



A Comprehensive Comparison

HFC-227ea vs. Inergen
Fire Extinguishing Systems

A Comprehensive Comparison HFC-227ea vs. Inergen[®]




When protecting critical assets from fire, choosing the right clean agent system is crucial.

By definition, a clean agent is a gaseous fire suppressant that is electrically non-conducting and leaves no residue upon evaporation. This makes it ideal for protecting high-value items like historical artifacts or sensitive electronic equipment.

Fire suppression systems, also known as gas systems or clean agent systems, are typically of two types—halocarbon or inert. Two leading clean agent brands are HFC-227ea (halocarbon) and Inergen (inert). Both can effectively suppress and extinguish Class A, B, and C type fires. However, Inergen offers several key advantages that make it the preferred choice for most applications requiring high levels of safety, sustainability, and asset protection.

HFC-227EA (HEPTAFLUOROPROPANE, HFC-227EA) FIRE EXTINGUISHING SYSTEMS

An Overview



While HFC-227ea is highly effective in fire suppression and requires minimal storage space, it is not without significant disadvantages. The chemical agent exhibits a moderate global warming potential, and its release into the atmosphere can pose health risks when inhaled at high concentrations. Since 2020, the use of "virgin" HFC-227ea has been prohibited, and in the event of a system discharge, only recycled HFC-227ea is permitted for replacement.

SUSTAINABILITY FACTORS

HFC-227ea is composed of hydrofluorocarbons (HFCs), substances currently under global efforts to be phased down, and eventually phased out, as part of international agreements like the Kigali Amendment to the Montreal Protocol. Although HFC-227ea is less harmful compared to other chemical agents, it possesses a global warming potential of 3,500 over a century. To put this into perspective, 1 kg of HFC-227ea has the same global warming potential as 3 tonnes of CO₂. The ongoing phase-down of HFC-227ea, aiming for a total ban by 2030, coupled with decreasing production, this is likely to have led to increased costs per kilogram of agent over time.

In Europe, HFC-227ea is treated as a waste product, with its production, storage, transportation, and usage tightly controlled under F-Gas regulations.

Personnel handling HFC-227ea are required to have F-Gas certification to prevent illegal venting into the atmosphere. The Environmental Protection Agency (EPA) has introduced additional restrictions this year, increasing owner responsibilities and maintenance requirements.

The American Innovation and Manufacturing (AIM) Act, passed in late 2020, mandates a phased reduction in HFC production and use in the U.S., starting in 2022. The goal is to cut HFC usage to 15% of baseline levels by 2036, encouraging the industry to develop and adopt more sustainable alternatives.

While HFC-227ea is being phased out according to this schedule, existing systems remain viable due to the infrequent need for discharge and the availability of recycled gas. This allows HFC-227ea systems to continue operating for up to 20 years, delaying the immediate need for replacement despite the rising costs of virgin HFC agents like HFC-227ea due to dwindling supplies.

HOW HFC-227EA WORKS

HFC-227ea

HFC-227ea is a chemical agent known as Heptafluoropropane, which disrupts the fire triangle. It interferes with the chemical chain reaction of combustion and removes heat from the fire. HFC-227ea can achieve extinguishing concentrations faster than Inergen, in as little as 10 seconds. Design concentrations vary according to the relevant standard and the type of agent, ranging between 4.5% and 8.5% by volume. HFCs have been identified as global warming gases and are covered by the Fluorinated Greenhouse Gases (F Gas) regulations.

HFC-227EA ADVANTAGES:

- Offers extremely fast fire suppression, acting within 10 seconds.
- Requires a small storage footprint for cylinders.
- Utilizes low-pressure cylinders (e.g., 25 bar), making them safer and easier to handle.
- Features straightforward installation processes.
- HFC-227ea is widely recognized and used globally.




HFC-227EA DISADVANTAGES:

- A chemical containing PFAS.
- Multi-zone installations are difficult to make.
- A 2-way pressure relief damper is required.
- Cylinders need to be close to the protected area.
- Hazardous decomposition occurs after activation.
- The AIM Act in the USA mandates the phase-down of HFC-227ea by 2037.
- The F-Gas Regulation in Europe mandates the phase-down of HFC-227ea by 2030.
- The production of virgin HFC-227ea is restricted; the use of recycled HFC-227ea must be tested by a laboratory.
- It is illegal to discharge HFC-227ea in Europe.
- Anyone working with HFC-227ea must be trained and certified under F-Gas Regulation.
- An extraction system is required to discharge the gas in the event of a fire.
- High cost to refill.
- Misuse or intentional inhalation of HFC-227ea can lead to death without warning.
- Vapors are heavier than air and can cause suffocation by reducing the oxygen available for breathing.
- HFC-227ea has a Global Warming Potential (GWP) of 3,500.

INERGEN (IG541)

FIRE EXTINGUISHING SYSTEMS

An Overview



Inergen comprises naturally occurring inert gases: nitrogen, argon, and carbon dioxide. It has zero ozone depletion potential and zero global warming potential, offering a truly green solution as environmental sustainability becomes increasingly crucial.

Inergen is a mix of natural gases available in atmospheric air, making it future-proof for long-term cost projections.

Unlike other fire suppression solutions, Inergen poses no safety concerns for occupied spaces, having been fully tested on humans and medically evaluated. It is approved by leading authorities worldwide for use in normally occupied areas.

Inergen extinguishes fires by reducing the oxygen level in a room to below 15%, the point at which most combustibles will no longer burn. Simultaneously, the carbon dioxide in Inergen stimulates the human body's uptake of oxygen, protecting anyone who might be trapped in the fire area from the effects of lowered oxygen levels.

Unlike chemical agents, Inergen does not form harmful decomposition products in a fire and is effective on all common types of fires (Class A, B, and C). Unlike Halon, its modern chemical counterparts, or pure carbon dioxide systems, Inergen does not form fog when discharged, ensuring that exits remain fully visible.

Stored as a gas, Inergen avoids condensation or thermal shock upon discharge into the protected area. The final Inergen/air mixture has approximately the same density as air, allowing suppression concentrations to be maintained longer than with traditional fire protection gases. Consequently, escape routes are not obscured, enhancing safety during evacuation.

Moreover, because Inergen/IG541 is a mixture of naturally occurring gases, it does not produce toxic or corrosive decomposition products in a fire. Its mixture specification ensures excellent retention time within a risk area, with a relative density close to that of air, resulting in outstanding hold time performance.

HOW INERGEN WORKS

Inergen

Inergen (IG541) consists of a blend of naturally occurring gases in the atmosphere: 52% nitrogen, 40% argon, and 8% carbon dioxide. It reduces the oxygen level from 20.9% to between 12-15%, thereby displacing oxygen. This reduction in oxygen suppresses the combustion reaction and quickly extinguishes the fire before it can spread.

INERGEN ADVANTAGES:

- Exhibits very good retention characteristics, maintaining effective concentration levels for longer durations.
- Uses high-pressure cylinders (200 bar, & 300 bar), allowing for cylinder storage over 300m away from the protected area.
- Eliminates the need for cleaning up or repairs after discharge, as it leaves no residue.
- Completely non-toxic and deemed safe for human occupancy even during discharge.
- Poses zero global warming potential and zero ozone depletion risk.
- Cost-effective to refill compared to other fire suppression agents.
- Can utilize shared or directional valve systems for more efficient protection.
- Inergen is also widely utilized globally, attesting to its reliability and effectiveness.

INERGEN DISADVANTAGES:

- Higher initial cost.
- High cost for cylinders.
- More storage required for cylinders.
- Weight of the cylinders.



COMPARATIVE ANALYSIS

HFC-227EA

INERGEN

SAFETY FOR HUMAN OCCUPANTS

While HFC-227ea is considered relatively non-toxic, it can cause dizziness, confusion, and even unconsciousness at high concentrations, with some cases of accidental exposure leading to hospitalization.

A significant advantage of Inergen is its excellent safety record for human exposure. Inergen has been rigorously tested by agencies like the U.S. Navy and FAA, proving to be

NO DAMAGE OR DOWNTIME AFTER DISCHARGE

HFC-227ea does not damage electronics or assets during fire suppression

Inergen does not damage electronics or assets during fire suppression. Inergen's advantage is its residue-free discharge, eliminating the need for cleanup and facilitating quick return to normal operations.

PLACEMENT OF THE CYLINDERS

HFC-227ea systems, operating at lower pressures, require closer placement to the areas they protect, limiting flexibility in system design.

Inergen's high-pressure operation (200 or 300 bar) allows for flexible placement of storage cylinders, up to 300 meters away from the protected area.

PRESSURE RELIEF DAMPERS

HFC-227ea needs both positive and negative pressure relief dampers to manage gas discharge pressures, adding to installation complexity and cost.

Inergen typically requires only positive pressure relief dampers, simplifying installation and reducing costs.

ENVIRONMENTAL IMPACT

HFC-227ea's chemical composition necessitates an air extraction system to clean the discharge before release into the atmosphere, further increasing costs and complexity.

Inergen, composed of natural gases, has no such requirement, making it a simpler, more environmentally friendly option.

The release of 1 kg of HFC-227ea equates to the global warming potential of releasing 3 tons of CO₂



CONCLUSION

HFC-227ea may offer rapid fire suppression in limited spaces, making it suitable for specific applications. However, Inergen stands out when considering human safety, sustainability, and the protection of critical assets. With its non-toxic nature, zero global warming potential, and absence of residue, Inergen is the preferable choice for comprehensive fire protection, reducing risks to personnel, equipment, and the environment.