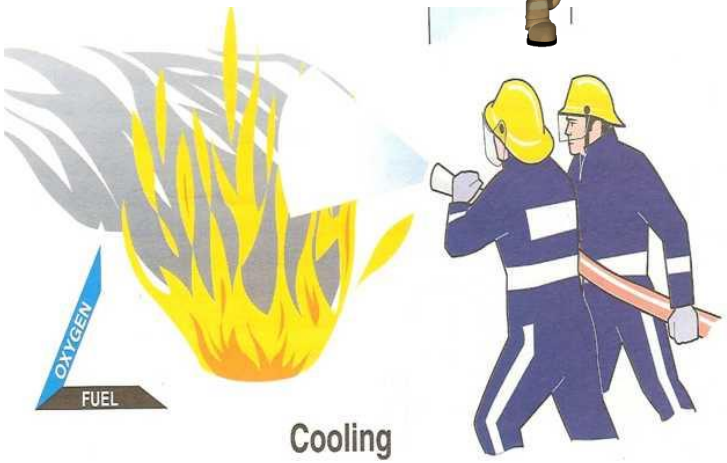
Can be enhanced by wind, or by natural or powered ventilation systems which will provide additional oxygen to continue burning.

Cylinders for medical or welding purposes can serve as an oxygen source.
Certain chemicals like nitrates, chlorates, chromates, and peroxides release oxygen when they burn, requiring no external air source."

Possible sources of ignition



Principles of Fire Extinction

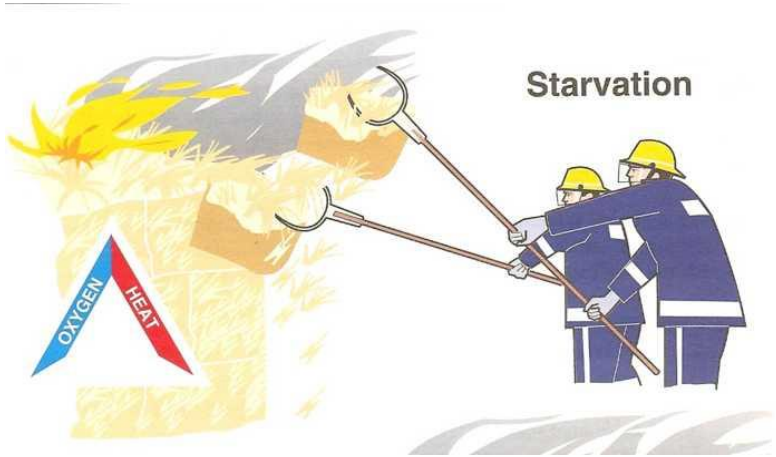


1. Cooling

Removal of heat from the burning material or fire area

2. Smothering

Cutting off the supply of oxygen from fire area



3. Starvation

Removal of un-burnt material from fire area

4. Break Chain Reaction

Stop or interrupt the chain reaction between the fuel, heat and oxygen the fire will be extinguished.

Principles of Fire Extinction

There are four main methods of extinguishing fires:

1. Cooling (Removing Heat)

Heat can be removed by the application of a substance which reduces the amount of heat available to the fire reaction. This is often water, which requires heat for phase change from water to steam. Introducing sufficient quantities and types of powder or gas in the flame reduces the amount of heat available for the fire reaction in the same manner.

2. Smothering (Reducing Oxygen)

Without sufficient oxygen, a fire cannot begin, and it cannot continue. With a decreased oxygen concentration, the combustion process slows. Oxygen can be denied to a fire using a carbon dioxide fire extinguisher or a fire blanket. For example, covering a fire with a fire blanket removes the "oxygen" part of the triangle and can extinguish a fire.

Principles of Fire Extinction

3. Starvation (Removing Fuel)

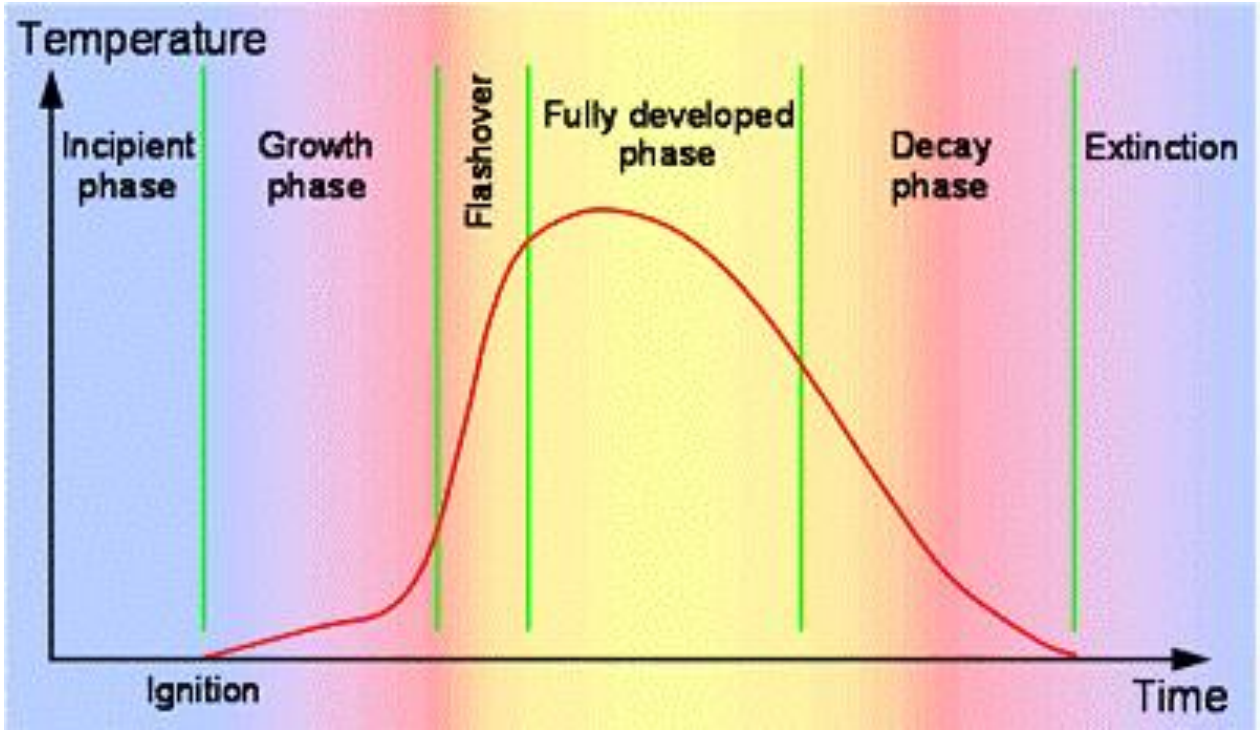
Without fuel, a fire will stop. Fuel can be removed naturally, as when the fire has consumed all the burnable fuel, or manually, by mechanically removing the fuel from the fire. Fuel separation is an important factor in fire suppression and is the basis for most major tactics.

4. Cut-off The Chain Reaction

The fire tetrahedron represents the addition of a component, the chemical chain reaction, to the three already present in the fire triangle. Once a fire has started, the resulting exothermic chain reaction sustains the fire and allows it to continue until or unless at least one of the elements of the fire is blocked.

STAGES OF FIRE DEVELOPMENT:

Fire Development Process:



Fires are very difficult to control once it crosses the flashover stage.
Therefore, calling fire brigade ASAP makes all the difference!

INCIPIENT STAGE: This is the first stage in the fire growth process, typically created by an outside heating source, such as an open flame or smoldering materials.

GROWTH STAGE: During this stage, the fire grows fast or slow, depending on the fuel load, type of combustion and availability of oxygen. The growth stage is largely dependent upon the fuel load present.

FLASHOVER STAGE: This is a transitional stage that takes place between the growth stage and the fully developed stage. Flashover is a phenomenon created by the thermal instabilities within a compartment.

FULLY DEVELOPED STAGE: During this stage, the fire has reached its maximum potential and is only limited by the availability of oxygen.

DECAY STAGE: During the final stage, the fuel load and oxygen decreases, and the gases and temperature begin to cool. The fire will begin to put itself out if left alone and no more fuel or oxygen is introduced into the compartment.

Understanding the Fire

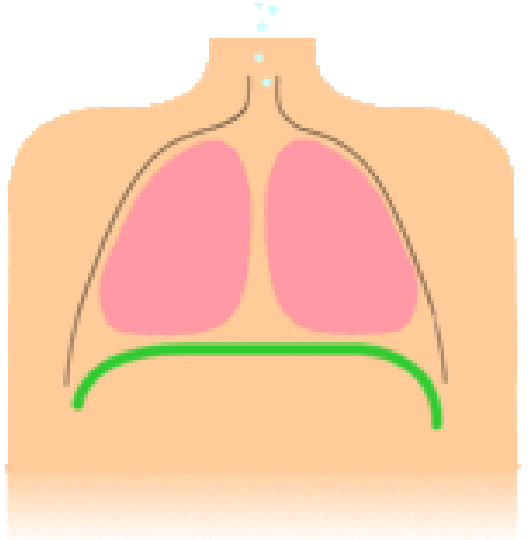
HAZARDS AND RISKS OF FIRE

There are five main hazards produced by fire that should be considered when assessing the level of risk:

1. Oxygen Depletion (*breathing difficulties, asphyxiation* (state of being deprived of oxygen), *poisoning*
2. Flames and Heat (*up to 1250°C* cause *burns)*
3. Smoke;
4. Gaseous combustion products;
5. Structural failures of buildings

   Building debris causes *Impact injuries and burns,*

   Injury while escaping the fire, *Trips, falls, trampling*



Principles of Heat Transmission and Fire Spread

Fire transmits heat in several ways, which need to be understood to prevent, plan escape from, and fight fires.

Fire spread or heat transmission can take place by four methods:

CONVECTION, CONDUCTION, RADIATION and **DIRECT BURNING**

1. Direct Burning/Ignition *is the process of initiating self-sustained combustion.*

This is the effect of combustible materials catching fire through direct contact with flames which causes fire to spread.

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

Principles of Heat Transmission and Fire Spread

2. Conduction-transfer of heat within the material itself.

3. Convection -transfer of heat by the physical movement of hot masses of air.

4. Radiation -the emission of heat in the form of electromagnetic waves.

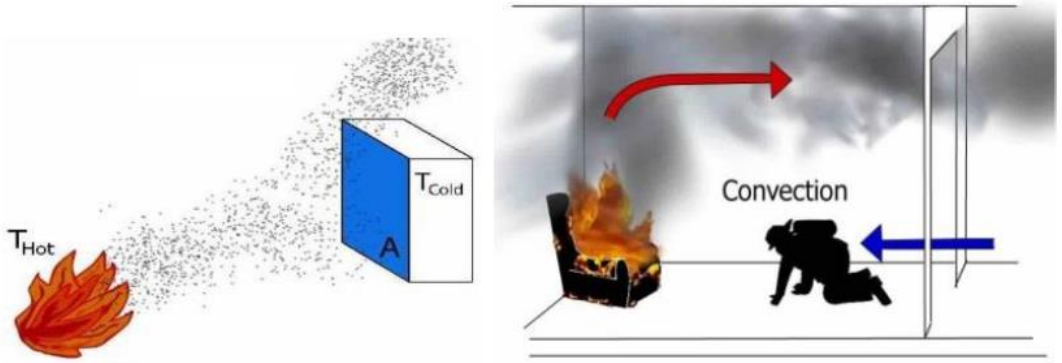


Figure 2.7: The fire convection

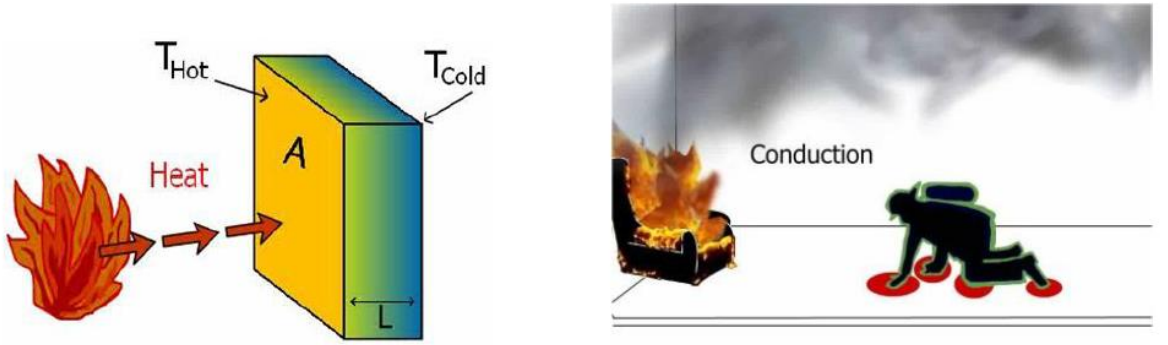


Figure 2.8: The fire conduction

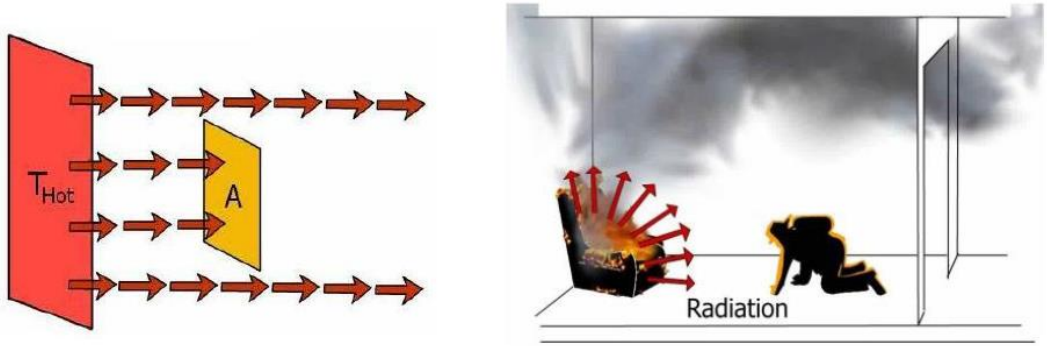


Figure 2.6: The fire radiation

Fire Prevention System

There are two types of preventing system:

i. Active Fire Protection

ii. Passive Fire Protection

Active Fire Protection (AFP):

It is an integral part of fire protection. AFP is characterized by items or systems, which require a certain amount of **motion** and **response** in order to work.

There are four categories of AFP:

1. **Fire Suppression:** *Fire Extinguisher, Fire Hydrant, Fire Blanket, Standpipes*
2. **Sprinkler Systems:** *Quick Response, Standard Response*
3. **Fire Detection:** *Smoke Detector System, Heat Detector System, Fire Alarm System*
4. **Hypoxic Air Fire Prevention:** *Nitrogen/Carbon Dioxide Gas Fire Suppression System*

Fire Prevention System

Passive Fire Protection (PFP):

PFP utilizes fireproof systems to contain fires or slow the spread of fires, such as:

i. Fire-Resistance Rated Wall/Door

ii. Firewall

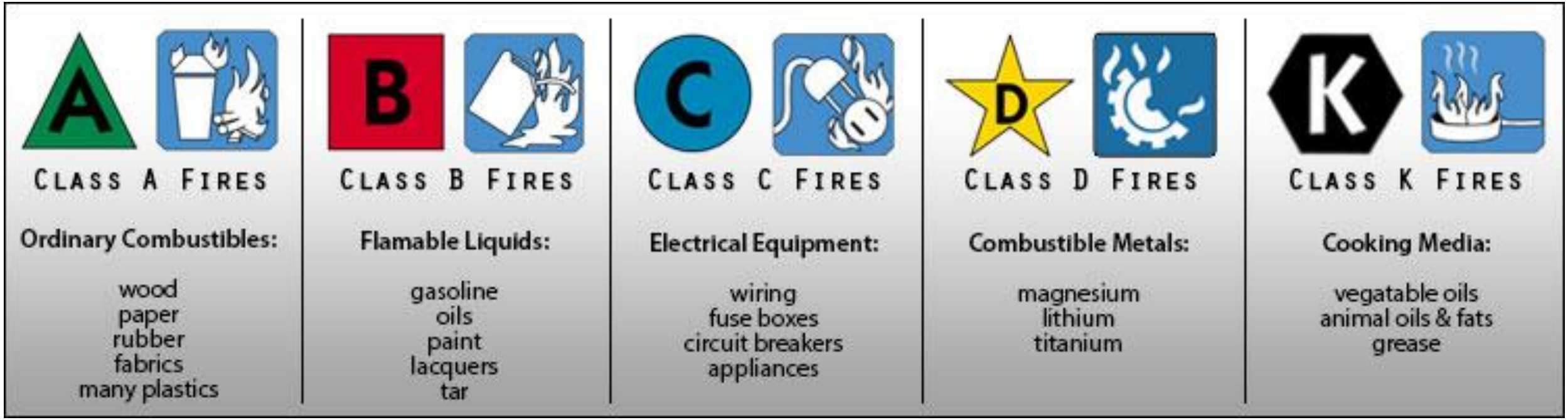
iii. Fire-resistant glass

iv. Fire-resistance rated floors

v. Occupancy separations

Fire Classification

In firefighting, fires are identified according to one or more fire classes. Each class designates the fuel involved in the fire, and thus the most appropriate extinguishing agent. The classifications allow the selection of extinguishing agents along lines of effectiveness at putting the type of fire out, as well as avoiding unwanted side effects.



Stages of Fire

Initial Stage

(0 Seconds to 10 Minutes)

Over 10 Minutes

Blaze Stage

	TIME FACTOR	
	Incipient Stage	**Blaze Stage**
Class A	0 -10 Minutes	Over 10 Minutes
Class B	0 -1 Minutes	Over 1 Minute
Class C	0 - 30 Seconds	Over 30 Seconds
Class D	Leads To a Fire in Another Class of Fire	

Fire Prevention

Be fire safety aware

Use good electrical equipment

Control ignition sources

Proper Storage of fuels

Do not block fire exits, call points/ extinguishers

Fire Prevention

GOOD HOUSEKEEPING IS THE KEY TO SAFETY

- CLEANLINESS
- ORDER
- A PLACE FOR EVERYTHING

ARE ESSETIALS OF SAFETY

Evacuation Procedure (in case of fire)

On hearing the alarm

- Call security on Ext: 2333 to advise of the fire alarm – do not assume someone else has done it.
- Do not delay your escape to collect belongings but if you can turn off equipment/close doors and windows as you leave then do so.
- If necessary, check that internal doors are cool with the back of your hand before opening them.
- Do not use the lifts.
- If smoke is present, then keep low to the floor to add your escape.
- Leave the building by the nearest available fire escape route.
- Go to the assembly area and await instructions.

Evacuation Procedure

On Exiting The Building

→ Report to designated assembly point promptly.

→ Don't block any Emergency Services route to the building.

→ Report any missing colleagues to Fire Warden.

→ Report any disabled persons left at Refuge Points.

→ Remain at the assembly point until advised otherwise.

→ Do not wander off as it may be assumed that you are trapped in the building.

People with Disabilities

→Need to be assisted by volunteers or nominated personnel.

→For special events ensure that disabled persons have been considered and an evacuation plan is in place.

Fire Emergency Response

R **Rescue** (any person in immediate danger)

A **Alarm** (alert others by activating alarm)

C **Contain** (the emergency by closing doors)

E **Extinguish** (extinguish the fire if trained and safe to do so)

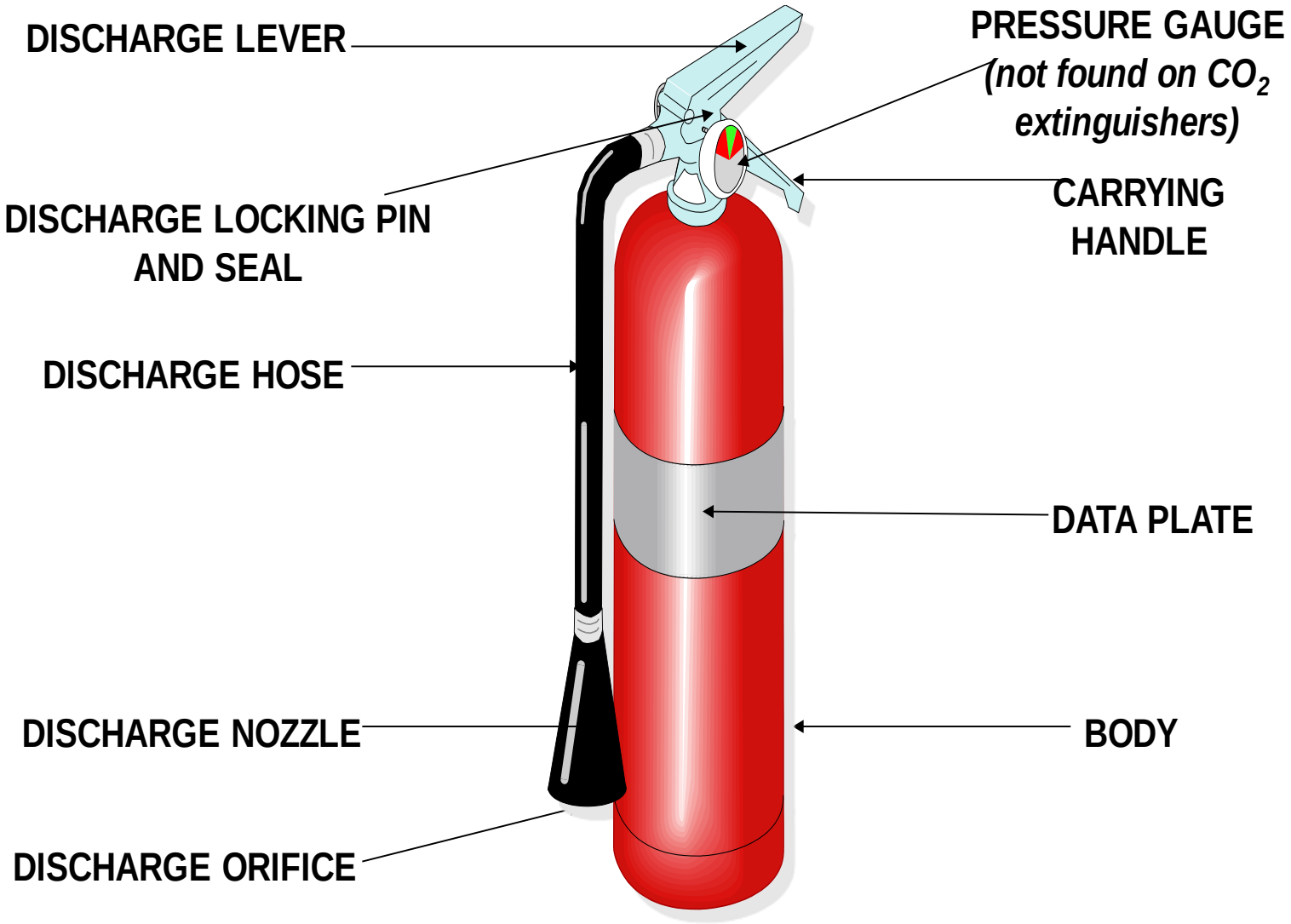
Firefighting Decision Criteria

- Know department emergency procedures and evacuation routes.
- Know the locations of extinguishers in your area and how to use them.
- Always sound the alarm regardless of fire size.
- Avoid smoky conditions.
- Ensure the area is evacuated.
- Don't attempt to fight unless:
  - Alarm is sounded.
  - Fire is small and contained.
  - You have a safe egress route (can be reached without exposure to fire).
  - Available extinguishers are rated for size and type of fire.
  - If in doubt, evacuate!

Fire Extinguishers

A fire extinguisher, flame extinguisher, or simply an extinguisher, is an active fire protection device used to extinguish or control small fires, often in emergency situations.

It is not intended for use on an out-of-control fire, such as one which has reached the ceiling, endangers the user (i.e., no escape route, smoke and explosion hazard etc.) or otherwise requires the expertise of a fire department.



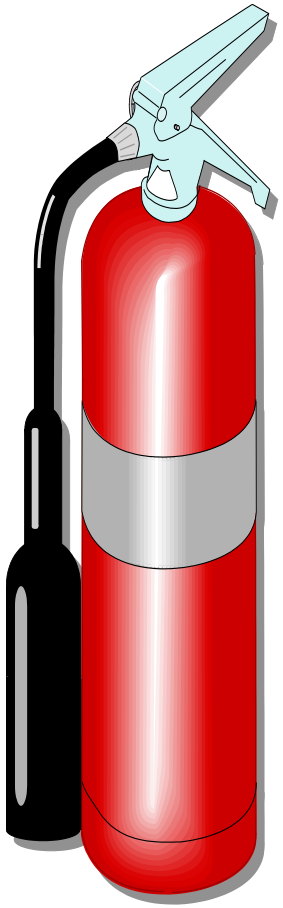
Fire Extinguisher Types

PRESSURIZED WATER

- Class "A" fires only.
- 2.5 gal. water at 150-175 psi (up to 1 minute discharge time).
- Has pressure gauge to allow visual capacity check.
- 30-40 ft. maximum effective range.
- Can be started and stopped, as necessary.
- Extinguishes by cooling burning material below the ignition point.

Fire Extinguisher Types

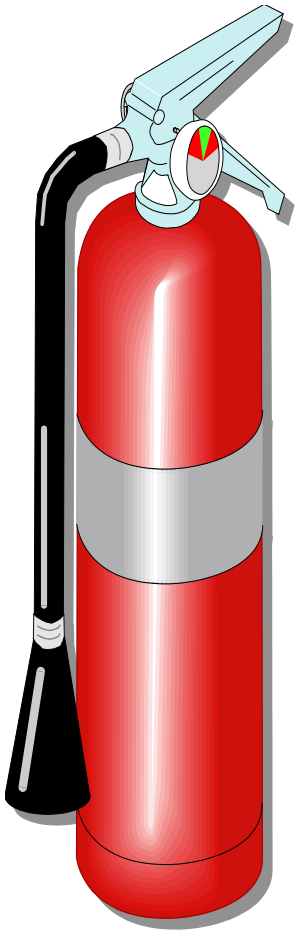
CARBON DIOXIDE (CO_2)

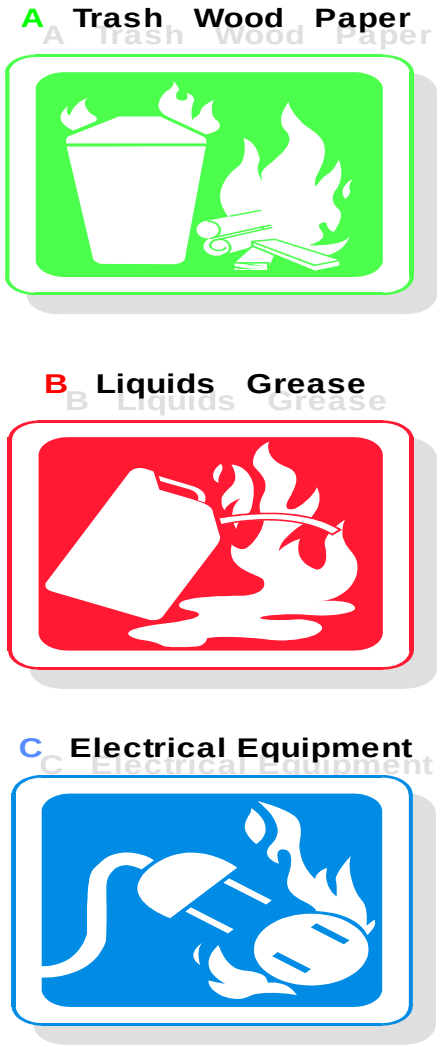


- Class "B" or "C" fires.
- 2.5-100 lb. of CO_2 gas (capacity) at 150-200 psi (8-30 seconds discharge time).
- Has NO pressure gauge--capacity verified by weight.
- 3-8 ft. maximum effective range.
- Extinguish by smothering burning materials.
- Effectiveness decreases as the temperature of burning material increases.

Fire Extinguisher Types

MULTIPURPOSE DRY CHEMICAL

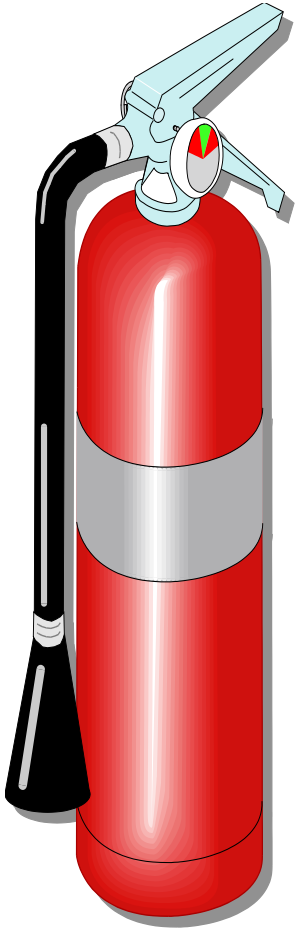


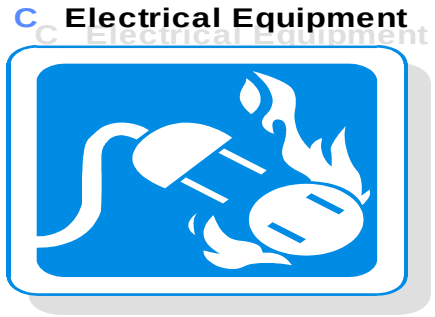


- Class "A", "B", or "C" fires.
- 2.5-20 lb. dry chemical (ammonium phosphate) pressurized to 50-200 psi by nitrogen gas (8-25 seconds discharge time).
- Has pressure gauge to allow visual capacity check.
- 5-20 ft. maximum effective range.
- Extinguish by smothering burning materials.
- Disadvantage: It leaves a residue, particularly making it difficult to clean up in case of sensitive equipment.

Fire Extinguisher Types

HALON



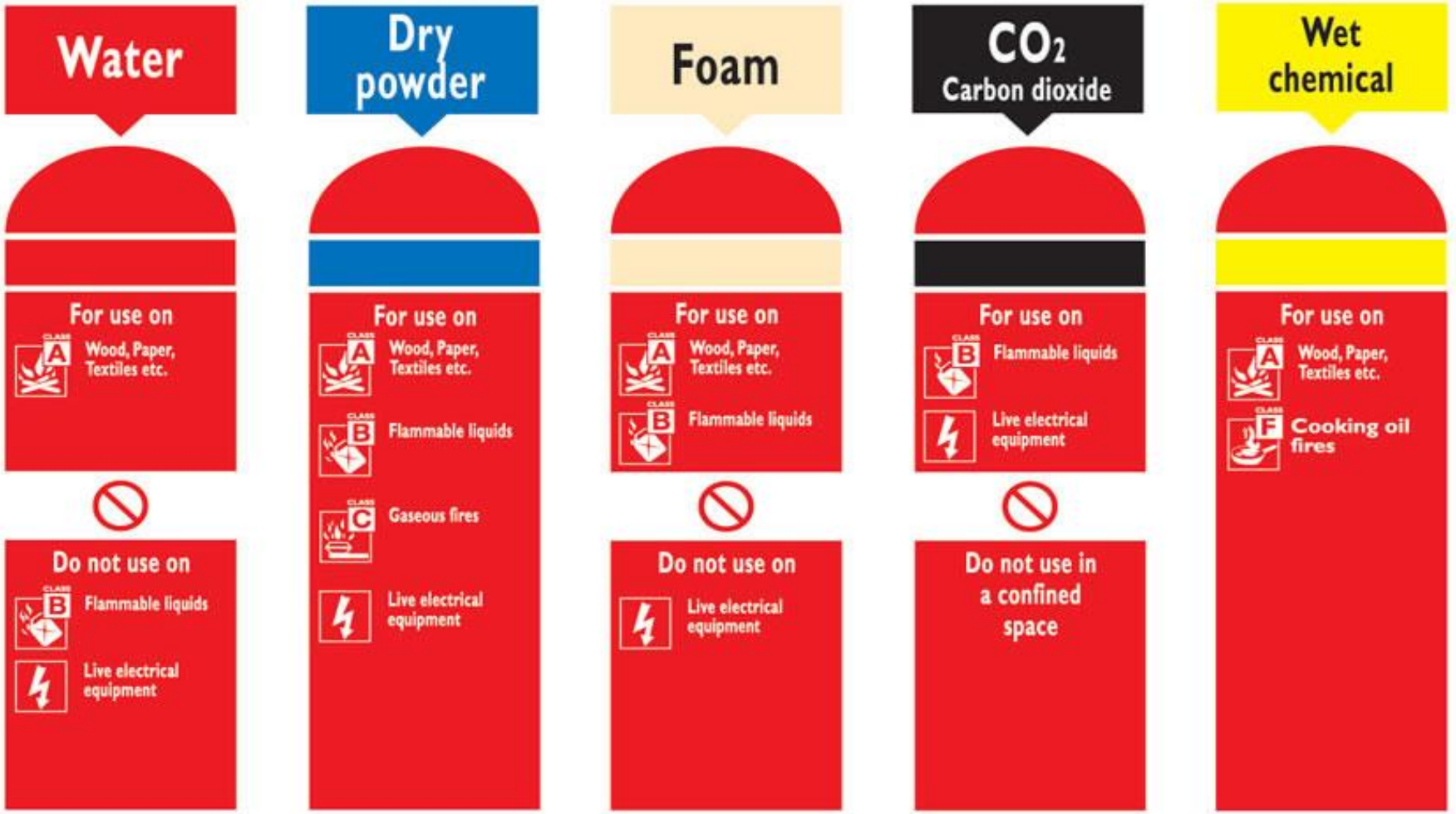


- Class B-C fire,
- Best choice for valuable electronics, no residue, easy clean-up.
- Very short range, only 3 to 6 ft.
- Discharges quickly! (5 to 10 seconds!)
  - Use 1-2 second spurts
- Disperses quickly!
- Halon weight-for-weight twice as effective as CO_2
  - Larger halon 1211 extinguishers are also rated for Class A

Fire Extinguisher Summary

CLASS	A	B	B	C	D	K
PICTURE SYMBOL						
TYPE	Common Combustibles Solids (wood, paper, cloth, etc.)	Flammable liquids Gasoline and solvents	Flammable gases Propane	Live electrical equipment Computers, fax machines	Combustible Metals Magnesium, Lithium, Titanium	Cooking Media Cooking oils and fats
Water	✓ Yes	✗ No	✗ No	✗ No	✗ No	✗ No
Foam	✓ Yes	✓ Yes	✗ No	✗ No	✗ No	✓ Yes (ABF Foam Only)
Dry Powder	✓ Yes	✓ Yes	✓ Yes	✓ Yes	✗ No	✗ No
M28/L2	✗ No	✗ No	✗ No	✗ No	✓ Yes	✗ No
Carbon Dioxide CO2	✗ No	✓ Yes	✗ No	✓ Yes	✗ No	✗ No
Wet Chemical	✓ Yes	✗ No	✗ No	✗ No	✗ No	✓ Yes

KNOW YOUR FIRE EXTINGUISHER COLOUR CODE



Number Ratings of Fire Extinguisher

- Possible ratings of **A fires** : **1A, 2A, 3A, 4A, 6A, 10A.**
- Possible ratings of **B fires** : **2B, 5B, 10B, 20B, 30B, 40B, 60B, 80B.**
- **C, D, K fires** : no rating number.

The higher the **number**, the greater the **fuel load** of the test fire.

3	A	40	B	E
Rating tested to a specific size of a wood fire	Fire type: combustible materials such as wood, paper, and fabric	Rating tested to a specific fuel load of a flammable liquid fire	Fire type: flammable liquids such as petrol, turpentine or paint	Fire type: electrical equipment such as appliances, computers, phones

Fighting the Fire

How to use a Fire Extinguisher

P	A	S	S
			
Pull the pin in the handle	**Aim** the nozzel at the base of the fire		

Fire In Building

What is a Fire Door?

Fire doors are designed to withstand fire, heat and smoke for a period of 20 minutes to 3 hours.

- Did you know that corridor office doors are fire doors and should have a 20-minute rating?
- Corridor laboratory doors should have a 60-minute rating.
- Fire Doors are required to:

– Be Self-Closing: Fire doors should have a door closure that pulls doors completely shut after the door has been opened.

– Have Positive latching: a positive latch locks a door in place.

Fire Protection and Prevention Safe Work Practices

Reporting and Extinguishing a Fire

- The fire department and area supervisor will be notified when a fire is spotted.
- All workers will be alerted and evacuated as needed.
- The PASS method will be used to extinguish the fire by those employees who have been properly trained.
- The area will be evacuated immediately if the fire is large.

Fire Protection

- Before each project begins, the project manager or designee will contact the local fire department and determine whether any variations from the company's standard fire-prevention procedures are required.
- Only approved containers will be used to store flammable or combustible materials.
- All containers will be grounded when transferring flammable or combustible liquids.
- All work areas will be kept free of debris and other combustible materials.

Fire Protection and Prevention Safe Work Practices

- Inside company-owned or leased buildings, fire extinguishers will be spaced no more than 100 feet apart and will have no less than a 2A rating for every 3,000 feet of protected building.
- No-smoking signs will be posted in all regulated areas.
- All employees will be trained on the use of fire extinguishers initially upon hire and annually thereafter.
- No employee will be permitted to use an extinguisher without having been fully trained.

Fire Extinguishers

- In buildings, all fire extinguishers will be mounted on walls and properly marked.
- All vehicles will carry at least one ABC-rated extinguisher.
- When at a job site, all employees will know the location of each fire extinguisher.
- Before using an extinguisher, all employees will be trained and familiar with the PASS method of firefighting.
- Each fire extinguisher will be inspected monthly to ensure it is in its designated location and has not been tampered with or actuated.
- Each fire extinguisher will be clearly visible, with nothing obstructing or obscuring it from view.
- All fire extinguishers will be examined at least yearly and/or recharged or repaired to ensure operability and safety. A tag must be attached to show the maintenance or recharge date and the signature or initials of the person performing the service.

Housekeeping

Good housekeeping habits are an essential part of maintaining a safe workplace.

Why is good housekeeping important?

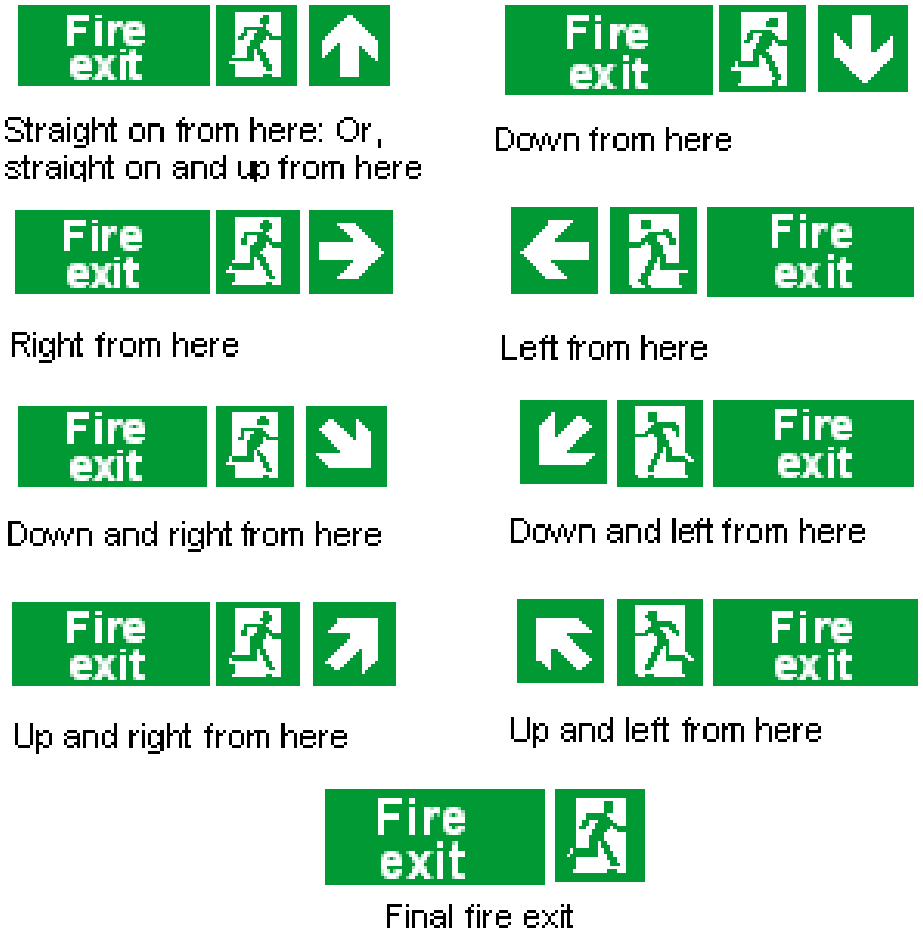
1. To reduce the amounts of flammable and combustible materials.
2. To minimize ignition hazards.
3. To facilitate the safe evacuation of occupants in case of an emergency.
4. To enable a swift emergency response.

Marking Signs for a Building:

Marking signs should consist of signs of similar size, design and format. Their location should be consistent throughout. Emergency signs, including escape route markings, are rectangular or square with an approved photo luminescent pictogram on a green background. The sign must be at least 50% green/red/yellow/blue depending on function. A few types of signs in a building are:

i. *Escape Route Sign*
ii. *Fire Fighting Equipment and Location Sign*
iii. *Escape Equipment Sign*
iv. *Mandatory Fire Action Sign*
v. *Mandatory Door Instruction Sign*
vi. *Prohibition Sign*
vii. *Hazard warning Sign*

Fire Protection and Prevention Safe Work Practices



Escape Route Sign

Fire Fighting Equipment and Location Sign

REMEMBER !

Fire Prevention : Everyone's Responsibility

And

When in doubt, leave the fire fighting to the Professionals!

THANK YOU!