THE TECHNOLOGY OF FIRE

DRONESVIP | CIVIL AERONAUTICAL TRAINING CENTER

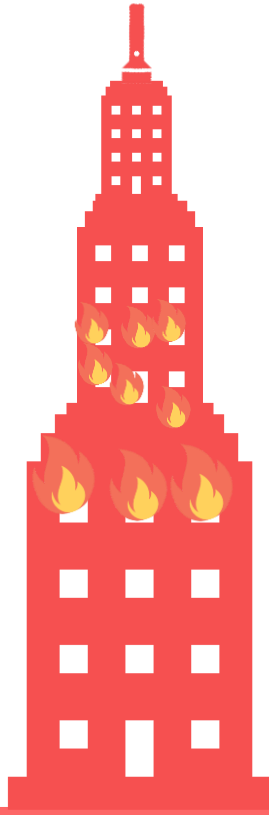
CONCEPTOS

COMBUSTION

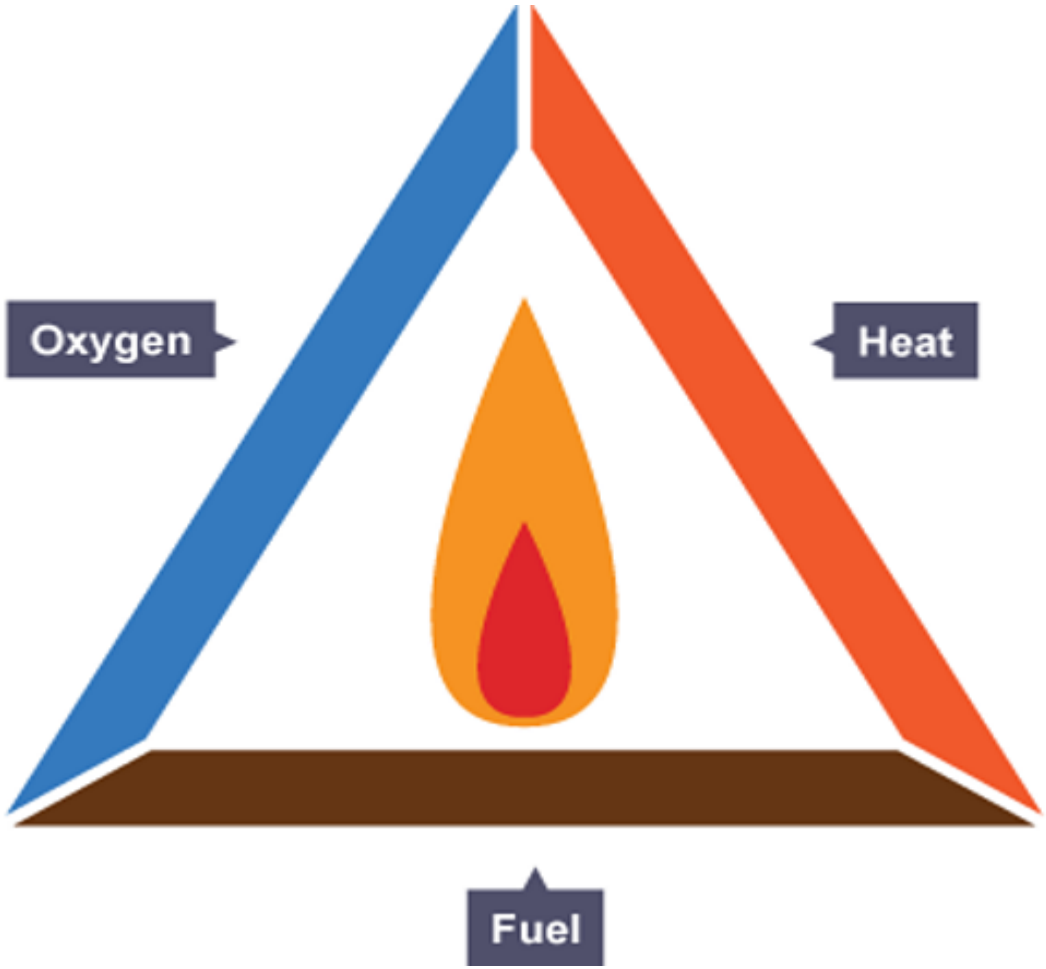
Combustion is a chemical reaction of oxidation, between a combustible material and an oxidizer, caused by an energy source.

WHAT IS FIRE?

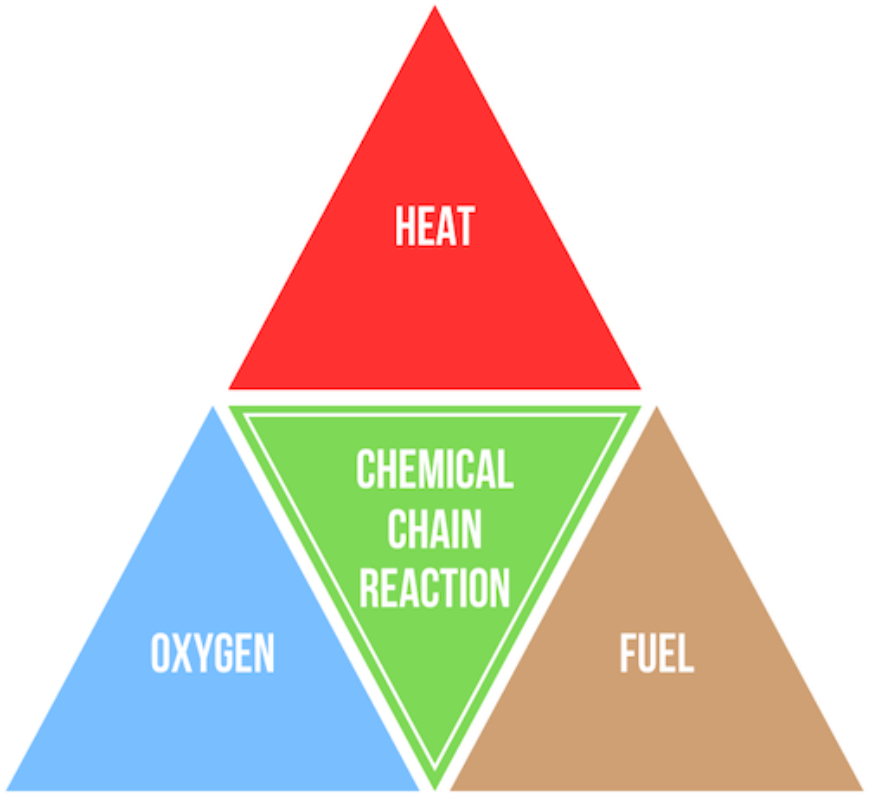
It is the manifestation of combustion, which is a chemical reaction of rapid oxidation, with the release of heat (exothermic) and light energy. Several components are involved in it.



COMBUSTION COMPONENTS



TETRAHEDRON OF FIRE



Chain Reaction

For the combustion process to be sustained, there must be a chemical chain reaction. This occurs because the heating of fuels generates the formation of highly reactive particles, known as free radicals. These burn rapidly, bringing more heat to the process that has been started.

Heat Energy

The activation energy can have several origins, and can be:

- Chemical heat energy (decomposition, combustion, etc.).
- Mechanical heat energy (friction, compression, etc.).
- Nuclear heat energy (nuclear fission and fusion).
- Electrical heat energy (resistance, static, electric arc, discharge).

Heat Transmission

Like all energy, heat is not destroyed or lost, but is transmitted. It always does so from a body that has more heat to one that has less.
There are three forms of heat transmission:

- Conduction
- Convection
- Radiation

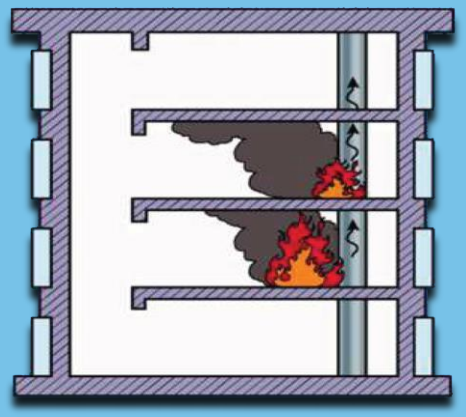
Heat Transmission

Conduction

1

It is produced in solids that are in contact with the heat source and occurs thanks to a characteristic of the material called "thermal conductivity".

VERTICAL

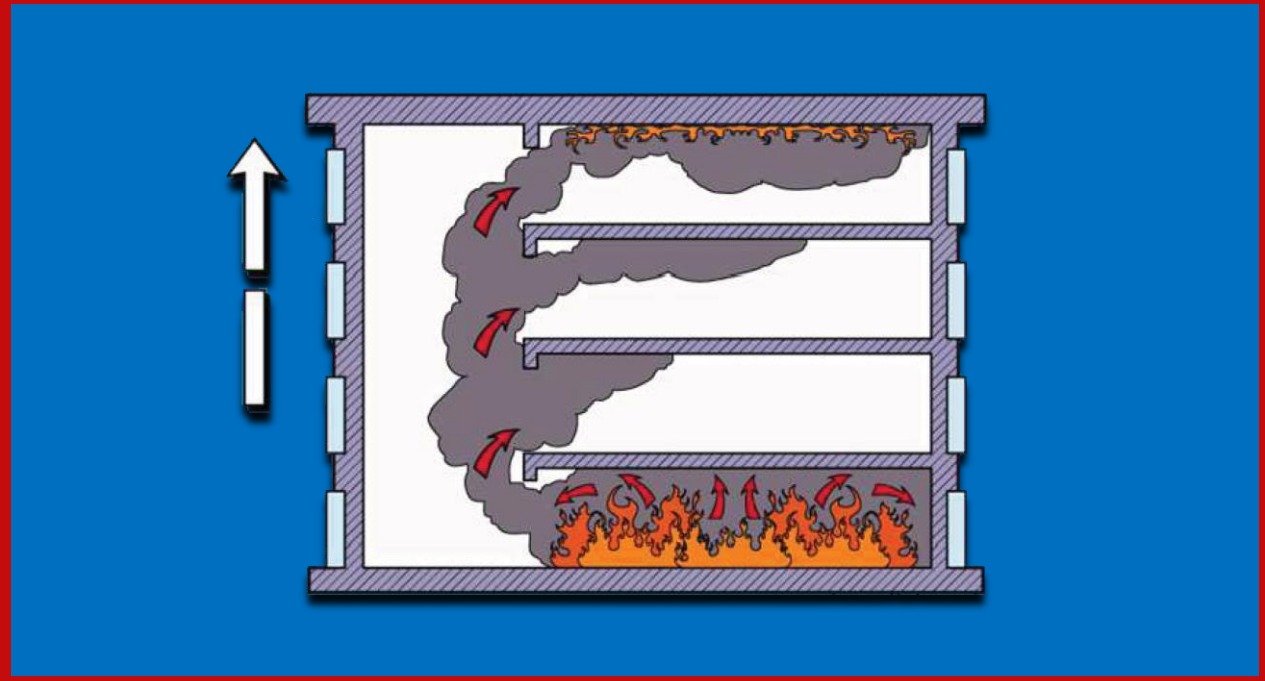


HORIZONTAL

Possibility of spreading the fire in two directions

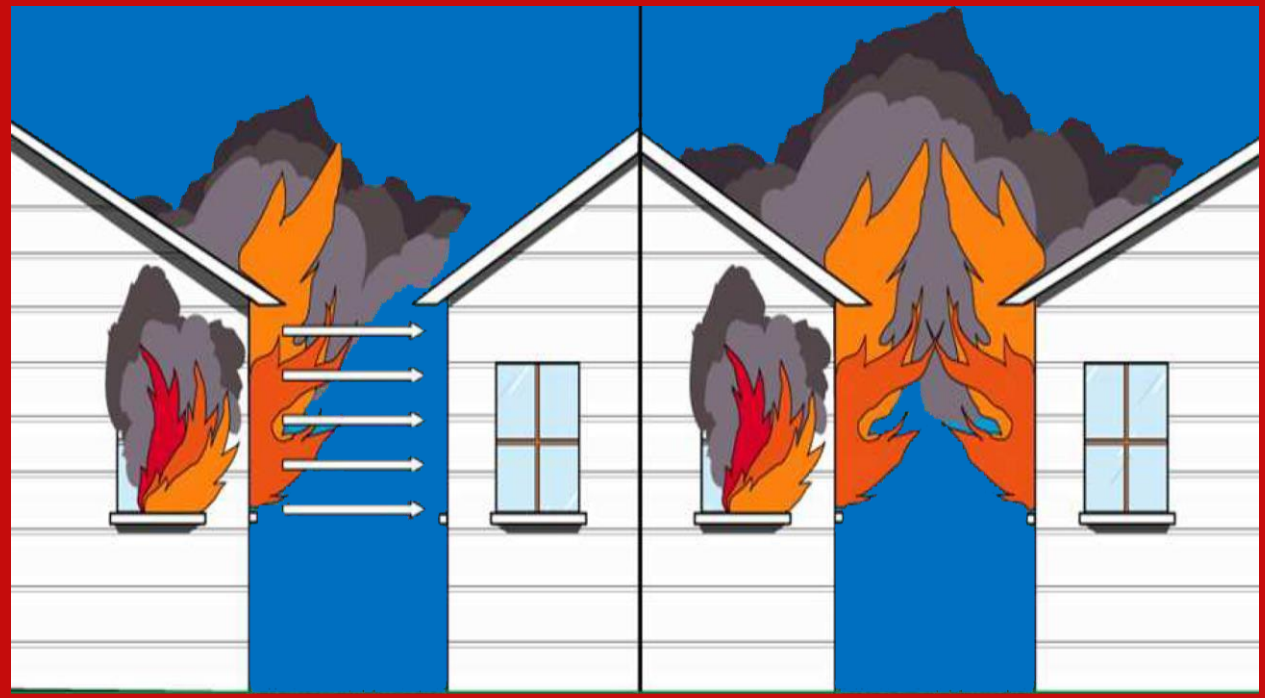
Convection 2

It is the transfer of heat by means of a liquid or gaseous fluid, which when heated, rises, generating a circulation, defined by temperatures.



Radiation 3

This type of transmission does not require a specific medium, because it propagates through electromagnetic waves (it occurs in the range of infrared waves).



FUEL TYPES

TYPES

SOLID FUELS

Those that after burning leave embers or embers as a product. Textiles, paper, wood, cardboard, garbage.

Ignition occurs when there is a gaseous state generated by the solid. This is achieved by exposing the fuel to heat, causing it to undergo a chemical decomposition called pyrolysis.

LIQUID FUELS

Liquid substances that go into combustion, such as alcohols, hydrocarbons and their derivatives. Also included in the classification are some solids that liquefy when heated (paraffins, stearin, among others).

As in solids, what goes into combustion is a released gaseous phase.
In this case by evaporation of the liquid, given by the heating of the latter.

It must be taken into account how they are contained and their volatility and rapid diffusion in the surrounding atmosphere. Gases and vapours, due to their form of diffusion, tend to remain in contact with the source.

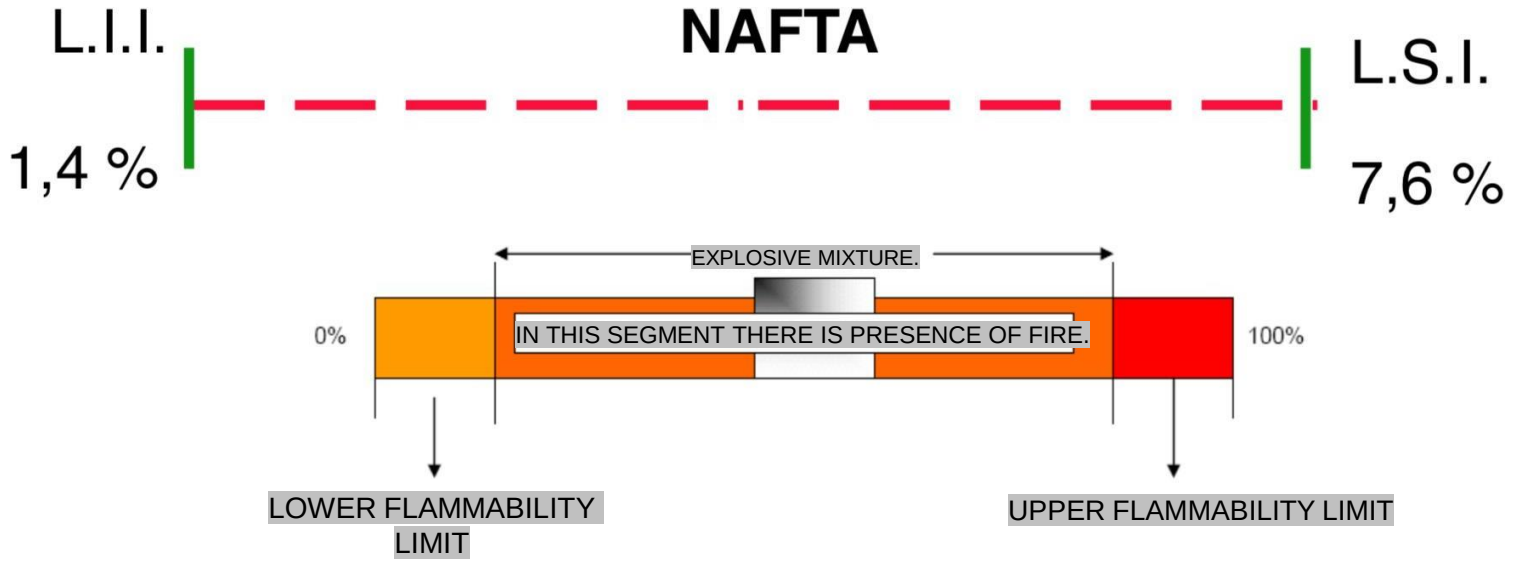
GASEOUS FUELS

Due to their state of aggregation, they are already in a condition to combust, requiring an adequate heat source and air flow.

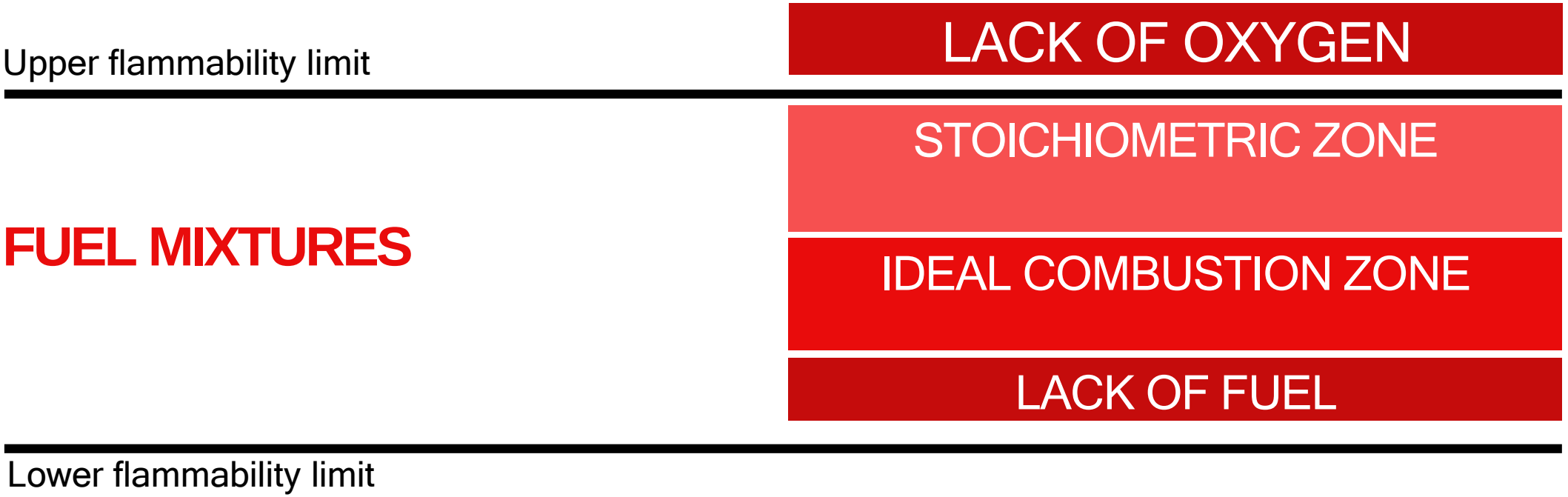
FLAMMABILITY LIMITS

DEFINITION: The percentage of a substance in the air that will burn once it is turned on. Most substances have a maximum (very rich) and a minimum (very poor) flammability limit. All flammable liquids have two flammability limits; one lower and one higher.

EXAMPLE: FUEL



FUEL-AIR MIXTURES



EFFECTS OF COMBUSTION RESIDUES AND EMISSIONS

The combustion of any type of fuel generates heat, fumes, toxic gases; that produce an atmosphere harmful to human health, during and after exposure. The most prolonged, direct and therefore risky exposure is that of firefighters and brigade members who work to extinguish these processes.

Heat effects

- Heat stroke or hyperthermia.
- First-, second-, or third-degree skin burns.
- Airway burns.

Oxidizer

It is the element that allows combustion to be activated. In order for fire to occur, there must be a mixture between the vapours or gases released by the fuel and the air.

COMBUSTION PHASES

To understand how a fire evolves and spreads, we can divide it into three clear phases:

Incipient Phase

Free combustion phase

Latent phase

Incipient Phase

- It is the initial phase of fire.
- Large smoke release as the material is not being smoked.
- consuming properly.
- It can be combated by using portable fire extinguishers.
- The flame can reach 530oC.
- The temperature is rising in the enclosure.

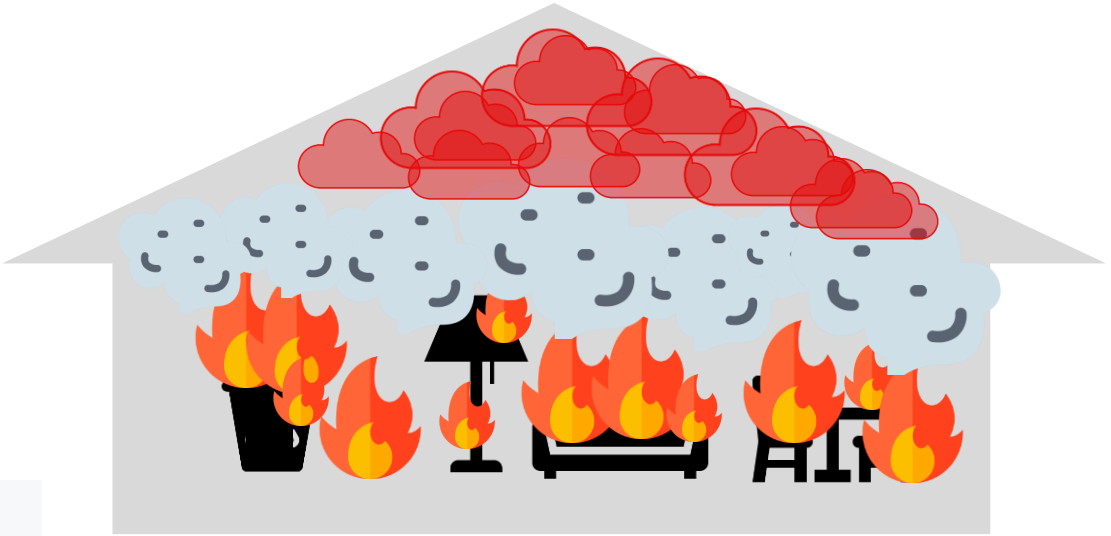
1

INITIAL STAGE
Rising hot gases.
Enclosure air 20.5%
Ambient temperature > 40ºC
Flame temperature > 530ºC

Free combustion phase

All materials found in the place are susceptible to combustion.

- The temperature has risen, above 700°C.
- The smoke decreases.
- Other means of extinguishing and suitable protection elements are required.



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FREE COMBUSTION STAGE

Reduced O2 supply

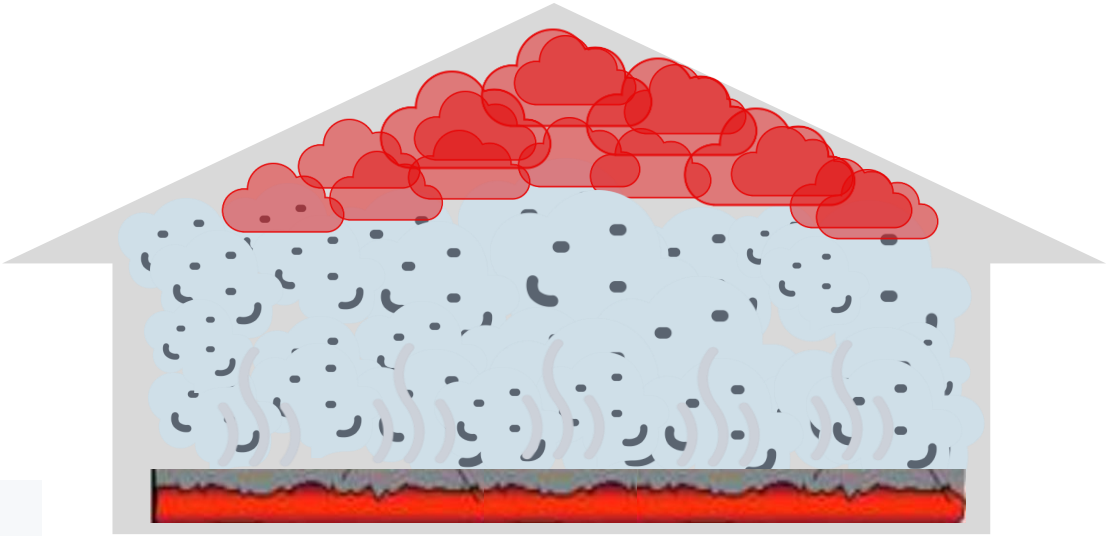
Ambient temperature > 704ºC

Flashover possibility

Latent phase

Oxygen is not found in adequate amounts.

- Possibility of re-ignition, if this element is supplied.
- Stage in which surfaces must be cooled and ventilated, due to the large
- smoke generation.
- Smoke explosions or backdraft phenomena can occur.



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FLAMELESS BURNING STAGE

Oxygen < 15%

Ambient temperature > 600ºC

Significant amounts of CO Possibility of backdraft

SMOKE EFFECTS

Among the most common are decreased visibility, irritation of the respiratory mucous membranes, and the conjunctivae of the eyes.

As they are solid particles of fuel that has not been burned, it causes disorientation and prevents following a safe route of entry and exit, which exposes the person to being trapped in an atmosphere with other potential dangers.

REMEMBER THAT SMOKE IS STILL A FUEL

SMOKE EFFECTS

Due to their effects and mode of affection and diffusion in the body, we can classify these pollutants into categories such as:

Simple asphyxiating gases

1

Those that displace oxygen from the atmosphere, generating a deficiency. The percentage of oxygen in the air is 21%, when it decreases and as it does, dysfunctions occur in the body

Carbon dioxide (CO2)

Chemists asphyxiating gases

2

Those that have a higher affinity for hemoglobin in the blood than oxygen. So they are more easily captured and distributed to the body's tissues, interfering with processes at the cellular level.

Carbon monoxide (CO), hydrogen cyanide (HCN).

Irritating gases

3

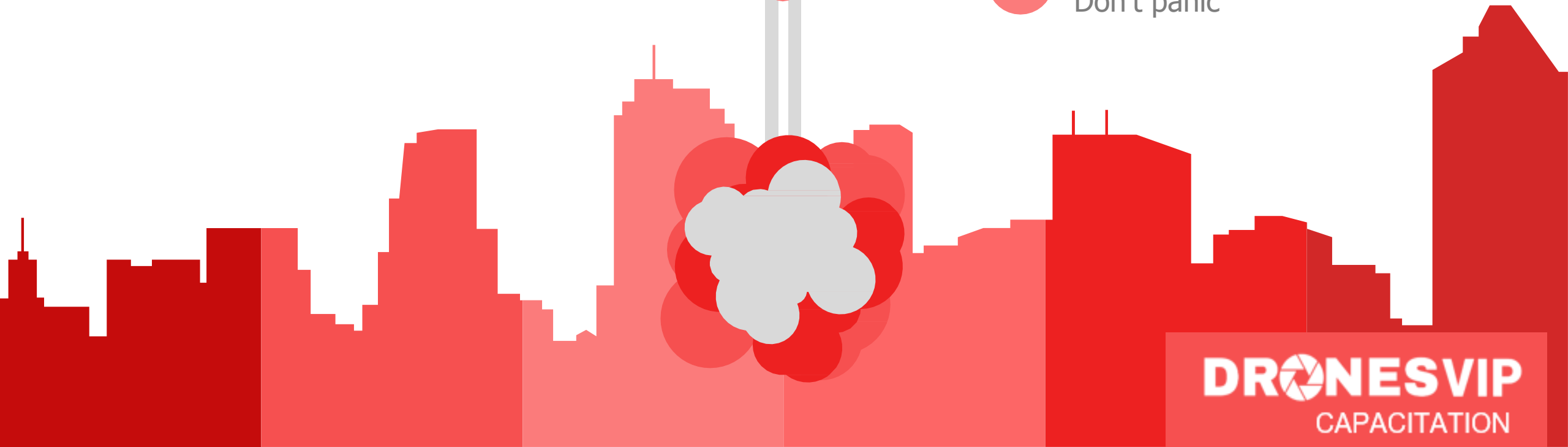
Among the most important irritating gases are chlorine, phosgene, sulfur dioxide, hydrogen chloride or sulfide, nitrogen dioxide, ozone and ammonia.

WHAT TO DO IN CASE OF FIRE

3 Call the Fire Department

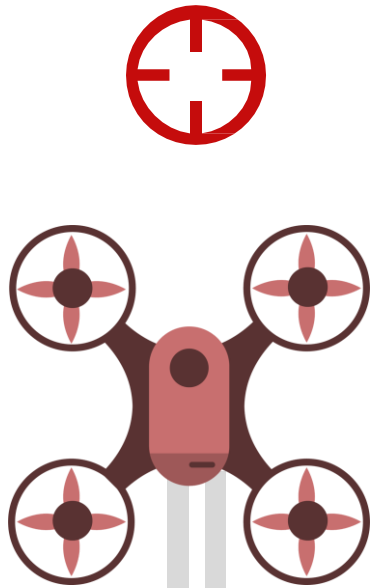
Locate fire and its intensity 2

1 Stay calm. Don't panic



DRONESVIP CAPACITATION

WHAT TO DO IN CASE OF FIRE



Dampen a cloth and cover your nose and mouth **6**

5 Use emergency exit

Use the fire extinguisher **4**

QUESTIONS TIME!

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CAPACITATION