

ACTIVE FIRE PROTECTION GUIDE HFC-125

This document has been produced by the RISCAuthority Active Suppression & Detection working group to provide information and outline guidance on the application of HFC-125.

Summary

Refer to AFIG-01 Overarching Active Fire Protection Guide – All Technologies.

HFC-125:

- is a 'compartment' and 'local application' fire protection system
- must be designed to ensure extinguishment
- performance greatly depends on ventilation and sealing of the compartment it is protecting
- whilst it is not an ozone depleting gas, it has a significant global warming potential and long atmospheric lifetime
- is not suitable for use in normally occupied spaces without controls to avoid occupant raw agent exposure
- will produce hydrogen fluoride in a fire which can be harmful to personnel and damage equipment.

What is HFC-125?

HFC-125 pentafluoroethane is a gaseous firefighting agent that is a hydrofluorocarbon (HFC) comprising elements of carbon, hydrogen, and fluorine. It is also known as FE-25, Ecaro, R-125, and MH125, and is marketed as a clean agent fire suppressant which meets NFPA 2001 standard for clean agent fire extinguishing systems.

HFC-125 systems can be used for compartment protection.

How it works

The fluid is stored as a liquid in cylinders pressurised with nitrogen to 42 bar. HFC-125 is required to discharge 95% of the agent within 10 seconds or less at a pressure of circa 9.0 bar at the nozzles.

HFC-125 is stored as a liquid but discharges as a gaseous vapour. Due to the storage of the liquid, this requires the storage cylinders to be in close proximity to the protected compartment/area. It can be permitted to be stored away from the hazard and used as a directional valved system for more than a singular compartment. HFC-125's main mode of operation is by the removal of heat from the fire as the agent breaks down within the flame. Some chemical activity may also occur.

Systems consist of cylinder storage of the agent, fixed discharge piping, and nozzles spaced within the enclosure(s). The system can be automatic or manually activated. The system will be designed to shut down any air conditioning system, close openings and doors, and control all sources of oxygen and fuel (energy) prior to discharge.

Challenges and considerations

HFC-125 can be an effective fire suppression system which extinguishes fire and prevents re-ignition. The raw agent for typical fire protection uses concentrations of 8.0%-13%, which could present a risk to people, and so should not be used in normally occupied spaces without control measures. The No Observable Adverse Effects Level (NOAEL) and Lowest



Observable Adverse Effects Level (LOAEL) of the raw agent are 7.5% and 10% respectively. Please see AFIG-01 for explanation. Limited damage to equipment is achievable when engineered and installed by a competent qualified fire suppression systems installation company. Under the action of fire, hydrogen fluoride and halogen acids are a by-product of its extinguishing action. The amount of hydrogen fluoride produced is a function of the fire size, and generated concentrations can be significant when considering human exposure and equipment damage, and this must be appreciated in the fire safety management plan. Hydrogen fluoride forms a very aggressive corrosive acid when dissolved in water and is capable of damaging any exposed metals and/or glass. Similarly, the release of any gaseous agent within a fire compartment will cause mixing of agent and fire products at all levels within the enclosure, which might impair escape through loss of visibility, acid gas irritation of eyes and lungs, and inhalation of toxic products such as CO and CO₂.

Like any gaseous system it is imperative that the enclosure it is protecting is designed to vent safely during discharge and hold on to the agent for the prerequisite time period of 10 minutes thereafter to secure all fire risks. This is normally achieved by conducting an enclosure integrity test, the data from which will be used to design a specific vent device. During discharge, HFC-125 can result in both under and over pressures. Best practice dictates that the pressure relief device should direct gas and fire products from the protected enclosure to the outside via a route that will not lead to exposure of people to the emitted gases.

In keeping with all chemical agents of the type capable of hydrogen fluoride production, after deployment in a real fire scenario, all equipment should be examined for fire damage and contamination by soot/other fire products and acid corrosion – especially high voltage switchgear that might incur resistive heating at corroded contactors.

Applicable standards

BS EN 15004-1:2019. *Fixed firefighting systems. Gas extinguishing systems. Design, installation, and maintenance.*

BS EN 15004-4:2020. *Fixed firefighting systems. Gas extinguishing systems. Physical properties and system design of*

gas extinguishing systems for HFC 125 extinguishant.

16/30339864 DC. BS EN 15004-1. *Fixed firefighting systems. Gas extinguishing systems. Part 1. Design, installation, and maintenance.*

14/30274909 DC. BS EN 15004-1. *Fixed firefighting systems. Gas extinguishing systems. Part 1. Design, installation, and maintenance.*

14/30274948 DC. BS EN 15004-4. *Fixed firefighting systems. Gas extinguishing systems. Part 5. Physical properties and system design of gas extinguishing systems for HFC 125 extinguishant.*

LPS 1204 – 3.1 *Requirements for firms engaged in the design installation, commissioning, and servicing of gas extinguishing systems.*

LPS 1230 – 1.2 *Requirements for fire testing of fixed gaseous fire extinguishing systems.*

BS ISO 14520-1 *Gaseous fire-extinguishing systems – Physical properties and system design – Part 1: General requirements.*

NFPA 2001:2018 *Standard on clean agent fire extinguishing systems.*

F.M. Global D-S 4.9 *Halocarbon and Inert gas (clean agent) Fire extinguishment systems 2019.*

BS 5839-1:2017 *Fire detection and fire alarm systems for buildings. Code of practice for design, installation, commissioning, and maintenance of systems in non-domestic premises.*

BS7273:2006 *Electrical actuation of gaseous total flooding extinguishing systems.*

UL 2166:2019 *Standard for Halocarbon Clean Agent Extinguishing System Units.*

Effective for use with (subject to establishing HF corrosion resistance):

- laboratories/telecommunication rooms
- computer and server environments
- control rooms/archive storage
- halon and CO₂ replacement
- Class A, Class B, and Class C Fires
- electrical equipment (non-conductive).

Has limitations in relation to:

- Class D Fires
- occupied spaces (not suitable based on NOAEL and LOAEL)
- combustible metals (sodium, potassium, magnesium, etc.)
- chemicals containing their own oxygen supply, such as cellulose nitrate
- requires the enclosure to be gas tight
- requires the air conditioning and openings to be closed/shut down on detection
- where equipment is sensitive to acid gases (hydrogen fluoride)
- pressure relief required during discharge.

Approvals

Underwriters Laboratory, Underwriters Laboratory Canada, F.M. Global, EPA SNAP Report.

Best practice

Discharge of the gas within the enclosure is by means of a suitable fire detection system, normally a conventional two stage detection system, in which the first detection would raise the alarm, and the second detection would discharge the gas. Fully addressable systems and VESDA/air pipe sampling detection can also be used.

Operation of the system should be interlocked with isolation of all sources of heat, energy, fuel, and conveyancing, and also invoke the main building's fire alarm system.

Mistakes at design stage can be costly in terms of performance and lead to fires not being extinguished. Specialist computer calculation software is essential to ensure that the design of the enclosure(s) (floor void, room void, and ceiling void) discharge the correct amount of extinguishing agent into each separate volume using the correct selection of nozzles and pipe sizes. Spacing of nozzles is also critical to ensure that an even flow of agent is distributed throughout the enclosures to interrupt the combustion process.

Best uses of HFC-125

'Asset protection' – HFC-125 is generally designed as an extinguishing system for use in business critical areas to protect specific assets from fire damage (e.g. servers).

'Life Safety' – Not installed for life safety, however, as a full system inclusive of fire detection system, it can aid in early detection and evacuation.

'Property protection' – Will only be considered as an extinguishment system. Failure of extinguishment and the fire will rekindle and continue unopposed potentially producing prolific quantities of hydrogen fluoride.

Environmental credentials

HFC-125 has 0 ozone depleting potential, a global warming potential of 3500, and an atmospheric lifetime of between 29-33 years. Whilst HFC-125 contains fluoride, there are no current or outright bans anywhere. However, there are a few notable exceptions where certain countries have created barriers limiting the ability to sell HFC-125 fire protection systems. Because HFC-125 has a global warming potential greater than 1, it falls under the F-gas Regulations, and as such the implications for system maintenance of HFC-125 systems also needs to be considered. Generally, gas suppression systems are serviced bi-annually but if the quantity of HFC-125 is 143 kg or more and there are no leakage detection devices fitted, then the service inspection visits should be increased to every three months.