ACTIVE FIRE PROTECTION GUIDE
INERGEN/IG541

This document has been produced by the RISCAuthority Active Suppression & Detection working group to provide information and outline guidance on the application of Inergen/IG541.

Summary

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

Inergen:

- 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
- has good environmental credentials
- has few toxicity issues aside from asphyxiation potential from homogeneity challenges and poor design.

What is Inergen/IG541?

Inergen/IG541 is a blend of naturally occurring gases, Nitrogen (42%), Argon (50%), and a small amount of Carbon Dioxide (8%). The amount of agent required depends upon the oxygen index of the fuels being protected. In typical applications, the agent will be added to achieve a residual oxygen concentration of 12.5%, but some liquid fuels might require a much lower value for extinguishment.

In an accidental discharge, systems designed for 12.5% residual oxygen can be safe for a short period of time for healthy persons, but where a fire may have already consumed oxygen, or the design demands more agent, occupation during discharge might be dangerous. Below 12%, the potential for harm increases disproportionately as available oxygen to support life is reduced. Between 12%-10% the maximum exposure time is 3 minutes, 10%-8% 30 seconds, and below 8% must be an unoccupied compartment (figures provided for a healthy adult).

Inert gas system quantities are determined from the experimental evaluation of the 'extinguishing concentration' for the fuel and on to this is added a safety factor of 30% to give the 'design concentration'.

How it works

Inergen/IG541 systems are total flooding gaseous extinguishing systems consisting of a fixed supply of the gas within high pressurised cylinders (up to 300 bar) connected to a piping system with nozzles located in accordance with design manuals to direct the agent into a protected enclosure (floor/room/ceiling void spaces). The systems can be manually operated but are usually operated via a fire detection system.

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.

It is an invisible clear gas insuring a safe and visually unobscured exit from the affected area if discharged accidentally. In a fire situation the discharge will mix the smoke to all levels of the compartment, and this needs to be carefully considered in the safety operating protocols.

Gaseous systems are 'extinguishing systems' only. Suppression without extinguishment is a failed design.

Challenges and considerations

Inergen/IG541 can be an effective fire protection system which extinguishes fire and prevents re-ignition with no risk to people or damage to equipment when engineered and installed by a competent qualified fire suppression systems installation company.

Inergen/IG541 can be effective for extinguishing fires within enclosures that may be populated when the system is discharged subject to the considerations previously described, although it should be avoided if possible. The No Observable Adverse Effects Level (NOAEL) and Lowest Observable Adverse Effects Level (LOAEL) of the raw agent are 43% and 52% respectively. Please see AFPG-01 for explanation. The gas does not and could never create a reaction with a fire to create harmful toxic or corrosive by-products over and above those produced by the fire itself. The inclusion of CO_2 in the Inergen mix increases the body's breathing rate and is purported to allow the body to compensate for the lower oxygen level, although the benefits of this will be different for an accidental discharge of agent, and discharge during a fire when other toxic by-products may be present.

Design standards ensure that an extinguishing concentration of gas should remain within the compartment above the height of the highest risk for at least 30 minutes to reduce the likelihood of reignition. Sealing of the enclosure is essential. This will be determined as part of the design by the conduct of a 'door-fan test' to establish and locate leaks, and the fitment of a specific vent to protect the enclosure from overpressure damage during discharge, and to channel potentially harmful fire gas out of the enclosure via a route that will not endanger people.

Applicable standards

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

BS EN 15004-10:2017. *Fixed firefighting systems. Gas extinguishing systems. Physical properties and system design of gas extinguishing systems for IG-541*.

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*.

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*.

Effective for use with:

- laboratories/telecommunication rooms
- computer and server environments
- control rooms/archive storage
- halon replacement
- conventional detection systems
- Class A, Class B, and Class C Fires
- electrical equipment.

Has limitations in relation to:

- Class D Fires
- combustible metals (Sodium, Potassium, Magnesium, etc.)
- chemicals containing their own oxygen supply, such as cellulose nitrate
- only for use in total flooding applications and some local application scenarios
- requires the enclosure to be gas tight
- more cylinders required for halon replacement than some alternatives.

Best practice

Inergen/IG541 systems need to be designed carefully to ensure that the discharge of gas provides the correct concentration within the enclosure, within the specific time frame to reduce the oxygen level to diminish the opportunity for the fire to develop and allow it to be extinguished. Once discharged, the gas concentration within the room needs to be 'held' to ensure that the fire cannot re-ignited. This is done by ensuring that the enclosure is air-tight by a room integrity test. This is undertaken by carrying out a door-fan test to investigate the fissures/unsealed air paths that could allow the enclosure to leak out the gas, and also allow natural air back into the enclosure. Computer calculations from the fan test confirm the natural air leakage of the enclosure to verify if this can be accommodated to meet the 'hold times' for the gas. Where this is deemed to be insufficient, smoke is added to the fan test to provide visualisation of the leakage paths, which can then be sealed off as required.

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, pipe sizes, and orifice plates within the nozzles. Spacing of nozzles is also critical to ensure that an even flow of gas is distributed throughout the enclosures to reduce oxygen levels within the specified discharge time required.

Best uses of Inergen/IG541

'Asset protection' – Inergen/IG541 is specifically designed as a total flood 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.

Environmental credentials

Inergen/IG541 has excellent environmental credentials and does not have any harmful hydrogen fluoride producing chlorofluorocarbons (CFCs) within the gas due to its mixture of naturally occurring gases, and is considered an inert gas that has no adverse effect to the ozone layer, zero global warming potential, and no atmospheric lifetime. The suppression agent is not considered to provide any harm to the environment and does not fall within the 'F-gas Regulations' as it does not contain any fluorinated greenhouse gases.