



White Paper on

Fire Suppression Systems for Micro Enclosed Spaces

Charting the way for fireproofing high-risk
enclosed spaces

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1. Introduction and GAP Analysis

Every premises, big or small, whether residential, commercial, office or leisure space, has certain vulnerable spots that are always high on the fire risk. These are also often enclosed micro spaces such as electrical panels, MCB boxes, Fume Hoods, Server Racks, Generators or CNC machines that become the source of fire due to a short circuit resulting from faulty wiring, loose fittings, power fluctuation or overheating.

Fire fighting in such high risk spaces becomes challenging due to the fact that they are enclosed in nature and often situated in a remote location within the premises, making manual fire detection impossible, till it reaches a point when flames have already reached dangerous intensity levels.

What makes matters worse for anyone trying to extinguish fire in such spaces is that they are most often electrically charged and live, making the risk of electrocution high. On the other hand, availability of trained firefighters at the site with appropriate fire extinguishing equipment with the right extinguishing agent, is never guaranteed.

Many times fire-proofing such high risk enclosed spaces in a premises is equal to fire-proofing the entire premises. This is because fault lines on fire safety are plugged in the premises when such spaces are safeguarded.

Need of the hour is of specialised fire suppression systems that are one, automatic in nature as manually monitoring such spaces 24x7 is virtually impossible and Two, the suppression system must be specifically designed to protect such high risk enclosed spaces.

The need for automatic fire detection and suppression in such spaces is important also because the fire needs to be quelled the very minute it is detected and needs to be extinguished while it is still small. Any delay in this can easily lead to fire spreading into surrounding areas in a premises taking the fire emergency to a whole new level.

Whereas the need for suppression systems to be designed specifically for such spaces is important because the systems need to arrest the unique characteristics of the fire risk present in these spaces. Whenever we depend on generic fire safety equipment available at the premises like fire extinguishers or total flooding for such hot-spot spaces, it is often a delayed response and the damage is already caused.

Also, what is the point in flooding the entire room or premises with hundred KGs of extinguishant **[could be expensive clean agent gas in a total suppression system present at the site or high-collateral-damage-causing conventional agents like ABC powder or water]** when all that was needed to be done was to extinguish flames in a small cabinet.

2. A Ground-Breaking Firefighting Solution

Considering the need for automatic fire protection in the form of customised systems that are specifically designed to protect high risk enclosed spaces in a premises, a highly reliable fire suppression system for micro enclosed spaces is introduced. This system is driven by a Heat Sensing Tube based fire detection and a mechanical and automatic fire suppression by a localised fire extinguishant available in a stored-pressure form.

The system is designed specially to protect high risk enclosed spaces considering the complexed construction, shape and characteristics of such spaces such as **electrical panels, MCB boxes, server racks, CNC machines**, etc where the fire risk is randomly distributed inside these spaces and any point inside could become a source of fire due to the complex nature of wirings, integrated circuits, fuses and power connections present inside.

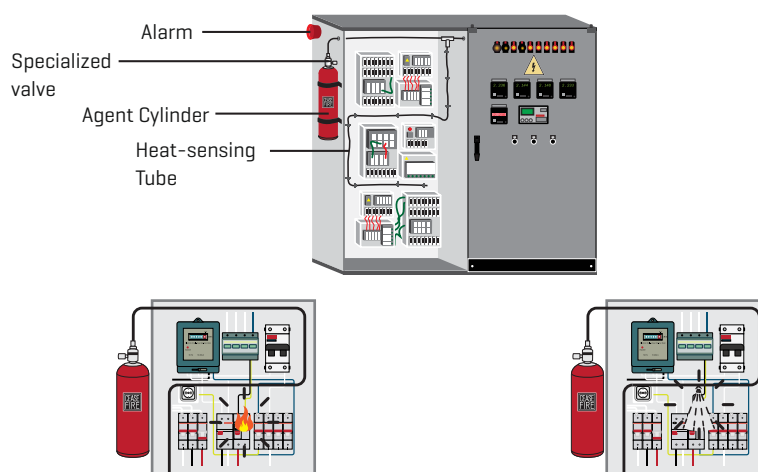
A signature component in Micro Enclosed Spaces Fire Suppression Systems is the specially designed heat-sensitive pneumatic polymer tube.. In the event of a fire, the heat-sensitive tube detects an increase in temperature and bursts upon coming into contact with flames, activating the system automatically and extinguishing the fire at the source.



2.1 How the system work?

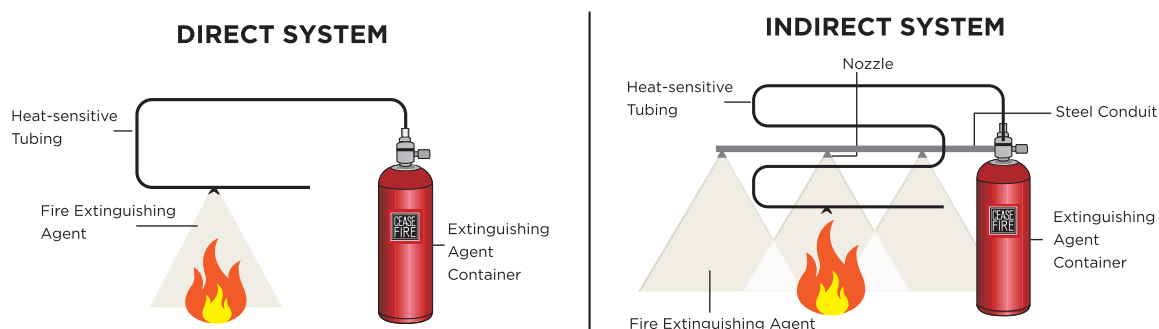
This heat-sensitive pneumatic polymer tube is connected to a extinguishing agent container at one end, while the rest of it runs unobtrusively inside the micro space that needs to be fire protected, covering all high risk points inside the space. In the event of a fire, the flames come in contact with this heat-sensitive tubing and upon reaching a temperature level of 150° - 180°C, this tube burst open and activates the system.

The technology makes this system entirely self-activated, and requires no human intervention once it has been installed. This makes it especially beneficial for high risk micro- environments that are high on the risk of fire and cannot be manually monitored 24x7.



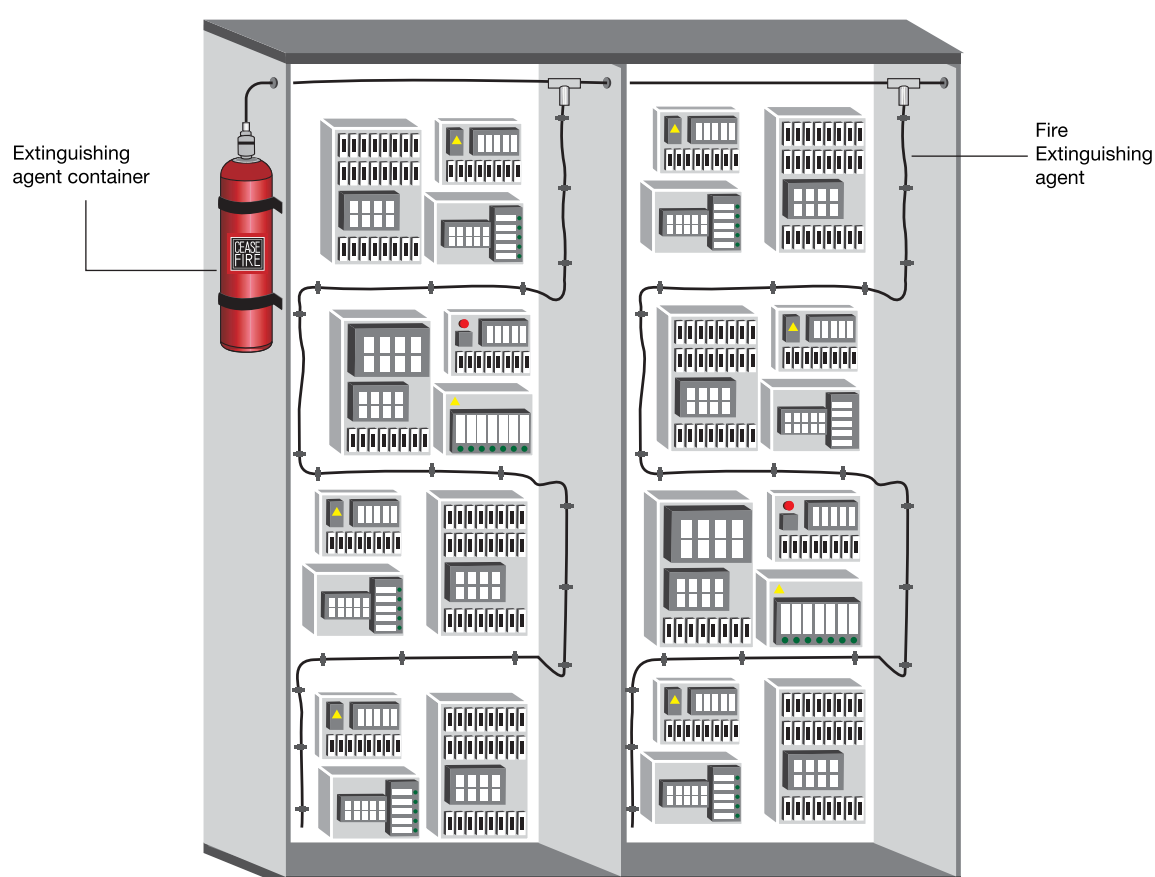
2.2 The Two Prime System Variants

There are two prime technologies in this system and the choice of selection of the system variant depends upon the nature of the space that needs to be protected.



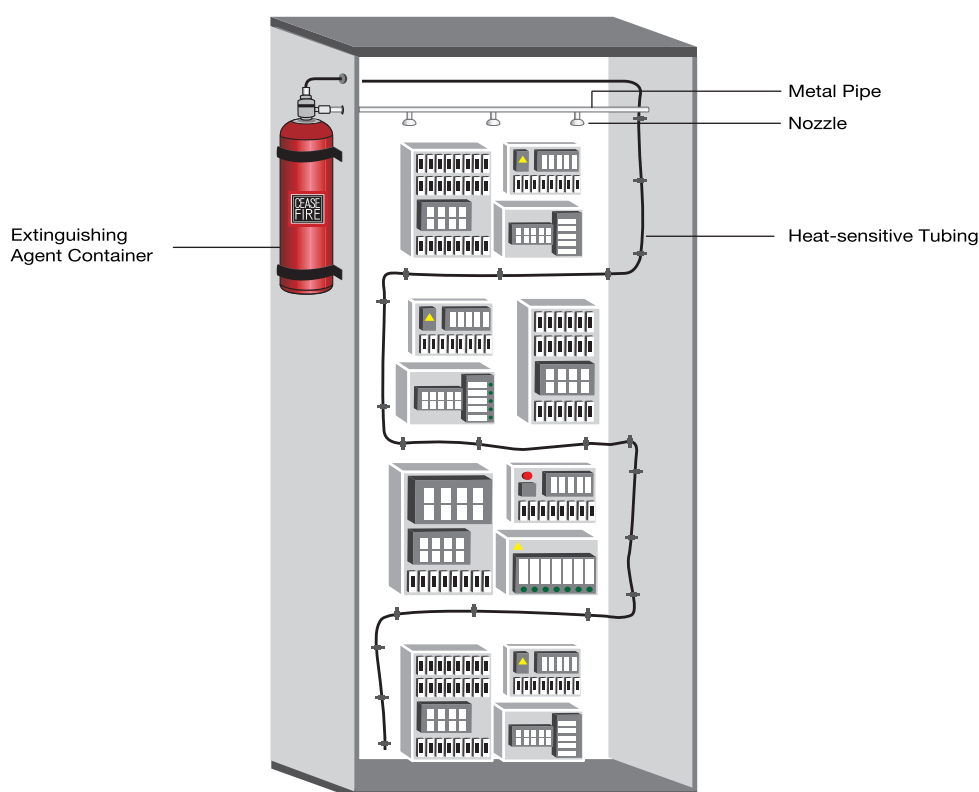
2.2a) The Direct System

In the Direct System the heat-sensitive tubing acts as an extinguishing agent delivery system. The tube bursts at the point where the fire is detected, forms a miniature nozzle and sprays the extinguishing agent. This system can run intricately and unobtrusively through **Panels, MCBs, Gensets and electrical mains boxes** that are often compartmentalised in nature, and is triggered instantly and automatically. This eliminates the need for human intervention and provides a swift and comprehensive solution. This is available in low-pressure and high-pressure systems.



2.2b) The Indirect System

In the Indirect system, the heat-sensitive tubing only acts as a detection device. The extinguishing agent is delivered through a steel conduit and sprayed across the entire area through strategically placed nozzles. This system configuration is ideal for spaces that are non-compartmentalised and total flooding in the entire cabinet / chamber is possible. For example, in a large electrical cabinet, where a voltage surge can short-circuit components at multiple locations and cause them to catch fire. This system variant too is available in both, low-pressure and high-pressure systems.



2.3 Diverse range of extinguishing agents to address a variety of applications

The Micro Environment Heat Sensing Tube Based Fire Suppression offers flexibility of configuration not only in terms of the Direct and In-Direct system configuration, but can also be based on a wide variety of extinguishing agents like ABC MAP90 Powder, HFC227ea, Fluoroketone [FK] and Foam in Low-Pressure Technology, and CO₂ in High-Pressure Technology, making it possible for system designers to configure any type of a micro environment suppression system to suit any kind of an application to address its unique fire risks, also while considering how critical the need for collateral damage control is in the application.

3. Key features & benefits of the system

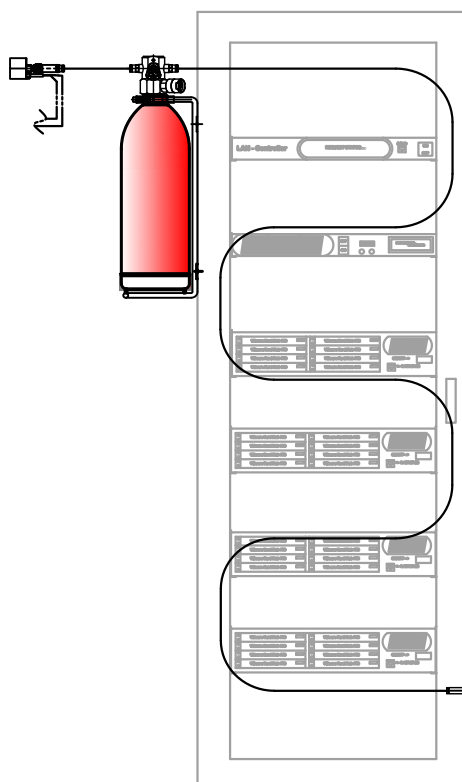
- Fights Class A, B, C and Electrically started fires.
- Ideal for places where fires can break out in localised areas.
- Does not require any power supply and will function normally in the event of a power outage.
- Eliminating the need for human intervention, the system is in a perpetual state of readiness to combat a fire as soon as it breaks out.
- Can be manually actuated to enhance fire protection, reduced damage, and increased safety in different environments and scenarios.
- The systems are specifically engineered to provide fire resistance for both Forced and Natural Air Flow cabinet applications.
- The Heat Sensing Tube exhibits exceptional quality due to its high-level certification, including UL certification.
- Flexible tubing extends protection to areas that are difficult to access and may not be able to accommodate any other means of detection.
- Simple design and can be installed within a few hours, which means a significant reduction in labour costs and downtime.
- Can withstand even harsh conditions where other types of detection systems might be rendered inadequate.
- Reed switch to monitor the readiness status of the system.
- Pressure Gauge with Switch multitasks for both, visual monitoring and integration with third party devices.
- The intelligent Response Panel with in-built hooter and flasher is capable of monitoring up to 4 cylinder systems.
- Response panel with intelligent third party integration system to cater to different battery types.
- Best agencies including BSI, LPCB, UL, and CE vouches for suppression systems who comply with their specific standards.

5. Specialised Solutions for unique enclosed spaces

- Networking Racks
- Electrical Panels
- CNC Machines
- Gensets
- Dust Collection Machine
- Fume Cabinets
- Motor Boats
- Wind Turbines
- Server Racks
- Heavy & Light Vehicle Engines
- Wave Solder Machine
- Injection Moulding Machine
- Transformers

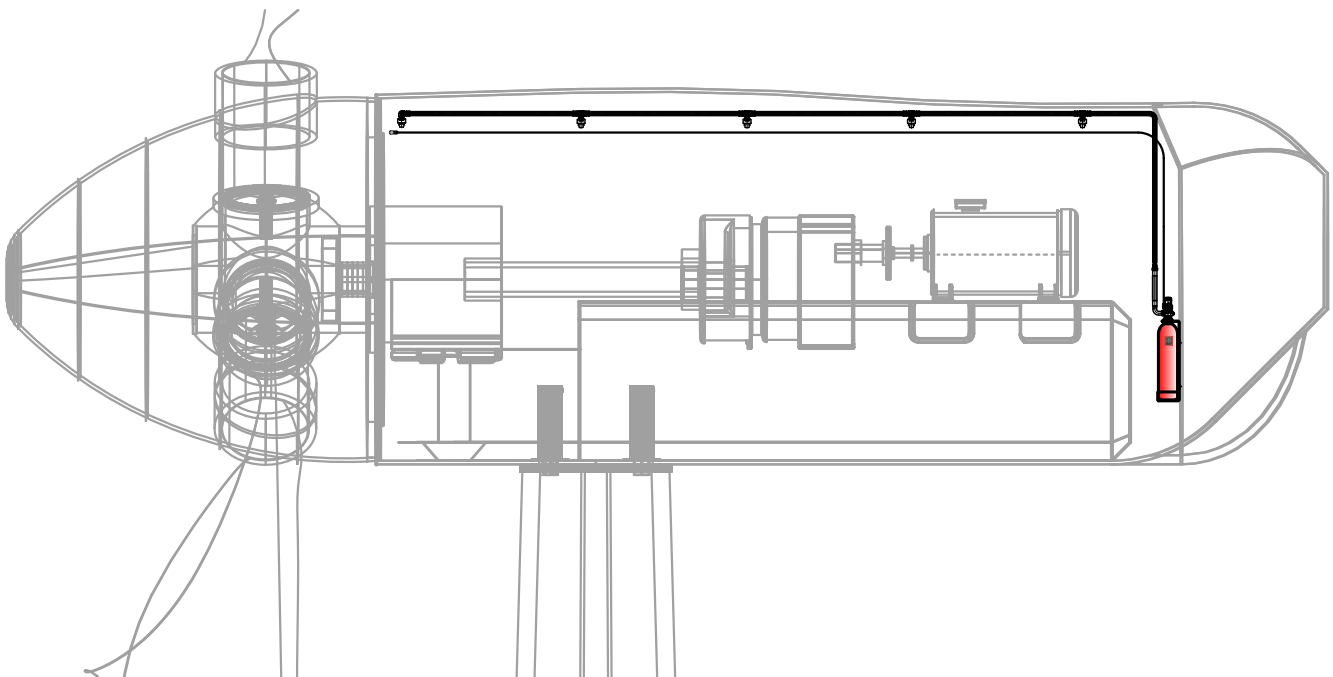
5.1 Networking Racks

Networking racks are commonly used to store a diverse array of networking equipment, including routers, patch panels, switches, and associated accessories. Unlike server racks, networking racks typically exhibit lower levels of heat generation. However, the absence of proper ventilation, electrical complications, incorrect installation practices, or excessive heat can engender fire incidents, resulting in undesirable business interruptions and potential data loss. Consequently, the installation of an In-Panel tube-based system within server rooms assumes critical significance, as it facilitates the automatic detection and suppression of fires.



5.2 Wind Turbines

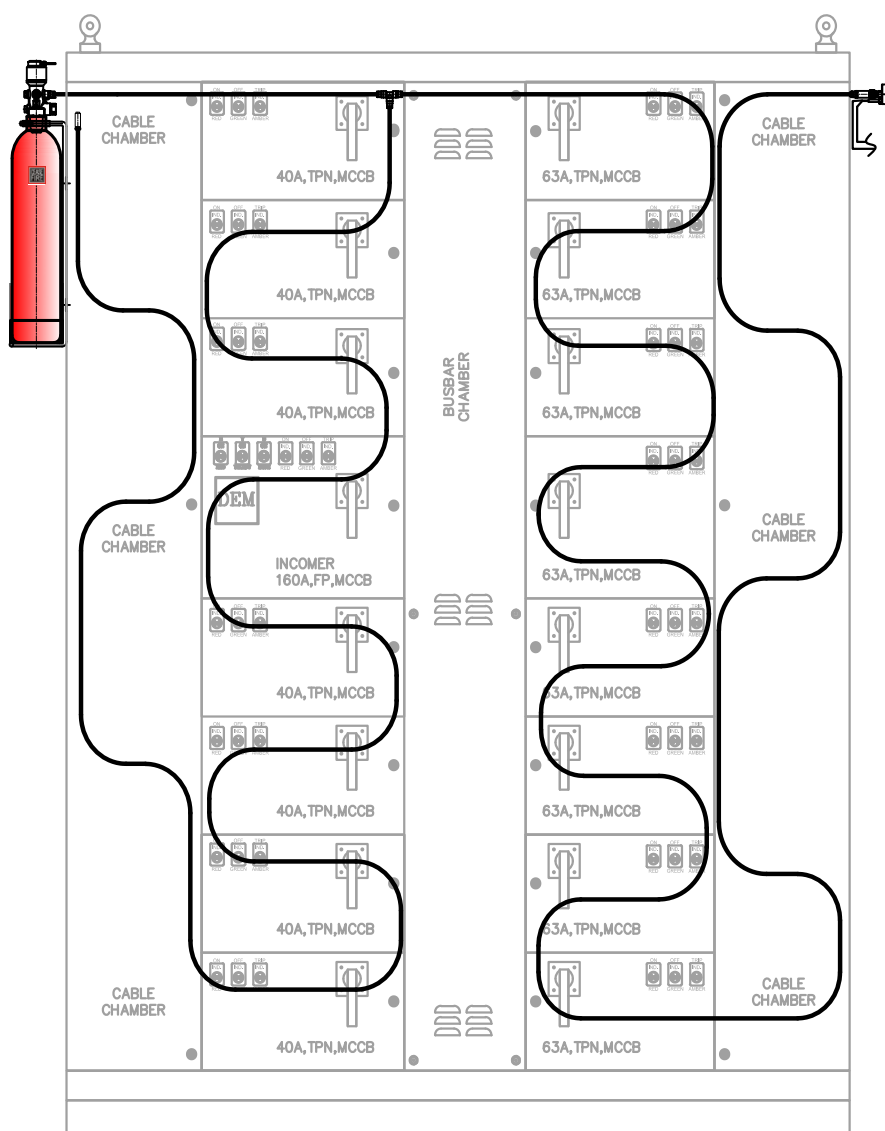
Fire is often a leading cause of downtime for wind turbines. This is because a wind turbine consists of components like wind turbine generator, electrical cables and harnesses, inbuilt transformers, cooling oils, gearboxes and hydraulic oils which can catch fire quite easily. As the wind turbines are installed at heights, high winds can quickly air the fire inside a wind turbine. In addition, lightning strikes are also one of the main causes of fire in a wind turbine. Once ignited, the chances of dousing the blaze are low due to the extreme height and the remote locations. Therefore, a conventional suppression system might not help when it comes to suppressing the fire risk that these remote machineries carry.



5.3 Electrical Panels

The statistics show that electricity is still the main source of accidental fires in commercial buildings which can not only cause severe disruption to businesses, but can also be a threat to the buildings and their occupants. This is because these panels are where the main power lines terminate and get branched for further distribution. With numerous electrical wires on the distribution board, fuses and circuit breakers present, there is an inherent possibility of rising heat in these panels leading to wires melting down causing short circuits.

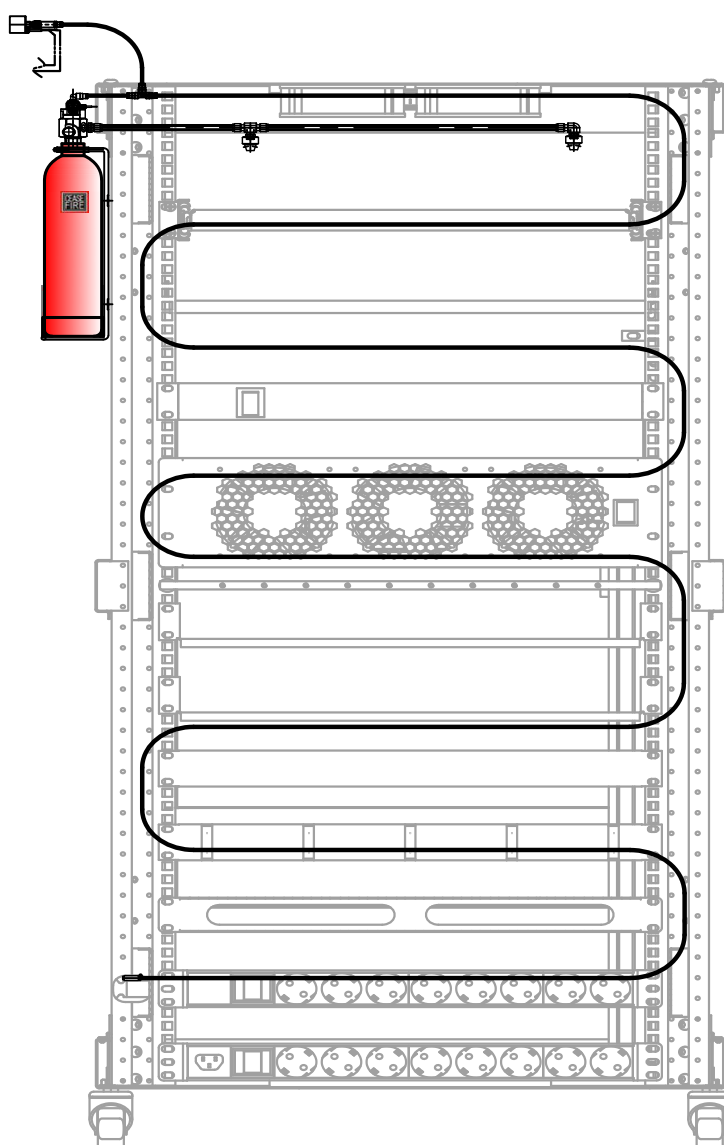
What makes detection of fire even more challenging in these panels is that they are usually present in a remote corner away from our direct sight. The only way the electrical cabinets / panels can be protected is through an In-panel suppression system that could not only stand guard to detect fire 24x7 but could also self-activate on sensing fire.



5.4 Server Racks

Server racks are specifically designed to accommodate high-end servers, routers, switches, wiring, and cords & cables.

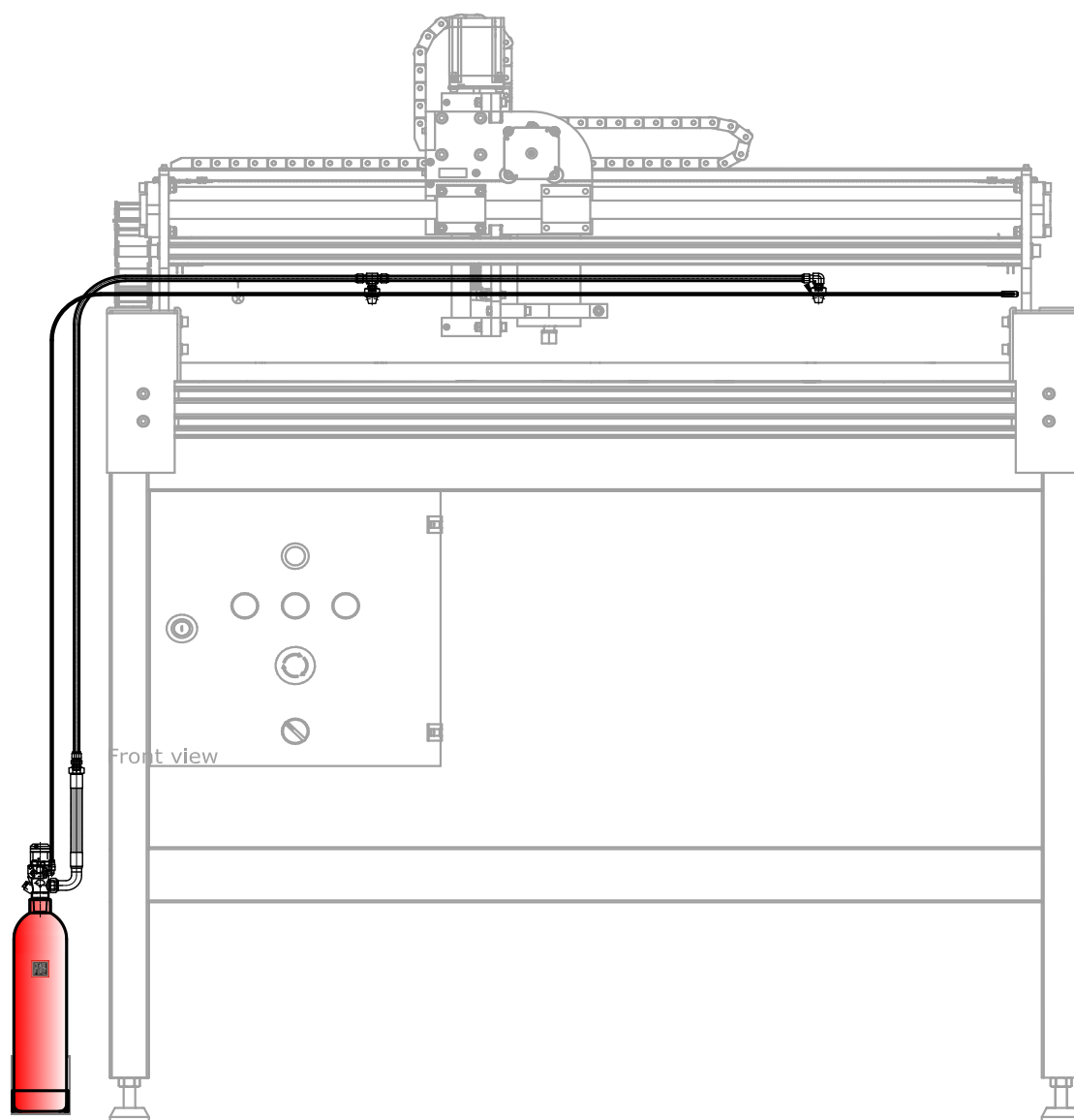
While a server rack is one of the most important & high value assets in an organisation, that helps store invaluable business data, These racks are the most vulnerable spot for fire. This is because these racks house complicated electrical circuitries, patch panels, switches & routers, and numerous wires & cables, that even a little overheating can lead to the risk of fire. What makes it even more challenging is that these server rooms do not have human presence 24x7 which can lead to undetected fires. There is so much at stake when it comes to server racks that you simply cannot take any chances with fire. The only way to ensure a foolproof fire safety for these server racks is to have a specially designed fire suppression system for them, which not only detects fire automatically but quells it without causing any collateral damage.



5.5 CNC Machines

While CNC Machines render numerous benefits to the industry, they also possess a significantly high risk of fire. This is because these machines carry out repetitive robotic movements and use flammable oils, lubricants, and other metalworking fluids operating at high speeds & temperature, giving rise to extreme levels of friction and heat that can eventually lead to a flash fire.

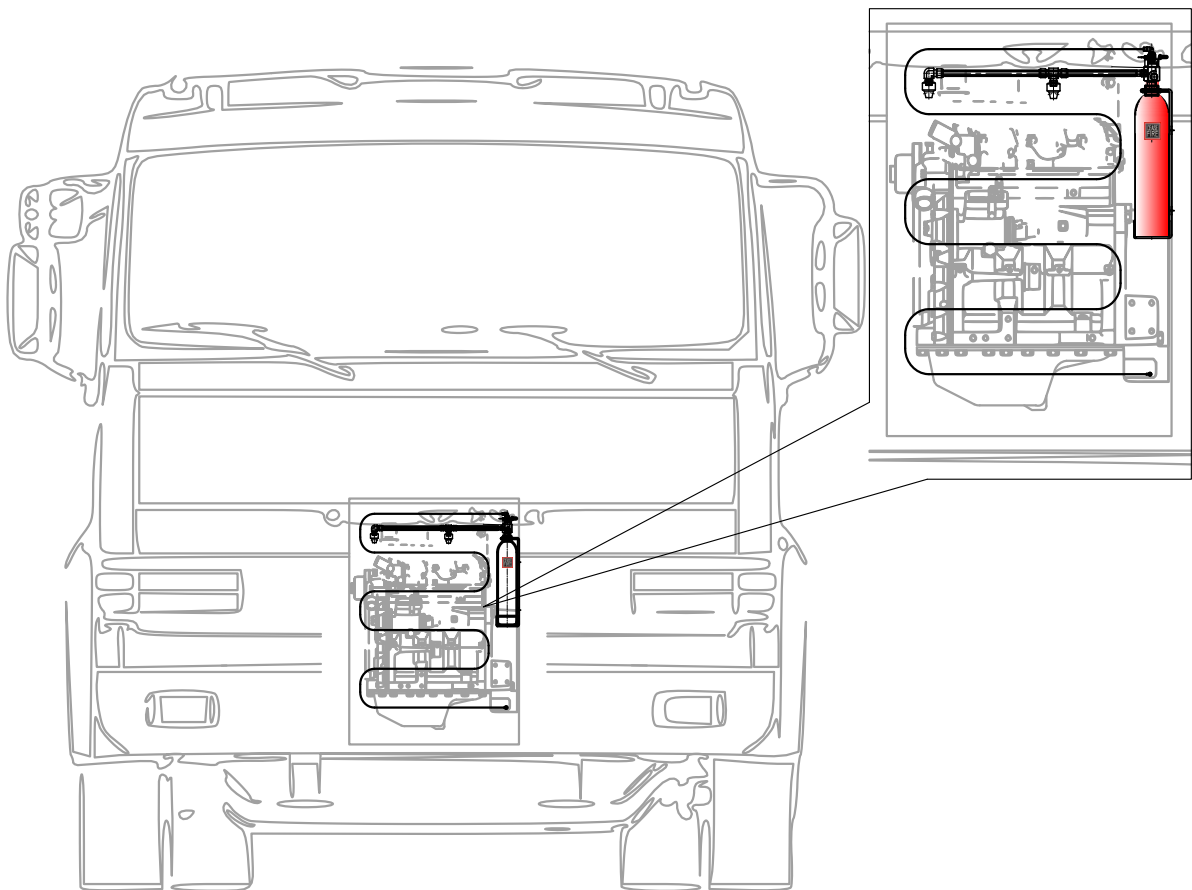
What makes the situation even more alarming is the absence of manpower around, as these machines operate on an automatic mode and do not need human intervention around the clock. Therefore, there is an ever present possibility of an unattended fire. To counter these fire risks CNC machines need to have tailor-made and automatic fire suppression systems that can quickly self detect & suppress fire in these high value machines.



5.6 Heavy & Light Vehicle Engines

While vehicle engines convert fuel into motion and make our lives & commute easy, they also possess a major threat of catching fire. With the presence of a lot of frictional components, flammable liquids and complex electric wiring, fire is one of the most common hazards in vehicle engines.

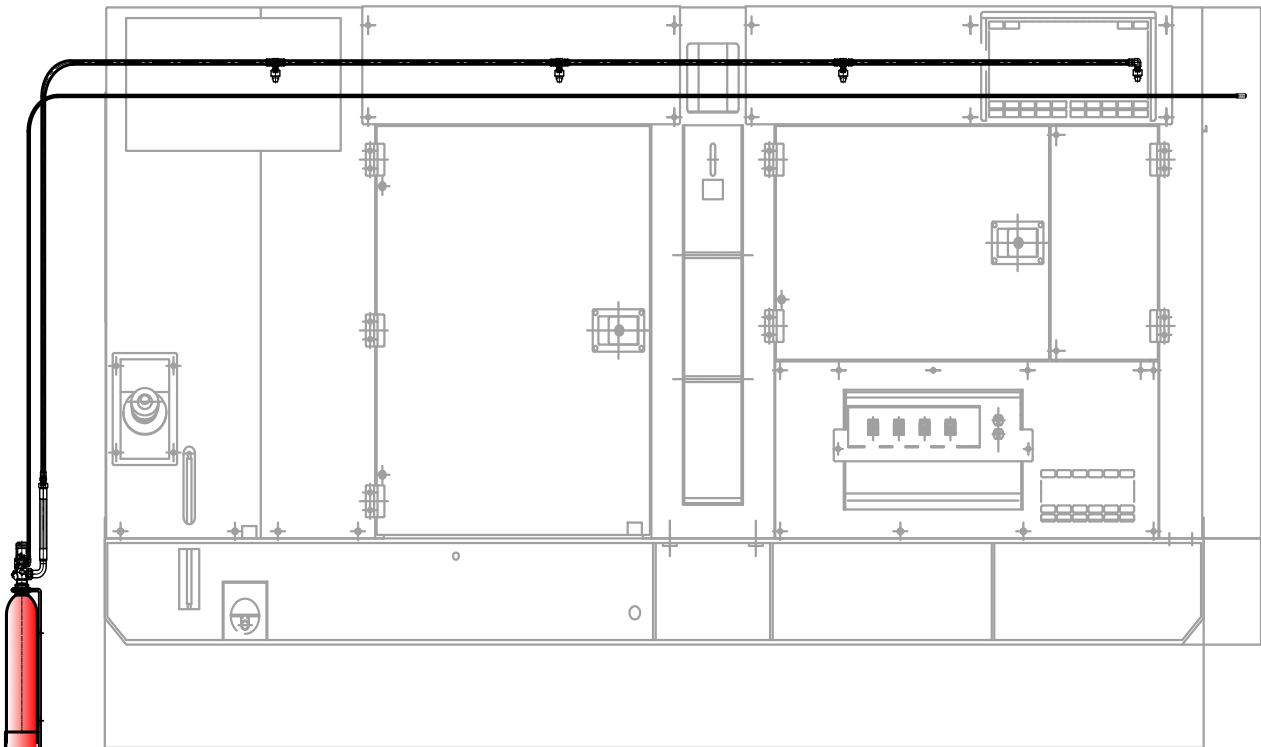
With engines being located mostly outside the passenger area, detection of fire becomes even more critical and so does the suppression. A fire prevention system that can automatically detect any signs of fire & mitigate the risk in such small enclosed spaces is what these engines require.



5.7 Gensets

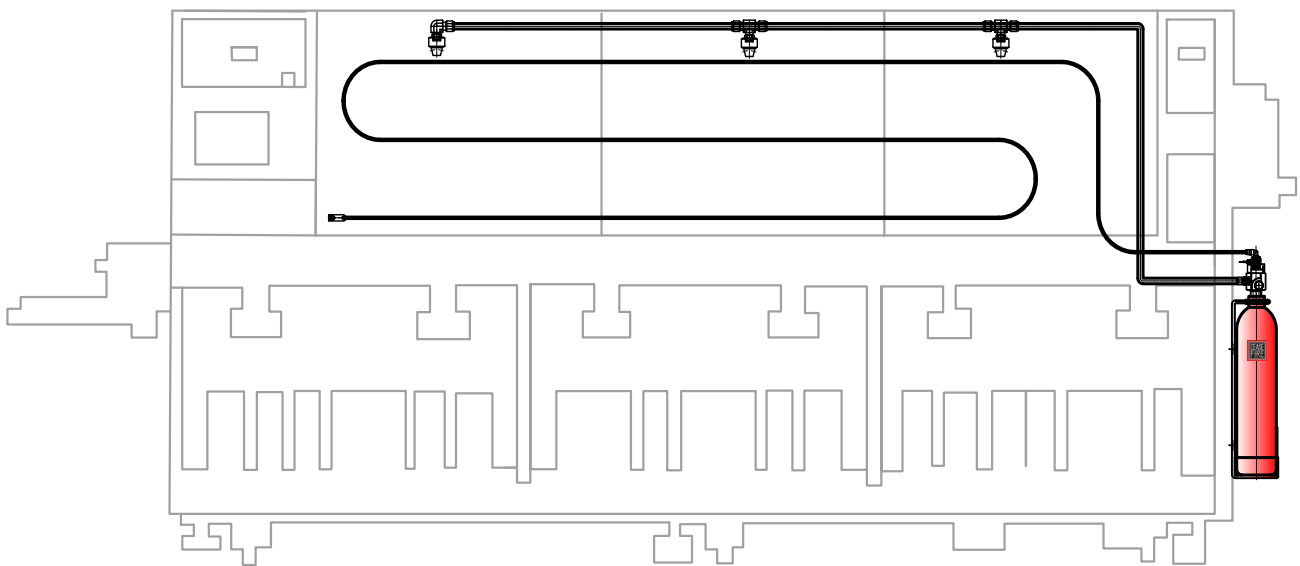
Generators convert mechanical or chemical energy into electricity by capturing the power of motion. With high speed moving engine parts combined with fuel, alternators, wiring and exhaust system there is an ever-present risk of overheating leading to fires. The very design of the canopy of these modern-day generators makes detection of fire an even bigger challenge as the canopy completely keeps the generator enclosed and away from our visual sight.

This is the reason generators need an exclusive fire suppression system that is one, automatic in nature and two, is designed exclusively to address the unique risk of generator fires.



5.8 Wave Solder Machine

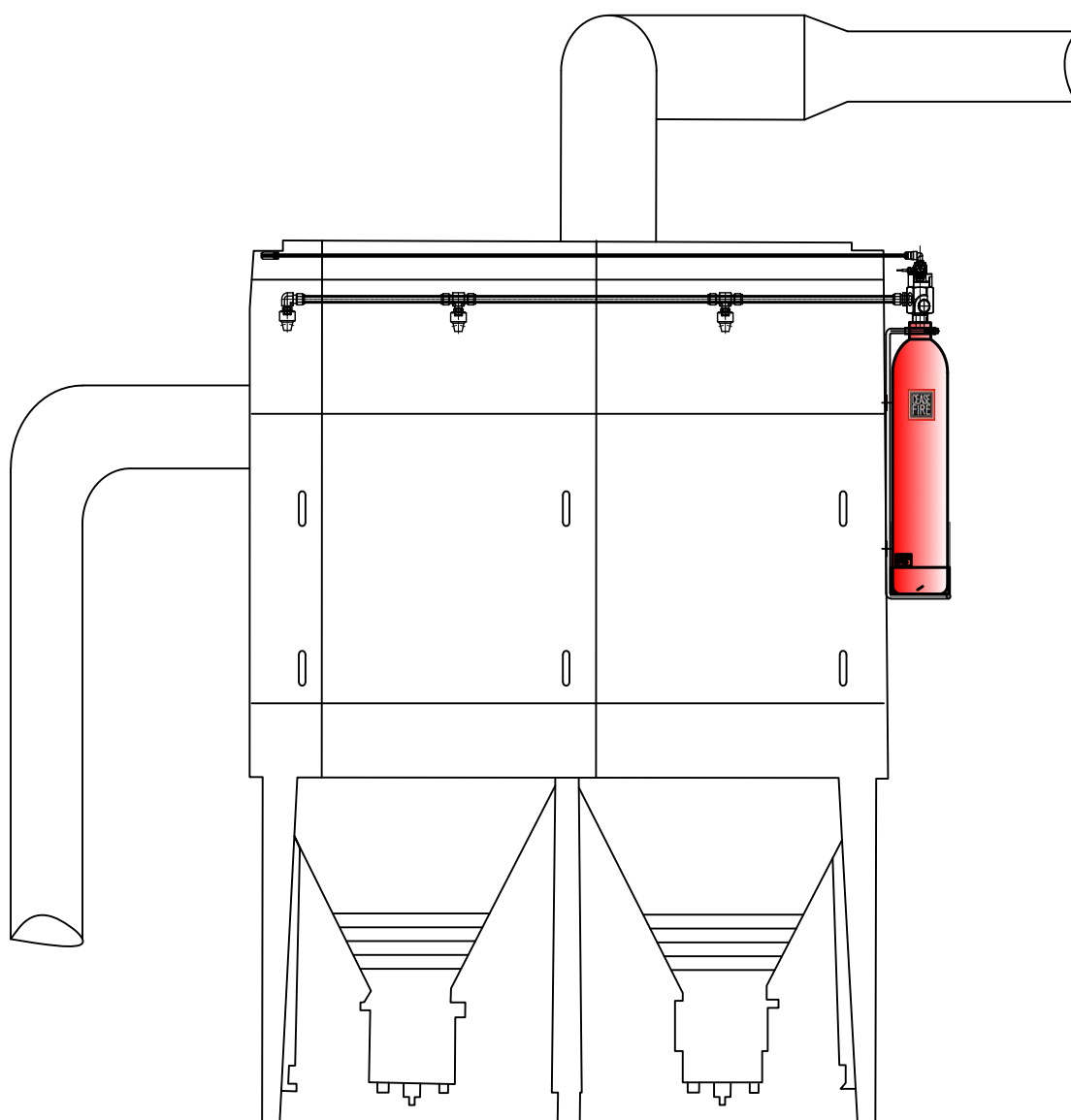
The chance of a fire occurring in a wave solder machine can be relatively high due to the presence of flammable materials such as solder and flux, as well as the high temperatures generated during operation. Wave solder machines utilise molten metal to solder components onto printed circuit boards, which can generate a significant amount of heat and pose a risk of ignition if not properly maintained. Installing fire prevention measures like an automatic fire suppression system is recommended to ensure fire safety of the machine.



5.9 Dust Collection Machine

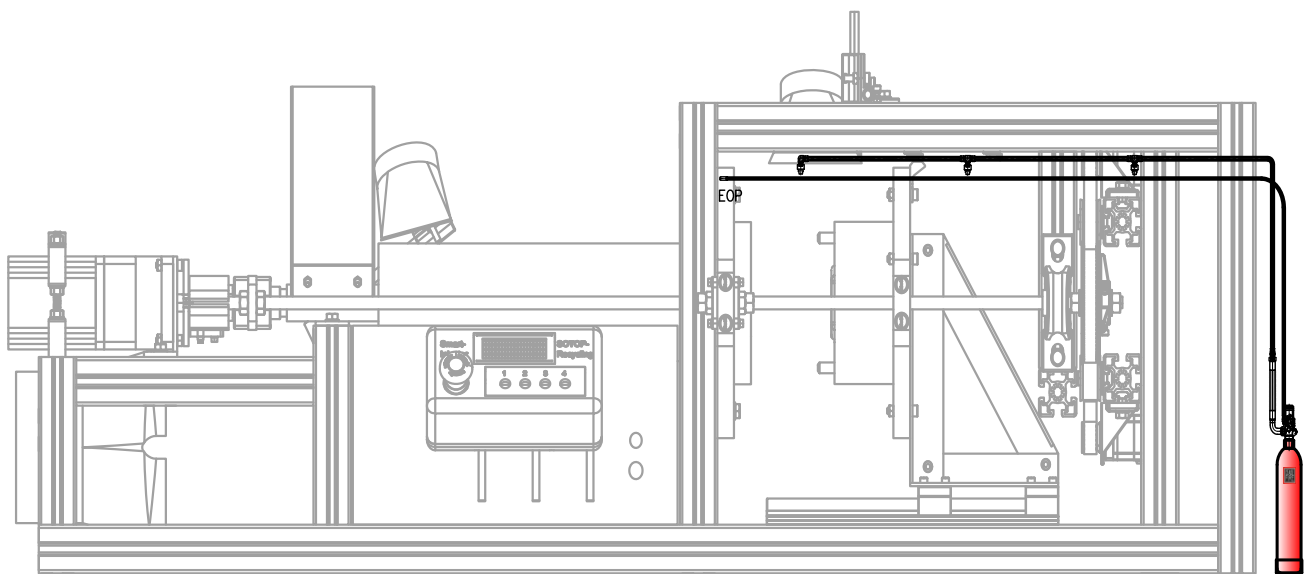
From metalworking and woodworking to food processing, dust collectors constantly pull combustible dust off the floor. This dust, along with the filter material themselves, is a continuous source of fuel for the fire triangle. This means there is a constant source of replenished oxygen circulating through the dust collector. In metalworking processes, such as welding, grinding, or cutting, sparks can get swept up into the dust collector and act as fuel to ignite a fire. Friction from processes can build up heat, which could build up enough to reach the flashpoint of the fuel within the collector.

With a Tube based suppression system installed inside the Dust Collector Machine, the system will release a suppression agent at the source of the fire, before you realise a fire has started.



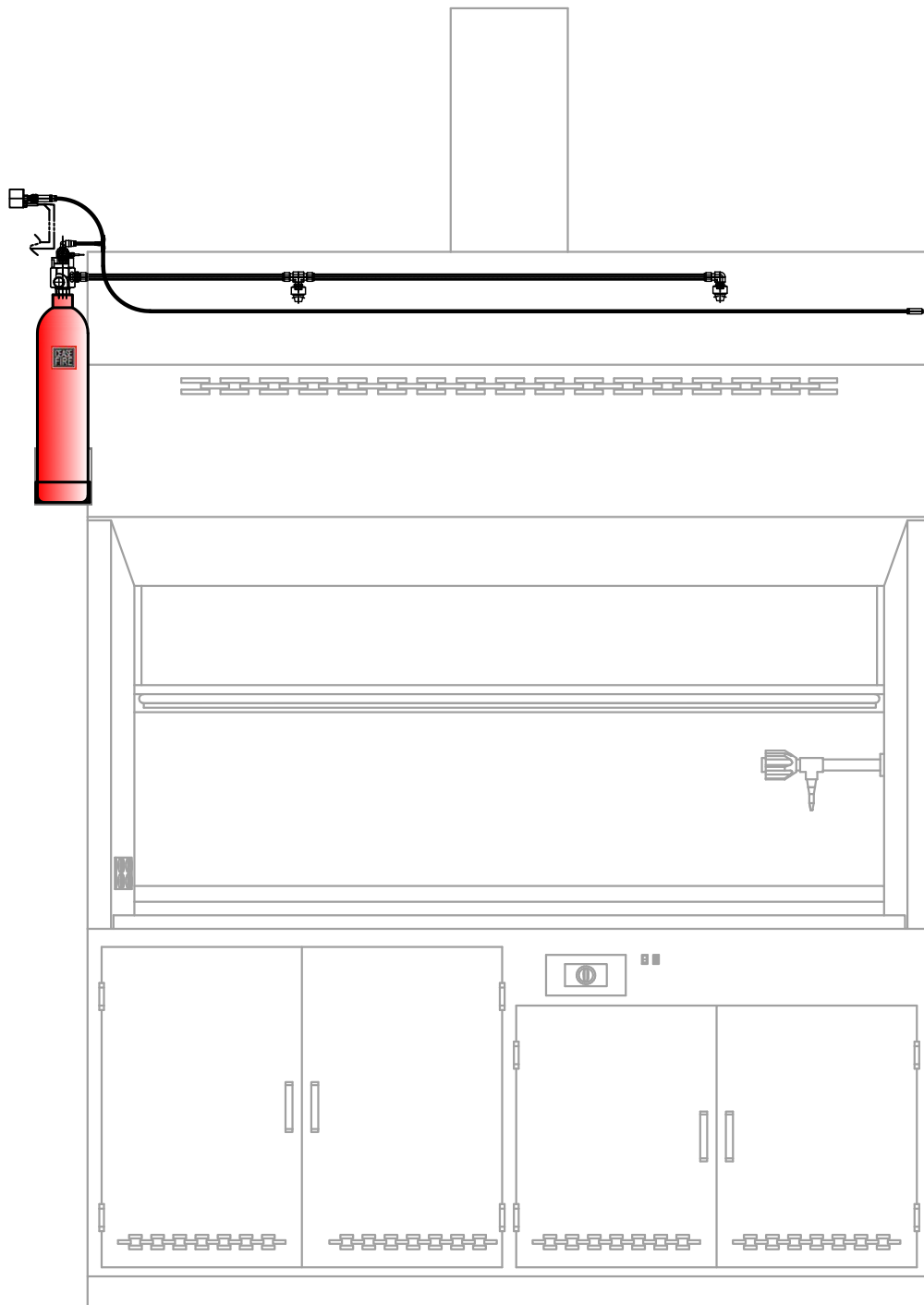
5.10 Injection moulding Machine

There are many reasons that can ignite a fire in the injection moulding machine including electrical faults, overheating due to blocked ventilation or insufficient cooling, and ignition of residual plastic or other materials inside the machine. Since these machines are working at high pressure, high speed, and high temperature, it is essential to ensure that the machine is used in a properly ventilated area.



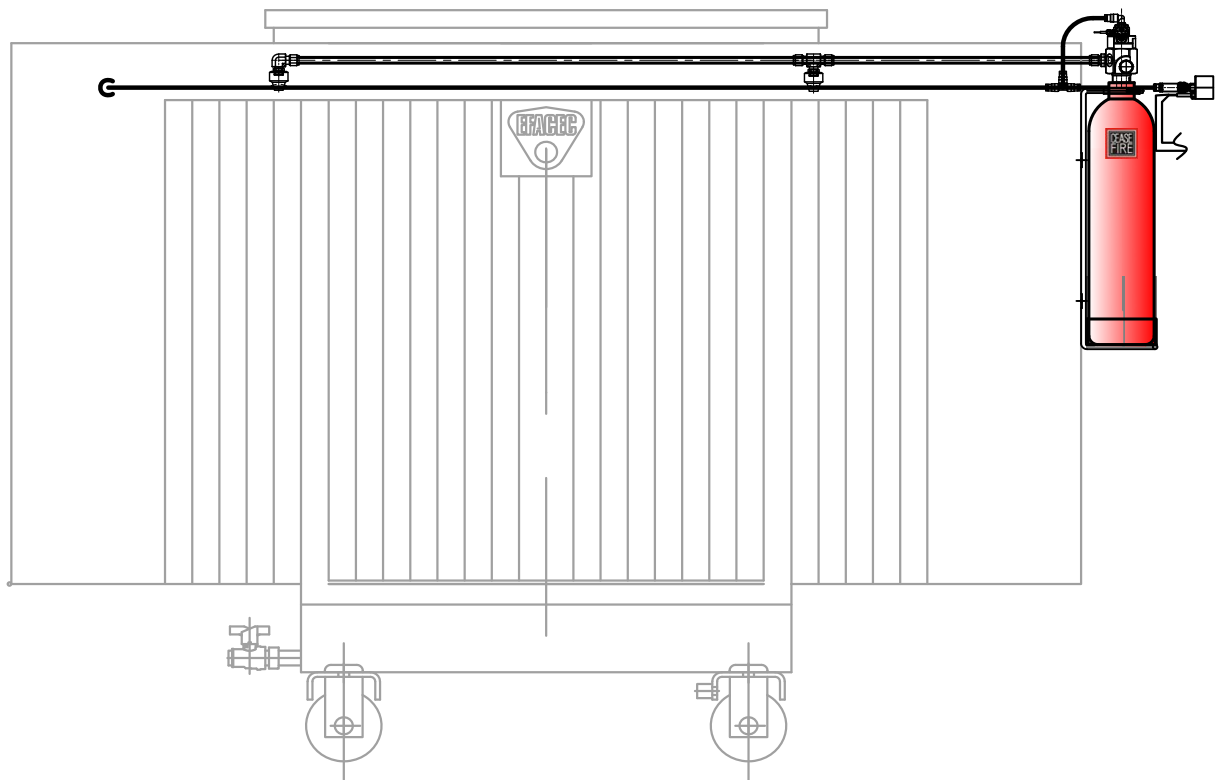
5.11 Fume Cabinets

Fume cabinets are designed to contain and exhaust hazardous materials, including flammable or combustible chemicals, and to prevent the spread of fire. The chances of a fire occurring in a fume cabinet depend on various factors, such as the type and quantity of chemicals being used, the condition of the fume hood, and the practices and procedures followed by the users.



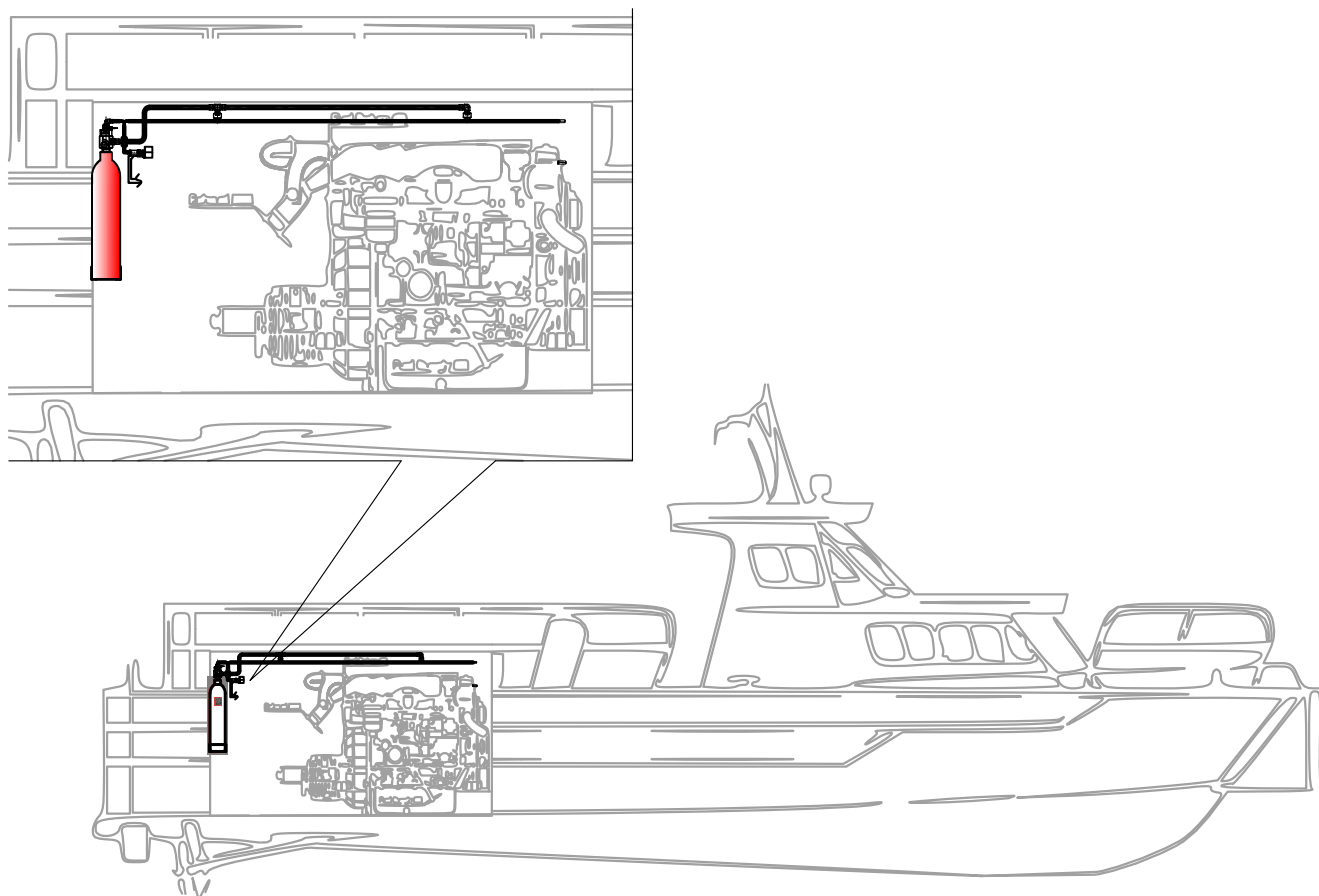
5.12 Transformers

Transformers are electrical devices that are designed to transfer energy from one circuit to another through electromagnetic induction. However, they generate heat during operation, which can cause insulation materials to degrade over time, leading to a breakdown of the transformer and the possibility of fire. They are also vulnerable to external factors such as lightning strikes, power surges, and overloading, which can increase the risk of fire. Environmental conditions, such as high temperatures, moisture, and corrosive substances, can also affect transformer performance and increase the likelihood of fire.



5.13 Motor Boats

Boats have several potential ignition sources that can increase the risk of fire, including engines, fuel systems, electrical systems, and cooking equipment. Older boats may be more prone to electrical issues, which can lead to fires, while boats with gasoline-powered engines may be more susceptible to fuel leaks and fires.



6. Conclusion

If there is a micro-environment in need of protection, you can always count on In-Panel Suppression Systems as your guardians. Depending on the volume or the application area, using these suppression systems can help instantly detect and extinguish a fire within seconds.



