National Operational Guidance

Control measure

Gas cooling

NFCC Fire Central Programme Office

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Control measure - Gas cooling

Control measure knowledge

Gas cooling is the approach of directing variable bursts or 'sweeps' of water-fog into the hot gas layer

Essentially, this involves the distribution of finely divided water droplets into the hot gas layer using a short 'burst and pause' (or pulsing) action at the branch nozzle as a means of reducing the temperature in the fire gases to a point where the threat of an impending flashover is limited or avoided. This technique can also be used where the hot gas layer is igniting and threatening to develop into a full compartmental flashover.

In either situation, an adequate flow rate (litres per minute) and an optimum spray pattern must be available at the branch.

It is extremely important to understand that gas cooling is predominantly a means of reducing the likelihood of flashover and should not be considered as a technique for dealing with either a fast developing or post-flashover fire. In such cases a solid stream (jet) directed at the fuel base becomes the dominant technique for fire suppression.

To fully understand the effects of gas cooling, it is essential to understand what the intervention is trying to control. Once it is understood that combustion can take place within the fire gases and how and why it occurs, firefighters are more prepared to intervene effectively.

Combustion is a chemical reaction that results in heat and light being produced. The fact that it is a chemical reaction means that new chemical substances are generated. Many chemical reactions generate heat but critically a combustion reaction will also produce light. The elements essential to the initiation of a combustion reaction are sometimes described in terms of the fire triangle; an ignition source or sufficient heat together with fuel and a supporter of combustion all have to be present.

Supporter of combustion

In its simplest form, combustion is a sequence of exothermic oxidation reactions, which means that energy (heat and light) is generated as the fuel source is broken down and an oxidant is added. This oxidant is the supporter of combustion. Under normal circumstances, the oxidant is most likely to be the oxygen in air.

A number of different factors can have a significant impact on the danger and intensity of a reaction within the fire gases:

- Stoichiometric mixture (ideal mixture)
- Flammable limits
- Flash point
- Fire point
- Auto-ignition temperature
- Ventilation

Intervention

When water evaporates it expands to water vapour (steam); this can be anywhere within the ratio range of 1,700:1 and 3,400:1 depending on the temperature. When restricted to a compartment, this can have significant benefits but it also carries some risks, for example; the expansion can lead to a significant increase in pressure in the compartment.

However, when properly applied, the contraction of the fire gases can be greater than the amount of water vapour formed. The result should be a noticeable rise in the smoke layer (previously referred to as the neutral plane) in the fire compartment. This benefits effective application as the overpressure area will rise with the smoke layer (previously referred to as the neutral plane); firefighters should not be subjected to a wave of hot fire gases and visibility will improve.

Incident commanders should be aware of:

- The most appropriate firefighting media, for example, water and foam
- The most appropriate weight of intervention (litres per minute), for example, firefighting jets and hose reels
- The most appropriate method of firefighting, for example, smothering, starvation and cooling (indirect or direct cooling)
- Contingency plans that are formulated, implemented and communicated to ensure the safety of committed personnel in the risk area, for example, committing a supporting firefighting team

Strategic actions

Fire and rescue services should:

- Provide appropriate equipment and media to enable effective gas cooling tactics to be implemented
- Develop tactical guidance and support arrangements for the hazards that may be encountered and the actions to be taken when considering gas cooling tactics for fires in buildings

Tactical actions

Incident commanders should:

- Use appropriate gas cooling techniques and equipment for the internal conditions identified