3M Science. Applied to Life.™

Device Integrated Fire Protection

Safety for people and electrical equipment

Safe extinguishing with 3M™ Novec™ Engineered Fluid

Authorized partner:

Thermo Bulbs

Developed for the future: 3M™ Novec™ Engineered Fluids are setting a new standard

Novec Engineered Fluids are a new generation of products, developed by 3M as a replacement for conventional solvents, heat transfer media, fire extinguishing agents, and for a wide range of other applications.

3M™ Novec™ Engineered Fluid applied in integrated fire protection solutions

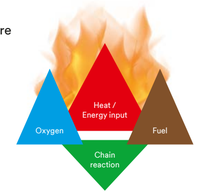
Used as an extinguishing agent, Novec Engineered Fluid helps to future-proof your fire protection system. It is classified as non-hazardous and not only meets today's regulations but also those of the foreseeable future.

It ensures:

- maximum fire protection for people
- protection for your **electrical equipment**, systems and valuable assets, as these remain undamaged by the extinguishing agent.

The Fire Triangle

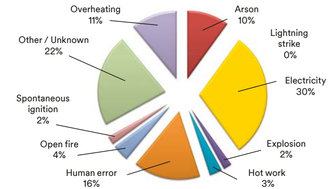
The triangle illustrates that a fire requires three elements: heat, fuel and an oxidizing agent. A fire naturally occurs when these elements are combined in the right mixture. In the presence of a fuel and oxygen, a sufficient amount of heat would be enough to ignite a fire.



Be aware that electrical equipment poses a constant fire risk!

Whether at home or in the office, in industrial plants, laboratories, hospitals or doctors' practices: electrical equipment and appliances can be found pretty much everywhere. These devices are permanently supplied with power, which means they pose an elevated fire risk.

Causes of fires
(Source: IFS Schadendatenbank 2012)



Frequent lack of active fire suppression systems

In many cases, the areas where electrical equipment is used are either unprotected or provide only insufficient protection against fire risks. Think about your home, for example. **Smoke detectors or hand-held extinguishers are useless here if nobody is at home.** And fire in electrical equipment spreads more rapidly than you would think. **No matter where we are – we are surrounded by potential fire risks!**

It is time to think about integrating fire protection solutions into electrical equipment

Miniature fire extinguishers, integrated into electrical devices, can provide direct protection from fire risks. The companies 3M and JOB Thermo Bulbs have therefore teamed up to provide the perfect solution.

You can now get maximum fire protection for your devices with minimal effort!

The perfect protection for electrical devices

When discharged, 3M™ Novec™ Engineered Fluid rapidly vaporizes from a liquid to a gas. It also poses no hazard to the human health.

With these optimum conditions, JOB Thermo Bulbs was able to develop two fire extinguishing solutions that provide direct protection of electrical devices.

Excellent extinguishing properties, combined with minimal space requirements, enabled JOB to develop fire extinguishing systems that require very little space, e.g. on a PCB or within an electrical device, but are still highly effective.

The E-Bulb – reliable fire protection and easy to install!

The E-Bulb makes it possible to fire-protect a full range of electrical equipment, or high-risk components within electrical devices with only little effort.

Compact in size, highly efficient – suitable for SMD/THT assembly

The E-Bulb is not much bigger than the average internal supplemental fuse and can be integrated directly onto the device's PCB during automated assembly. The glass bulb, containing 3M™ Novec™ Engineered Fluid, is held in a standard fuse holder found in countless, modern electrical devices. This extinguishing bulb is inserted into the fuse holder during assembly.

Protected volume and dimensions of the JOB E-Bulb

Dimension (standard)*	5 x 20 mm	5 x 40 mm	7 x 40 mm
Sensitivity [s][1]	48	48	48
Gas volume V_{Gas} [ml]	16.6	42	88.5
Protected volume $V_{4\%}$ [ml][2]	416	1,049	2,212

The E-Bulb is available in a variety of electrical specifications				
Currents	Class 1: <1A	Class 2: <5A	Class 3: <10A	Class 4: <16A
Voltage	0..250V AC/DC	0..250V AC/DC	0..250V AC/DC	0..250V AC/DC

1] Tested in the wind tunnel test at 2.54 m/s and 135°C air temperature
2] In accordance with NFPA 2001 "Clean Agent Extinguishing Systems"
*] Other sizes and volumes are available

Outstanding environmental properties

3M™ Novec™ 1230 Fire Protection Fluid for indoor fire suppression systems and 3M™ Novec™ Engineered Fluid for E-Bulb and AMFE systems ensure long-term investment security, even in large-scale installations. Both agents have the lowest global warming potential (GWP) and ozone depletion potential (ODP) of all hydrocarbon alternatives.

Approval and references for E-Bulb and AMFE

- MPA and VDE tested
- E-Bulb is UL listed (E484622)
- REACH compliant

For more information on E-Bulb and AMFE fire protection systems:

Thermo Bulbs

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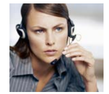
www.job-group.de/e-bulb
www.job-group.de/amfe



For further information on 3M™ Novec™ Engineered Fluids:

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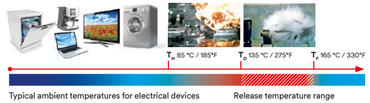
How the E-Bulb works

The E-Bulb triggers the release of the fluid at a defined, application-specific temperature. This means it is calibrated to a critical temperature lying within the temperature range of an incipient fire, e.g. initiated by a short circuit or over-heating.



The glass bulb bursts when the defined temperature is reached and 3M™ Novec™ Engineered Fluid is immediately released into the device.

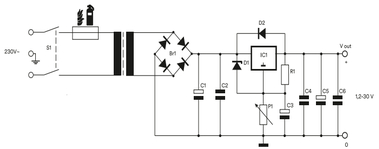
Thanks to the superior fire suppressing properties of Novec™ Engineered Fluid, a fire will be extinguished within seconds, before it has the chance to spread.

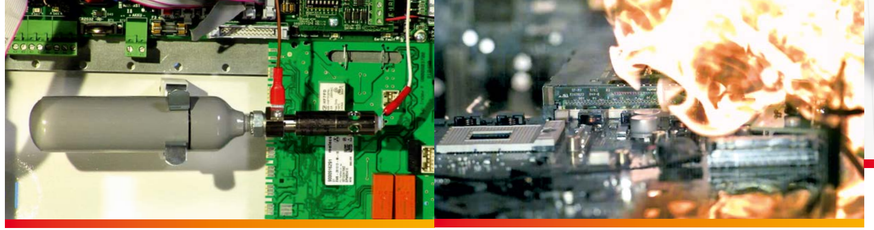
Built-in safety

The E-Bulb is a fire extinguishing fuse. The glass bulb has a conductive coating able to carry a current of up to 16A.

Installed in a device's input power circuit, the E-Bulb will also **safely and permanently interrupt this current** flow after being activated as a result of the pre-defined temperature rise.

This ensures that the fire cannot re-ignite.





Automatic Miniature Fire Extinguisher (AMFE)

JOB's AMFE fire suppression system is designed to protect devices and spaces that are too large for the E-Bulb. The AMFE system incorporates cylinders containing extinguishing agents that are equipped with a triggering unit with an integrated heat sensitive glass bulb.

How AMFE works

The heat sensitive glass bulb integrated into the AMFE bursts at a predetermined temperature (similar to the way sprinkler systems work) and triggers a spring mechanism. This opens the connected fire extinguishing cylinder that releases 3M™ Novec™ Engineered Fluid.

In a matter of seconds, the device or area is flooded with the Novec extinguishing medium, suppressing the fire when it is still at an early stage.

The AMFE is available in a range of product variations. S-AMFE, for example, is equipped with sensor connections, allowing it to monitor the release of the extinguishing agent.

The R-AMFE can be remotely triggered by activating a current signal, for example by a central fire control panel. This means that it can be integrated into a system that also uses smoke detectors, and upon the earliest detection of smoke, initiates the signal to release the R-AMFE even before the critical temperature is reached.

The system is installed in accordance with applicable standards and/or regulations (e.g. NFPA2001).

Very short extinguishing times

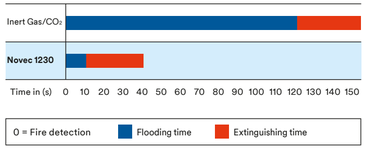
Once the AMFE is activated, the device is rapidly flooded with 3M™ Novec™ Fire Protection Fluid. Depending on the size of the cylinder, it takes approximately just 10 seconds to reach the required concentration level of extinguishing agent. At this point, the full extinguishing effect is already achieved. The extinguishing medium withdraws the heat from the fire, thus interrupting the chain reaction of the fire. In just a few seconds, the fire within the device is extinguished.

An AMFE system with Novec™ Engineered Fluid extinguishes fires much faster than an AMFE with inert gas or CO_2.

The damage to high-value equipment and machines caused by the rapid spreading of fire can thus be significantly reduced.

The comparison of the performance of stationary fire suppression systems shown below illustrates the extinguishing performance of various agents.

Time advantage: fire suppression system with Novec 1230



Other applications of 3M™ Novec™ Engineered Fluid as a fire extinguishing agent

Novec 1230 Fire Protection Fluid is exclusively intended for the use in **stationary indoor fire suppression systems and in lockable rooms**. It is a highly efficient extinguishing agent that is electrically non-conductive and leaves no residue to clean up. This makes it ideal for use in special hazard areas where maintaining continuous operation of high-value equipment is critical both during and after the outbreak and suppression of a fire.

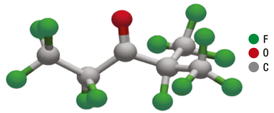
Thanks to its properties and the design of the required fire suppression system, Novec 1230 Fire Protection Fluid can also be used in occupied spaces.

Applications for stationary fire extinguishing systems:

- **IT areas**
  Data centers, computer rooms
  Control stations (e.g. at airports)
- **Control rooms**
  Clean rooms
  Laboratories
- **Telecommunication**
  Telephone exchanges, technology locations
- **Power stations**
  Control stations, substation rooms
- **Hospitals, medical centers**
  CT and MRI rooms
- **Marine**
  Machinery spaces and pump rooms
  Communication and control centers
- **Archives, libraries and museums**

How 3M™ Novec™ Engineered Fluid works as an extinguishing agent

This specific Novec Engineered Fluid is a C_6-fluoroketone with the chemical formula $CF_3CF_2C(O)CF(CF_3)_2$. At room temperature it is a liquid. It has a boiling point of 49°C.



After being discharged by the E-Bulb or AMFE, it gasifies immediately to flood the area as a gaseous agent. Novec Fire Protection Fluid has an excellent penetration capacity and rapidly reaches all critical areas (e.g. in switching cabinets).

Unlike inert gases, the **extinguishing effect** of Novec Fire Protection Fluid is not based on oxygen displacement, but on the principle of homogenous inhibition (which means there is no hazard to human life from a shortage of oxygen).

When the extinguishing agent comes into contact with the source of the fire, it removes heat energy and reduces the temperature to the point that the chain reaction is interrupted.

High safety for people

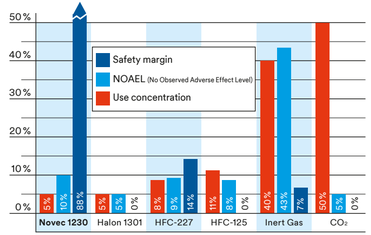
Typically, fire extinguishing agents pose a potential hazard to human health. The hazardous effect of an agent after its discharge is evident from its approved use concentration. The NOAEL scale (No Observed Adverse Effect Level) is the internationally accepted limit for the various extinguishing media.

The **safety margin for people** is calculated on the basis of the difference between the use concentration and the specific NOAEL value. The use concentration is the amount of extinguishing agent required to safely extinguish the fire.

The E-Bulb and AMFE use amounts of the extinguishing agent small enough that this aspect can be safely ignored.

As the graphic shows, Novec 1230 Fire Protection Fluid provides by far the highest safety margin when used in large-scale stationary fire extinguishing systems. This level of safety is maintained, even in the case of subsequent modifications made within the protected area (e.g. the integration of additional inventory, whereby the room's oxygen content is lowered and the safety margin reduced).

The safest extinguishing agent for occupied spaces



At a glance – properties and advantages for use in electrical devices and equipment:

- Rapid extinguishing
- Highly efficient, only small quantities are required
- No hazard to human health
- No damage to equipment and materials
- Electrically non-conductive and no corrosive effects
- Lowest global warming potential (GWP=1)
- Zero ozone depletion potential
- Minimizing consequential damage