

**Theories of
Fire, Fire Extinguishment
&
Instruction on the use of Extinguishers**

June 2004

R.A.C.E.

Upon discovery of Fire or Smoke

1. **R**emove persons from immediate danger!
2. **A**lert others in near vicinity and Administration
3. **C**ontain Fire and Smoke (close doors)
4. **E**vacuate and/or Extinguish

WHAT IS FIRE?

Fire is a chemical reaction in which oxygen is combined with a gaseous or vaporous fuel. Note that, even if the fuel is a solid (e.g. wood) or a liquid (e.g. petrol) it is the vapours given off when the fuel is heated that burn. This rapid oxidation produces heat and light (flames). Fire can usually take place only when these three elements are present:

- **Oxygen**
- **Fuel**
- **Heat (energy)**

These 3 elements make up what is commonly called the '**Fire Triangle.**'

Oxygen:

- Oxygen is usually readily available. It makes up 21% of the air we breathe.

Fuel:

- solid combustibles like paper, furniture, clothing and plastics
- flammable liquids like petrol, oils, kerosene, paints, solvents and cooking oils / fats
- flammable gases like natural gas, LPG, acetylene

Heat:

- The heat given off by the oxidation reaction sustains the fire once it is established. But first, a heat source is required to produce ignition

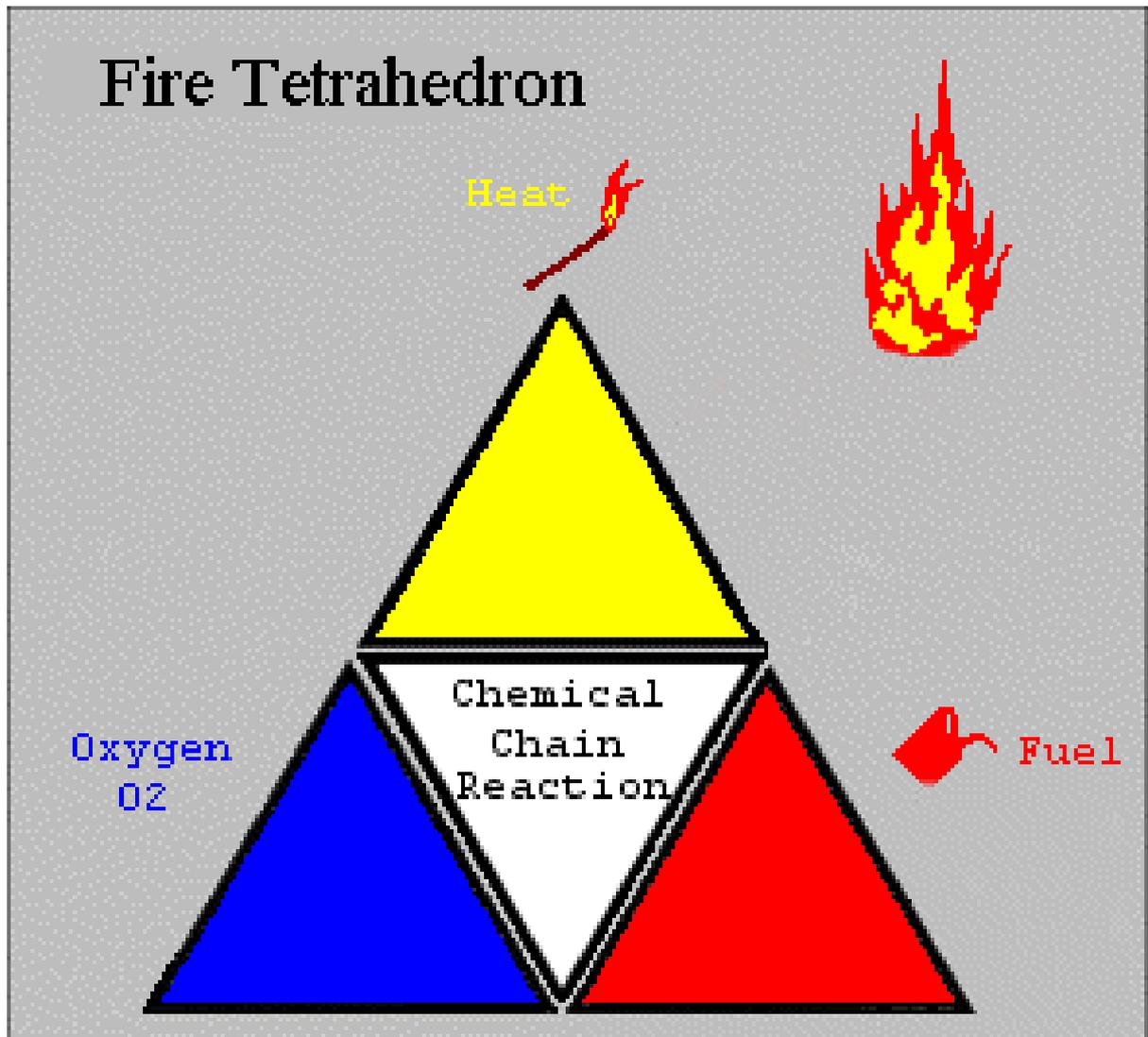
Ignition sources include:

- heating and cooking appliances
- faulty electrical equipment
- cigarettes, lighters and matches
- friction

Chemical Chain Reaction:

Research has added a **fourth side to the fire triangle** concept resulting in the development of a new model called the '**Fire Tetrahedron.**'

The **fourth element** involved in the combustion process is referred to as the '**chemical chain reaction**'. Specific chemical chain reactions between fuel and oxygen molecules are essential to sustain a fire once it has begun.



FIRE EXTINGUISHMENT

Essentially, fires are extinguished by **taking away one or more of the elements** in the fire tetrahedron.

This can be achieved by:

- Removal or separation of unburnt **FUEL** (eg turn off the gas)
- Removal or dilution of the **OXYGEN** supply (eg smothering the fire with a fire blanket or an inert gas)
- Removal of the **HEAT** of the oxidation reaction (eg spraying the fuel with water)
- Inhibiting the **CHAIN REACTION** by modifying the combustion chemistry

Sound fire prevention practices are based upon the principle of keeping fuel and ignition sources apart.

CLASSES OF FIRE

Fires are classified according to the type of fuel involved. Not all extinguishing agents are compatible with all types of fuel (eg water used on a flammable liquid fire is likely to increase the rate of burning dramatically and to disperse the fuel to cover a greater area).

Thus, if the wrong type of extinguisher is selected the fire situation can be made worse, often threatening your own personal safety. Some extinguishers are simply more effective than others on particular classes of fire.

The various types of fires are classified as follows:

- Class A** Fires involving carbonaceous solids, such as wood, cloth, paper, rubber and plastics. *Class A* does not include flammable metals (*see Class D*).
- Class B** Fires involving flammable and combustible liquids.
- Class C** Fires involving combustible gases.
- Class D** Fires involving certain combustible metals, including potassium, sodium, & magnesium. Specialist advice should be sought.
- Class E** Electrical Hazards
- Class F** Fires involving cooking oils and fats.

Most fire extinguishers have a pictograph label identifying the type of fuels that may be extinguished.

Electrical hazards

Where a fire, involving an electrical hazard, can be expected, the extinguisher must be electrically non-conductive, in addition to having the correct classification for the materials involved. The marking of '(E)' on the fire extinguisher indicates the extinguisher is safe for extinguishing a fire involving energised electrical equipment.

FIRE SAFETY INFORMATION

FIRE EXTINGUISHERS

Portable fire extinguishers are designed to attack a fire in its initial stage. The selection of a suitable extinguisher is primarily influenced by the following factors:

- the size and rate of fire spread
- the Class of fire (i.e. type of materials involved)
- the training and capabilities of the person using the extinguisher

Note: *Always follow the specific instructions on a fire extinguisher and familiarise yourself with these instructions prior to an emergency situation. Persons should be trained in the use of extinguishers to optimise their effectiveness.*

General Guidelines for Using a Fire Extinguisher

P.A.S.S.

1. raise the alarm, summon help and have someone call the fire service on '000'
2. Keep your escape path at your back. Never allow the fire to get between you and the escape path
3. Select the correct extinguisher for the Class of fire
4. remember **P.A.S.S.**

... Pull	the pin
... Aim	the extinguisher nozzle at the base of flames
... Squeeze	trigger while holding the extinguisher upright
... Sweep	the extinguisher or nozzle from side to side covering the base of the fire.

5. observe fire after initial extinguishment, it may rekindle
6. the contents of small extinguishers may last as little as 8 seconds and up to 60 seconds for larger extinguishers. The time to discharge an extinguisher depends on the type and size of the extinguisher

Do Not Use (or continue to use) an extinguisher if:

- the fire is larger than a waste paper basket
- the fire is spreading quickly beyond the point of origin
- the extinguisher is not having any effect or is having an adverse reaction on the fire
- you are putting your life at risk
- you cannot extinguish the fire quickly (less than 30 sec)
- you do not know what fuels are involved in the fire

REMEMBER - *Saving lives through a quick escape is far more important than saving property.*

An emergency is not the time to read extinguisher instructions, if you do not know how to use the extinguisher or the type of materials involved in the fire:

- Close the door to contain the fire
- Ensure everyone is out of the building
- Ring the fire service on “**000**”
- Never go back into the building once out
- Wait to meet the fire service

Fire Extinguishers

Fire extinguishers are provided for a 'first attack' fire fighting measure generally undertaken by the occupants of the building before the fire service arrives. It is important that occupants are familiar with which extinguisher type to use on which fire.

Most fires start as a small fire and may be extinguished if the correct type and amount of extinguishing agent is applied whilst the fire is small and controllable.

The principle fire extinguisher types currently available include:

Extinguishing Agent

Water (solid **Red**)

Foam (**Blue** band)

Carbon Dioxide (**Black** band)

Dry Chemical (**White** band)

Wet chemical (**Oatmeal** band)

Special Purpose (**Yellow** band)

Principle Use

wood and paper fires - not electrical

flammable liquid fires - not electrical

electrical fires

flammable liquids and electrical fires

fat fires - not electrical

various (eg. metal fires)

Fire extinguisher locations must be clearly identified. ***Extinguishers are colour coded according to the extinguishing agent.***

The important thing to remember is that fire fighting must always be secondary to the safety of people.