WESTBURY FIRE DEPARTMENT

PROBATIONARY DRILL

CHEMISTRY OF FIRE

INTRODUCTION TO FIRE EXTINGUISHERS

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CHEMISTRY OF FIRE

To understand FIRE and how to EXTINGUISH it, we first need to know: **What is FIRE** ?

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It is the rapid oxidation of a material, in the chemical process of combustion, releasing heat, light, and various reaction products.

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Combustion is the self sustaining process of rapid oxidation of a fuel, which produces heat and light

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The *flame* is the visible portion of the fire or combustion and consists of glowing hot gases.

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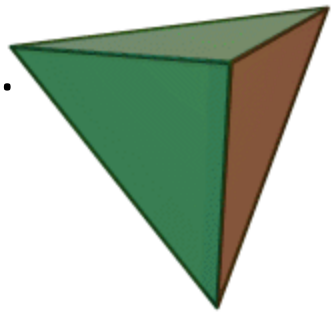
Fires start when a flammable and/or a combustible material, in combination with a sufficient quantity of an oxidizer such as oxygen or another oxygen-rich compound , is exposed to a source of heat or temperature above the flash point for the fuel/oxidizer mix, and is able to sustain a rate of rapid oxidation that produces a chain reaction.

This is commonly called the fire tetrahedron.



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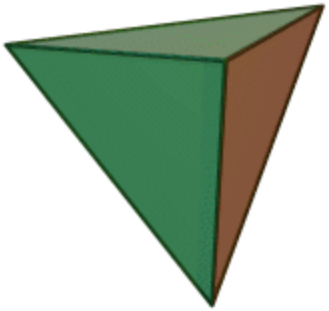
[fire tetrahedron](). 

Tetrahedron – is a pyramid shape depicting the four elements necessary for combustion to occur; oxygen, fuel, heat, and chemical chain reaction.

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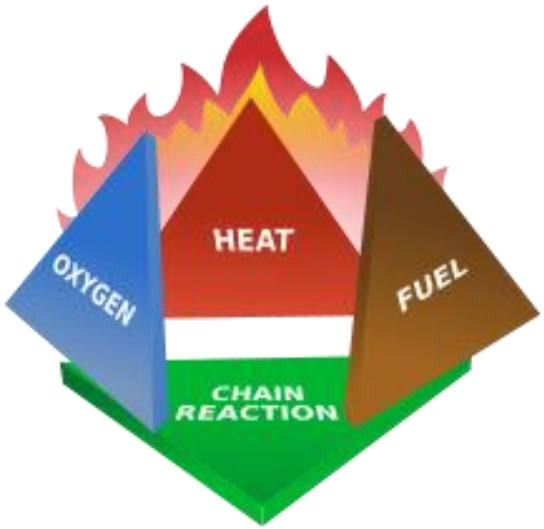
The Fire Tetrahedron



1 . Heat
2. Oxygen
3. Fuel
4. Chain Reaction

Must have all 4 parts to maintain FIRE

REMOVE 1 of the 4 and the Fire goes out.

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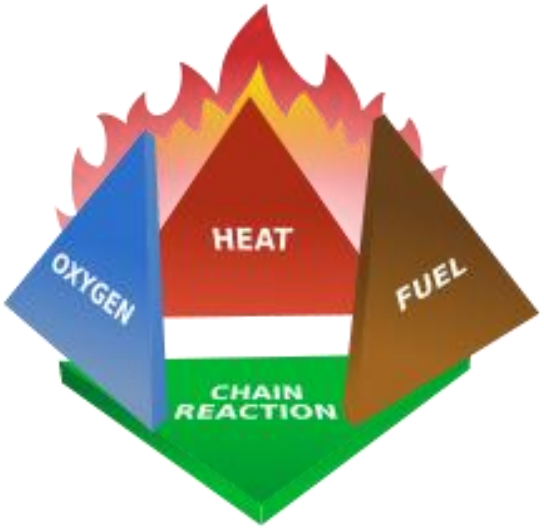
The Fire Tetrahedron

1 . Heat

How do we Remove the heat ?



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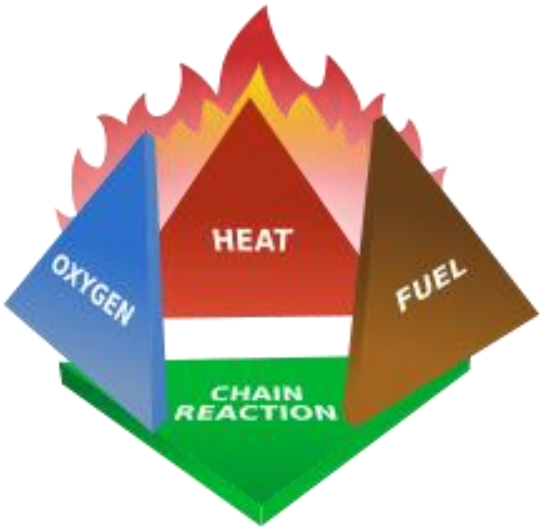
The Fire Tetrahedron



1 . Heat

How do we Remove the heat ?

Adding Water – Cooling
Getting the fuel temperature below it's Flash Point .

Most common way we Extinguish Fires.

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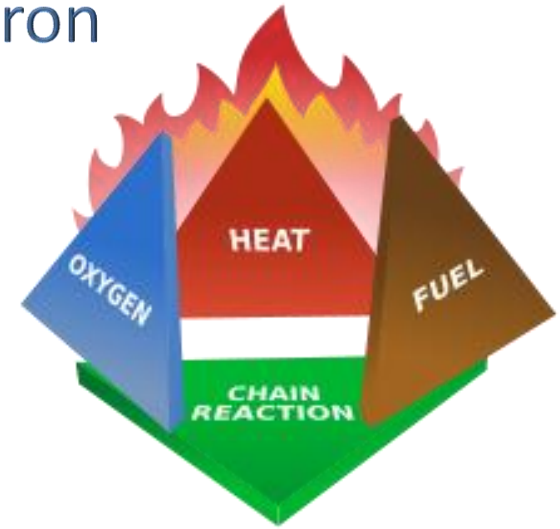
The Fire Tetrahedron

2 . Oxygen

How do we Remove the Oxygen ?



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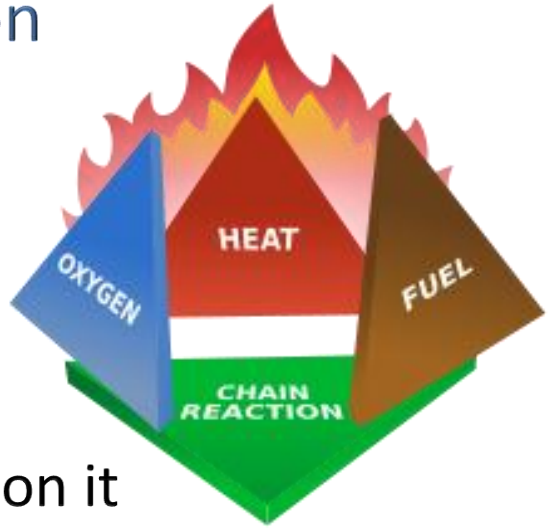
The Fire Tetrahedron



2 . Oxygen

How do we Remove the Oxygen ?

If contained to small area – put a cover on it
Most common with FD – CO2 extinguisher & Foam

Oxygen – occurs normally in the atmosphere at about 21 percent. The percentage has a great deal to do with how the fire will react. Below 19.5 percent is oxygen deficient and the intensity of the fire will decrease. Above 21 percent and the fire will intensify.

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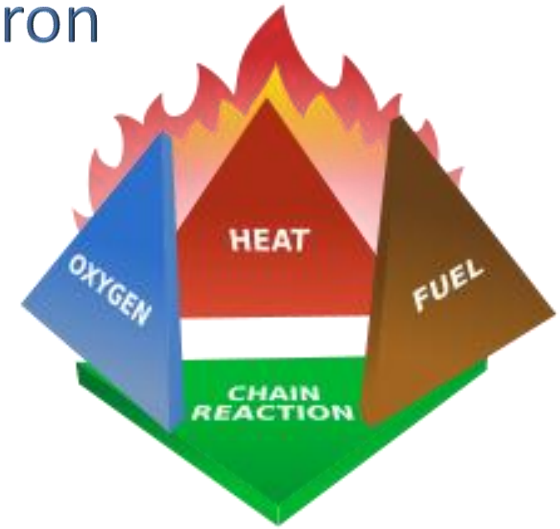
The Fire Tetrahedron



3 . Fuel

How do we Remove the Fuel ?

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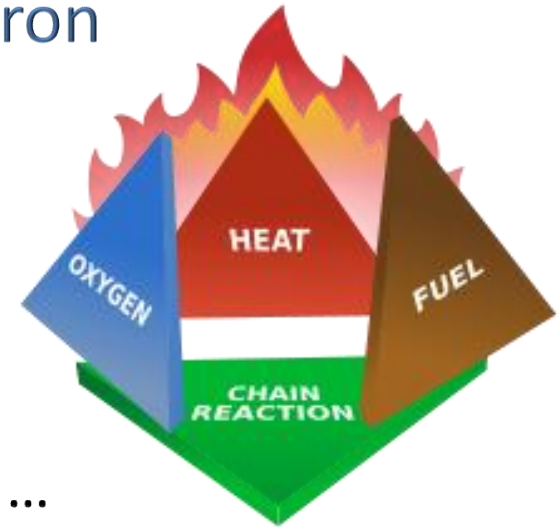

3 . Fuel

How do we Remove the Fuel ?

Turn off the supply – Turn the gas off …

Shut off the electric power…

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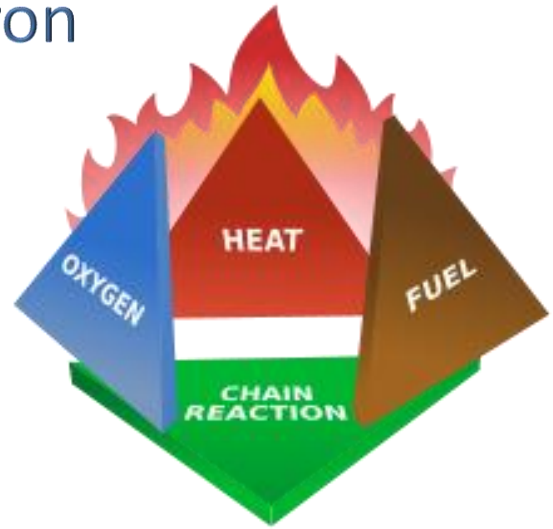
The Fire Tetrahedron

4 . Chain Reaction

How do we Stop the Chain reaction ?



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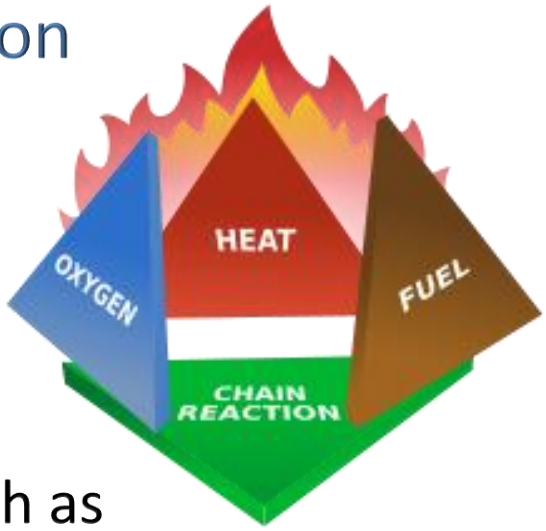

4 . Chain Reaction

How do we Stop the Chain reaction ?

Adding a retardant chemical agent such as Halon, Dry Powder or Dry Chemical .

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CHEMISTRY OF FIRE

CLASSES OF FIRES

A . Ordinary combustibles

B. Flammable liquids & gases

C. Electrical equipment

D. Combustible metals

A		Common Combustibles	Wood, paper, cloth etc.
B		Flammable liquids and gases	Gasoline, propane and solvents
C		Live electrical equipment	Computers, fax machines
D		Combustible metals	Magnesium, lithium, titanium

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CLASSES OF FIRES

A . Ordinary combustibles:

Organic material such as Wood, Paper, Cloth, Rubber & Some Plastics

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CLASSES OF FIRES

B . Flammable Liquids/Gases:

Gasoline, Kerosene, Natural Gas, Propane…

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CLASSES OF FIRES

C . Electrical Equipment:

Potentially energized electrical equipment such as short-circuiting machinery or overloaded electrical cables.

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CLASSES OF FIRES

D . Flammable or combustible Metals:

Metals fire such as alkali metals including sodium and potassium and other exotic metals including magnesium, titanium, aluminum, and zirconium…

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Heat Transfer

- **Radiation –** is electromagnetic waves through the air.
- **Convection –** heat transfer by the movement of air or a liquid.
- **Conduction –** heat transfers from one object to another by direct contact.

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Heat Sources

- Chemical
- Mechanical
- Electrical
- Nuclear

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Phases Of Fire

- **Incipient -** occurs shortly after ignition.
- **Growth -** open burning occurs.
- **Fully Developed -** all contents are burning**.**
- **Decay or Smoldering -** the point that all fuels have been consumed and the fire is starting to diminish.

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Backdraft

Backdraft will occur when the fire lacks the oxygen it requires to burn freely. The fire has built up a tremendous amount of heat and pressure, with plenty of fuel left to burn. Once the firefighters open up and allow oxygen into the area, a violent explosion occurs.

Ventilation is best performed at the highest point to prevent from occurring.

Warning signs of a backdraft are:

- Smoked stained windows
- Smoke puffing from windows, doors, and cracks of structure
- Smoke pushing, under pressure
- Heavy black smoke
- No visible fire
- Windows and doors that are very hot

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Flashover - this is the point at which all contents in the immediate area of the fire simultaneously heat to their ignition temperature and begin to burn.

This generally will occur during the growth phase.

Items that need to be addressed to identify the warning signs of a flashover are:

- Rapid buildup of heat in the area
- Environment becomes pitch black

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Rollover

Rollover - the least dangerous, it consists of escaping smoke and gases being ignited overhead, which will consume the fuel in the air very quickly and burn out.

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Now that we know :

1. What Fire is,
2. What it's components are
3. And how fire is rated, by class

We now can better understand how we can best Extinguish the Fire.

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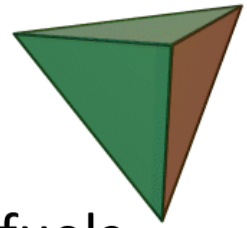
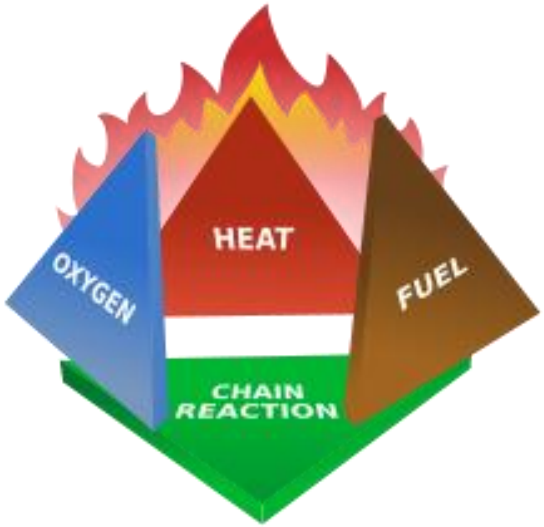
FIRE EXTINGUISHERS



We Know we want to either:

1. Reduce the temperature to below the fuels Flash Point
2. Take away the Fires Oxygen
3. Take ways its Fuel Source
   or
4. Stop the Chain Reaction



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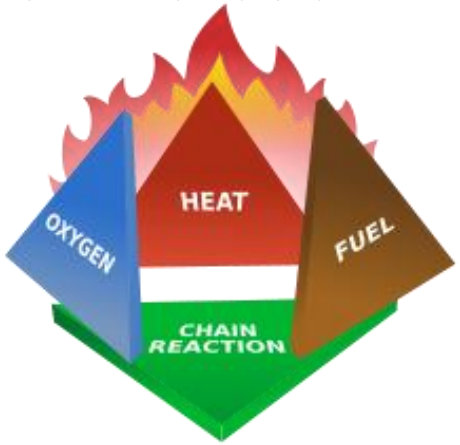

The best method of achieving one of the above is by 1st recognizing the Class of fire you have then selecting the extinguisher for that Class of Fire.

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CLASS A Fire -

The best method of extinguishment is Cooling – Bringing the Temperature of the Fuel below it's ignition point.

Ordinary Combustibles ignition temperature are very high,
so cooling the fuel is a very effective.

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FIRE EXTINGUISHERS

CLASS A Fire -

USE CLASS **A** EXTINGUISHER

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CLASS B Fire -

The most effective way to extinguish a liquid or gas fueled fire is by inhibiting the chemical chain reaction of the fire, which is done by **dry chemical** extinguishing agents, although smothering the Oxygen with CO_2 or foam is also effective.

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CLASS B Fire -

USE CLASS **B** EXTINGUISHER

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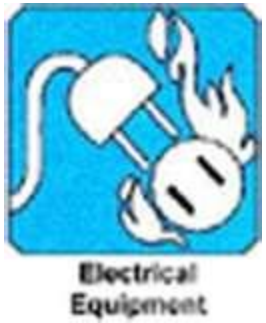
CLASS C Fire -



While this fire is, or could possibly be electrically energized, it can be fought with any extinguishing agent rated for electrical fire. CO_2 and dry chemical extinguishers are best suited to extinguishing this sort of fire.

Once electricity is shut off to the equipment involved, it will generally become an ordinary combustible (Class A) fire.

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CLASS C Fire -

USE CLASS **C** EXTINGUISHER

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CLASS D Fire -

Metal fires be fought with **dry powder** extinguishing agents. Dry Powder agents work by smothering and heat absorption.

Water and other common firefighting materials can excite metal fires and make the fire worse.

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FIRE EXTINGUISHERS

CLASS D Fire -

USE CLASS **D** EXTINGUISHER

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FIRE EXTINGUISHERS

NOTE DIFFERENCE

FLAMMABLE

B C

LIQUIDS

D

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FIRE EXTINGUISHERS

How To USE a Fire EXTINGUISHER

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FIRE EXTINGUISHERS

How To USE a Fire EXTINGUISHER

P. **A.** **S.S.**

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FIRE EXTINGUISHERS

REVIEW – TYPE OF EXTINGUSHER

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FIRE EXTINGUISHERS

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FIRE EXTINGUISHERS

REVIEW – TYPE OF EXTINGUSHER

Make sure Pressure is good before committing Extinguisher use.

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FIRE EXTINGUISHERS

REVIEW – TYPE OF EXTINGUSHER

CLASS D – <u>NOT</u> a B/C