



National
Operational
Guidance

Control measure

Select an appropriate firefighting
method



NFCC
Fire Central
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Control measure knowledge

The fire tetrahedron identifies the four components needed for burning to take place. To extinguish a fire it is largely a matter of depriving the fire of one or more of these factors, so methods of extinguishing fire can be classified in terms of removing these factors.

All fires can be extinguished by cooling, smothering, starving or by interrupting the combustion process to extinguish the fire.

- **Cooling:** limiting temperature by increasing the rate at which heat is lost from the burning material
- **Smothering:** limiting oxygen by preventing air from reaching the seat of the fire to allow the combustion process to reduce the oxygen content in the confined atmosphere until it extinguishes itself
- **Starving:** limiting fuel by removing potential fuel from the vicinity of the fire, removing the fire from the mass of combustible materials or by dividing the burning material into smaller fires that can be extinguished more easily
- **Interrupting:** inhibiting the chemical chain reaction by applying extinguishing media to the fire that inhibit the chemical chain reaction at the molecular level)

Cooling

One of the most common methods of extinguishing a fire is by cooling with water. This process depends on cooling the fuel to a point where it does not produce sufficient vapour to burn, with the reduction in temperature dependent on the application of an adequate flow of water to establish a negative heat balance. For example, if the rate at which heat is generated by combustion is lower than the rate at which it is lost from the burning material, burning will not continue.

To extinguish a fire by cooling, the rate at which heat energy is lost from the burning material must be increased by removing some of the heat energy. This reduces the temperature of the burning mass, reducing the heat release rate. Eventually, the rate at which heat is lost from the fire may be greater than the rate of heat production and the fire will die away.

When water is applied, it undergoes changes as it absorbs heat from the fire:

- Its temperature will rise



- It may evaporate (boil)
- It may react chemically with the burning material

To achieve maximum effect, the quantity of heat energy absorbed should be as great as possible. The properties of a good cooling agent are therefore:

- High specific heat capacity (thermal capacity)
- High latent heat of vaporisation
- High heat of decomposition

Water is a good cooling agent because of its high thermal capacity and latent heat of vaporisation. This, combined with the fact it is available in large quantities, makes it by far the most widely useful fire extinguishing agent.

The role of decomposition is insignificant in the case of water but very relevant with certain substances, such as carbon dioxide, that absorb heat in this way.

Smothering

If the oxygen supply to the burning material can be sufficiently reduced, burning will cease. The general procedure is to prevent fresh air from reaching the seat of the fire, allowing the combustion to reduce the oxygen content in the confined atmosphere until it extinguishes itself, for example by:

- Snuffing out candles
- Smothering a pan with a fire blanket
- Wrapping a person in a fire blanket
- Applying a blanket of foam over the burning surface, thus separating the fuel from the air

Smothering can also be achieved by removing the oxygen in the atmosphere, thus extinguishing the fire, for example, by:

- Introducing carbon dioxide (CO₂) to the immediate vicinity of the fire
- Introducing an inert gas to the immediate vicinity of the fire, such as through systems installed to protect computer server rooms

Starvation

In some cases, a fire can be extinguished simply by removing the fuel source. This may be accomplished in a number of ways, such as stopping the flow of liquid or gaseous fuel, removing solid fuel in the path of the fire or allowing the fire to burn until all of the fuel is consumed.

Fires can be starved of fuel by removing potential fuel from the vicinity of the fire, for example:



- Back burning forestry fires
- Draining fuel from burning oil tanks
- Removing cargo from a ship's hold
- Creating firebreaks in peat, heathland and forest fires
- Removing vehicles in the proximity of the fire
- Creating firebreaks in thatch roofs
- Removing tyres not affected by the fire from a tyre dump

Interrupting the combustion process

Dry powder, Bromochlorodifluoromethane (BCF) and other halon extinguishers work by releasing atoms that interrupt the chemical chain reaction. They also create an inert gas barrier.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements for the hazards that may be encountered and the actions to be taken when selecting an appropriate firefighting method

Tactical actions

Incident commanders should:

- Select an appropriate firefighting method (i.e. cooling, smothering, starving, interrupting)
- Consider the impact of the extinguishing method on the fire, personnel, property and environment
- Consider the isolation or containment of the fire compartment