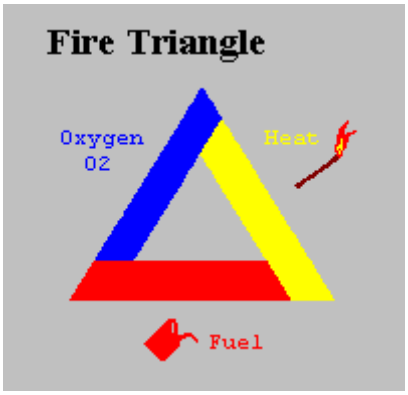
# Adventurer's MK

# Fire Safety

## Common fire hazards

- Kitchen fires from unattended cooking, such as frying, boiling, and simmering
- Electrical systems that are overloaded, resulting in hot wiring or connections, or failed components
- Combustible storage areas with insufficient protection
- Combustibles near equipment that generates heat, flame, or sparks
- Candles and other open flames
- Smoking (Cigarettes, cigars, pipes, lighters, etc.)
- Equipment that generates heat and utilizes combustible materials
- Flammable liquids and aerosols
- Flammable solvents (and rags soaked with solvent) placed in enclosed trash cans
- Fireplace chimneys not properly or regularly cleaned
- Cooking appliances - stoves, ovens
- Heating appliances - fireplaces, wood burning stoves, furnaces, boilers, portable heaters
- Household appliances - clothes dryers, curling irons, hair dryers, refrigerators, freezers
- Chimneys that concentrate creosote
- Electrical wiring in poor condition
- Leaking Batteries
- Personal ignition sources - matches, lighters
- Electronic and electrical equipment
- Exterior cooking equipment - barbecue

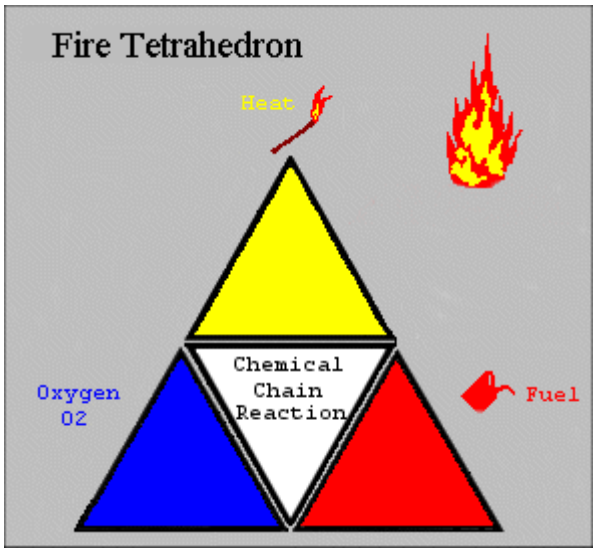
## The Fire Tetrahedron (A pyramid)




For many years the concept of fire was symbolized by the Triangle of Combustion and represented, fuel, heat, and oxygen. Further fire research determined that a fourth element, a chemical chain reaction, was a necessary component of fire. The fire triangle was changed

to a fire tetrahedron to reflect this fourth element. A tetrahedron can be described as a pyramid which is a solid having four plane faces. Essentially all four elements must be present for fire to occur, fuel, heat, oxygen, and a chemical chain reaction. Removal of any one of these essential elements will result in the fire being extinguished.

The four elements are oxygen to sustain combustion, sufficient heat to raise the material to its ignition temperature, fuel or combustible material and subsequently an exothermic chemical chain reaction in the material. Each of the four sides of the fire tetrahedron symbolise the Fuel, Heat, Oxygen and Chemical Chain Reaction. Theoretically, fire extinguishers put out fire by taking away one or more elements of the fire tetrahedron.




The symbol although simplistic, is a good analogy, how to theoretically extinguish a fire, by creating a barrier using foam for instance and prevent oxygen getting to the fire. By applying water you can lower the temperature below the ignition temperature or in a flammable liquid fire by removing or diverting the fuel. Finally interfering with the chemical chain reaction by mopping up the free radicals in the chemical reaction using, BCF and other halon extinguishers, it also creates an inert gas barrier. However this type of extinguisher is being phased out and in the future other extinguishing agents may be found using this principle. The 2D figure opposite represents a 3D model of a tetrahedron.

## A Definition of Fire

One generally accepted definition of combustion or fire, is a process involving rapid oxidation at elevated temperatures accompanied by the evolution of heated gaseous products of combustion, and the emission of visible and invisible radiation. Oxidation occurs all around us in the form of rust on metal surfaces, and in our bodies by metabolising the food we eat. However, the key word that sets combustion apart from other forms of oxidation is the word “rapid”.

The combustion process is usually associated with the oxidation of a fuel in the presence of oxygen with the emission of heat and light. Oxidation, in the strict chemical sense, means the loss of electrons. For an oxidation reaction to occur, a reducing agent the fuel, and an oxidizing agent, usually oxygen must be present. As heat is added, the ignition source, the

fuel molecules and oxygen molecules gain energy and become active. This molecular energy is transferred to other fuel and oxygen molecules which creates a chain reaction. A reaction takes place where the fuel looses electrons and the oxygen gains electrons. This exothermic electron transfer emits heat and/or light. If the fire is in a fire grate/ or furnace we refer to this process as a controlled fire, and it is a building on fire we refer to this process as a uncontrolled fire.

# The Combustion Modes

The combustion process occurs in two modes:

- The flaming
- The non-flaming, smouldering or glowing embers.

For the flaming mode it is necessary for solid and liquid fuels to be vaporized. The solid fuel vapours are thermally driven off, or distilled and the liquid fuel vapours evaporated. It is this volatile vapour from the solid or liquid fuels that we see actually burning in the flaming mode. This gas or vapour production, emitted from the fuel is referred to as pyrolysis. Once a flame has been established, heat transfer from the flame to the fuel surface continues to drive off more volatile gases and perpetuates the combustion process. For continued burning in the flaming mode requires a high burning rate, and the heat loss associated with transfer of heat from the flame area by conduction, convection, and radiation must be less than the energy output of the fire. If the heat loss is greater than the energy output of the fire the fire will extinguish.

Both modes, flaming and non-flaming surface modes, can occur singly, or in combination. Flammable liquids and gases only burn in the flaming mode. Wood, straw, and coal are examples where both modes may exist simultaneously.

Flaming combustion can occur in the following forms:

1. Premixed flames where the fuel and oxygen are mixed prior to ignition. For example the flame on a bunsen burner, gas stove, or propane torch.
2. Diffusion flames, more common, where the fuel and oxygen are initially separate but burn in the region where they mix, like a burning of a pool of flammable liquid or the burning of a log.

# Stages of a Fire

There are three generally recognized stages to a fire. The incipient stage, smoldering stage, and flame stage.

- **The incipient stage** is a region where preheating, distillation and slow pyrolysis are in progress. Gas and sub-micron particles are generated and transported away from the source by diffusion, air movement, and weak convection movement, produced by the buoyancy of the products of pyrolysis.
- **The smouldering stage** is a region of fully developed pyrolysis that begins with ignition and includes the initial stage of combustion. Invisible aerosol and visible

smoke particles are generated and transported away from the source by moderate convection patterns and background air movement.

- **The flaming stage** is a region of rapid reaction that covers the period of initial occurrence of flame to a fully developed fire. Heat transfer from the fire occurs predominantly from radiation and convection from the flame.

## Classes of fire

Combustible and flammable fuels involved in fires have been broken down into five categories:

- **Class A fires –** are fires involving organic solids like paper, wood, Esc
- **Class B fires –** are fires involving flammable Liquids
- **Class C fires –** are fires involving flammable Gasses
- **Class D fires –** are fires involving Metals
- **Class F fires –** are fires involving Cooking oils.

## EXTINGUISHING A FIRE

You should only tackle a fire in its very early stages, having immediately raised an alarm. You should always put your own safety (and other people's safety) first when deciding whether to tackle the fire of exit the building and, before engaging, you should ensure you have a clear escape route.

If it becomes apparent that the fire cannot be put out (or the extinguisher is depleted) you should vacate the building closing doors behind you as your leave and ensure that the fire brigade has been called.

| Type (Fire / Extinguisher) | CLASS A<br>**Combustible materials** (e.g. paper & wood) | CLASS B<br>**Flammable liquids** (e.g. paint & petrol) | CLASS C<br>**Flammable gases** (e.g. butane and methane) | CLASS D<br>**Flammable metals** (e.g. lithium & potassium) | Electrical<br>**Electrical equipment** (e.g. computers & generators) | CLASS F<br>**Deep fat fryers** (e.g. chip pans) | Comments |
|---|---|---|---|---|---|---|---|
| Water | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | Do not use on liquid or electric fires |
| Foam | ✓ | ✓ | ✗ | ✗ | ✗ | ✗ | Not suited to domestic use |
| Dry Powder | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | Can be used safely up to 1000 volts |
| CO2 | ✗ | ✓ | ✗ | ✗ | ✓ | ✗ | Safe on both high and low voltage |
| Wet Chemical | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | Use on extremely high temperatures |

# Where to aim the extinguisher for best effect?

**Water Fire Extinguishers**

- Fire spreading horizontally - Aim the hose at the base of the fire, moving the jet across the area of the fire.
- Fire spreading vertically - Aim the hose at the base of the fire, slowly moving the jet upwards following the direction of the fire.

**ABC Powder Fire Extinguishers**

- Solid materials - Aim the hose at the base of the flames, moving across the area of the fire.
- Spilled liquids - Aim the hose at the near edge of the fire and with a rapid sweeping motion drive the fire towards the far edge until all the flames have been extinguished.
- Flowing liquid - Direct the hose at the base of the fire and sweep upwards until the flames have been extinguished.

**Foam Fire Extinguishers**

- Electrical equipment - Switch the power off if safe to do so and direct the hose straight at the fire.
- Flammable liquids - Aim the hose at a vertical surface near the fire, do not spray directly at the fire as this could push the fire causing it to spread to surrounding areas. You need to smother the fire with a build up of foam.
- Solid combustibles - Aim the hose at the base of the fire, moving across the area of the fire.

**CO2 Fire Extinguishers**

- Flammable liquids - AIm the horn at the base of the fire and move across the area.
- Electrical equipment - Swithc off the power if safe to do so and direct the hose straight at the fire

**Wet Chemical Extinguishers**

Hold at arm's length well above the fire with its nozzle at least a metre away. Apply the spray in slow circular movements allowing the wet chemical agent to fall gently onto the surface of the fire and avoiding hot oils being splashed onto the user.

# Wildfires

A wildfire is an unplanned, unwanted fire burning in a natural area, such as a forest, grassland, or prairie. As building development expands into these areas, homes and businesses may be situated in or near areas susceptible to wildfires. This is called the wildland urban interface.

Wildfires can cause death or injury to people and animals, damage or destroy structures, and disrupt community services including transportation, gas, power, communications, and other services. The impact may cover large areas with extensive burning, embers traveling more than a mile away from the wildfire itself, and smoke causing health issues for people

far away from the fire. Wildfires damage watersheds leave areas prone to flooding and mudslides for many years.

Wildfires can occur anywhere in the country. They can start in remote wilderness areas, in national parks, or even in your back yard. Wildfires can start from natural causes, such as lightning, but most are caused by humans, either accidentally—from cigarettes, campfires, or outdoor burning—or intentionally.

Wildfires can occur at any time throughout the year, but the potential is always higher during periods with little or no rainfall, which make brush, grass, and trees dry and burn more easily. High winds can also contribute to spreading the fire.

# Treatment for burns

Appropriate first aid must be used to treat any burns or scalds as soon as possible. This will limit the amount of damage to your skin.

**First aid for burns**

- Stop the burning process as soon as possible. This may mean removing the person from the area, dousing flames with water, or smothering flames with a blanket. Don't put yourself at risk of getting burnt as well.
- Remove any clothing or jewellery near the burnt area of skin, including babies' nappies. However, don't try to remove anything that's stuck to the burnt skin as this could cause more damage.
- Cool the burn with cool or lukewarm running water for 20 minutes, as soon as possible after the injury. Never use ice, iced water, or any creams or greasy substances such as butter.
- Keep yourself or the person warm. Use a blanket or layers of clothing, but avoid putting them on the injured area. Keeping warm will prevent hypothermia, where a person's body temperature drops below 35C (95F). This is a risk if you are cooling a large burnt area, particularly in young children and elderly people.
- Cover the burn with cling film. Put the cling film in a layer over the burn, rather than wrapping it around a limb. A clean clear plastic bag can be used for burns on your hand.
- Treat the pain from a burn with paracetamol or ibuprofen . Always check the manufacturer's instructions when using over-the-counter medication. Children under 16 years of age should not be given aspirin.
- Sit upright as much as possible if the face or eyes are burnt. Avoid lying down for as long as possible as this will help to reduce swelling.

**When to go to hospital**

Once you have taken these steps, you'll need to decide whether further medical treatment is necessary. Go to a hospital accident and emergency (A&E) department for:

- large or deep burns – bigger than the affected person's hand
- burns of any size that cause white or charred skin
- burns on the face, hands, arms, feet, legs or genitals that cause blisters
- all chemical and electrical burns

**Also get medical help straight away if the person with the burn:**

- has other injuries that need treating
- is going into shock – signs include cold, clammy skin, sweating, rapid, shallow breathing, and weakness or dizziness
- is pregnant
- is over the age of 60
- is under the age of five
- has a medical condition such as heart, lung or liver disease, or diabetes
- has a weakened immune system (the body's defence system) – for example, because of HIV or AIDS, or because they're having chemotherapy for cancer

If someone has breathed in smoke or fumes, they should also seek medical attention. Some symptoms may be delayed, and can include:

- coughing
- a sore throat
- difficulty breathing
- singed nasal hair
- facial burns