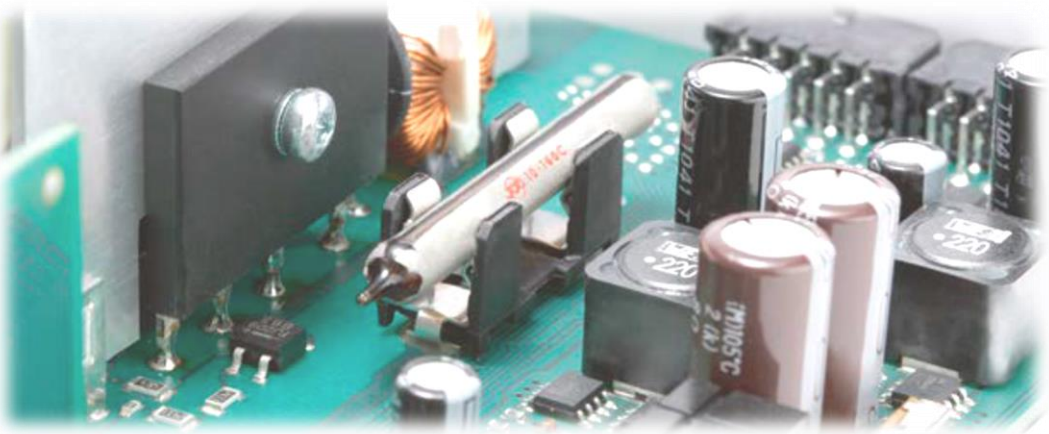
FIRE AND SECURITY TECHNIQUES

E-Bulb

Device Integrated Fire Protection

Safety for people and electrical equipment



Developed for the future: The E-Bulb

Smallest fire extinguisher in the world

Around 30% of all fires are caused by electricity, many of them in within electrical appliances.

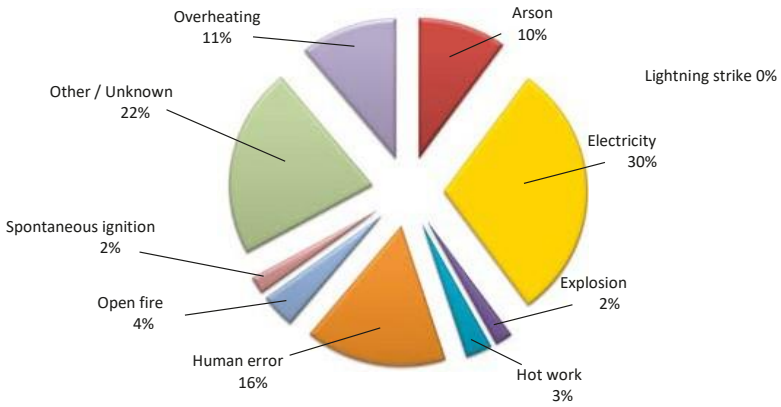
Be aware that electrical equipment poses a constant fire risk

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.

The E-Bulb is a device integrated fire protection component, which can extinguish fires directly in electronics, before they become visible and cause damage.

Causes of fires

(Source: IFS Schadendatenbank 2012)



What is the E-Bulb and how does it work

The E-Bulb is a Circuit Interrupter with Fire Extinguishing Agent (CIFEA, UL 60692), which in its smallest version is just 2 cm tall, and can even be hidden behind a 1-Euro coin. This makes the E-Bulb the smallest fire extinguisher in the world.

Quality-conscious manufacturers have been bringing safe products to the market for years. The causes which can lead to a technical defect, and possibly fire, can never be completely excluded.

Around every third fire is caused by electricity, many from electrical appliances. The E-Bulb can be built directly into the electronics by manufacturers, and protects you from further damage when it otherwise would have been too late.

If an electrical device develops a technical defect, the E-Bulb can detect the fire, extinguish it, and prevent it from reigniting.

The E-Bulb is an innovative new component and can support quality-conscious manufacturers in making safe electrical devices even safer.

The E-Bulb triggers the release of the fluid at a defined, application-specific temperature and 3M™ Novec™ Engineered Fluid is immediately released into the device.

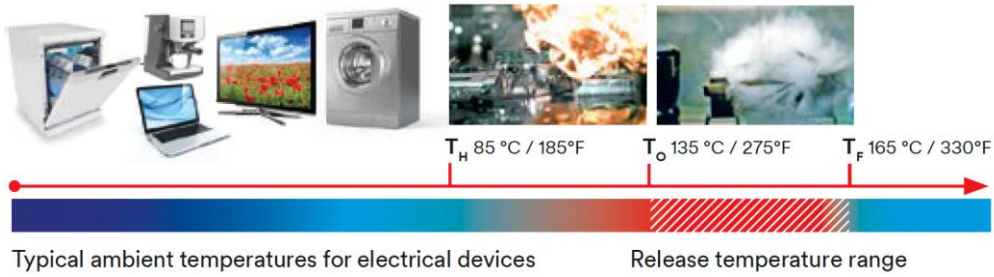
This means it is calibrated to a critical temperature lying within the temperature range of an incipient fire, e.g. initiated by a short circuit or over-heating.

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.

Comparable to the aqua-stop leak protection in washing machines, the E-Bulb is part of the fire-stop system for electrical appliances.

The E-Bulb can be easily installed directly onto circuit boards or in the electronics area, protecting your electrical devices around the clock.

The E-Bulb was developed based on sprinkler glass technology, which has been tried and tested billions of times, and consists of a coated glass bulb filled with a non-toxic extinguishing agent



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

Small	Medium	Large
Ø 5 x 20 mm	**Ø 5 x 40 mm**	**Ø 7 x 40 mm**
Irreversible power interruption	Irreversible power interruption	Irreversible power interruption
Prevention of re-ignition	Prevention of re-ignition	Prevention of re-ignition
Fire extinguishing function	Fire extinguishing function	Fire extinguishing function
Extinguishing agent: 3M™ Novec™ Engineered Fluid	Extinguishing agent: 3M™ Novec™ Engineered Fluid	Extinguishing agent: 3M™ Novec™ Engineered Fluid
Protected volume [Litre]: **0,416**	Protected volume [Litre]: **1,049**	Protected volume [Litre]: **2.212**
Activating temperature: **135°C – 165°C**	Activating temperature: **135°C – 165°C**	Activating temperature: **120°C – 165°C**
Max. Continuous ambient temperature: **+85°C**	Max. Continuous ambient temperature: **+85°C**	Max. Continuous ambient temperature: **+85°C**
Current load capacity per version: **<1A, <5A, <10A oder <16A** possible	Current load capacity per version: **<1A, <5A, <10A oder <16A** possible	Current load capacity per version: **<1A, <5A, <10A oder <16A** possible
Voltage: **0..250V AC/DC**	Voltage: **0..250V AC/DC**	Voltage: **0..250V AC/DC**
Minimum operating-/Storage temperature: **-40°C/-40F**	Minimum operating-/Storage temperature: **-40°C/-40F**	Minimum operating-/Storage temperature: **-40°C/-40F**

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.

3M™ Novec™ 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.

Recognised and confirmed by:

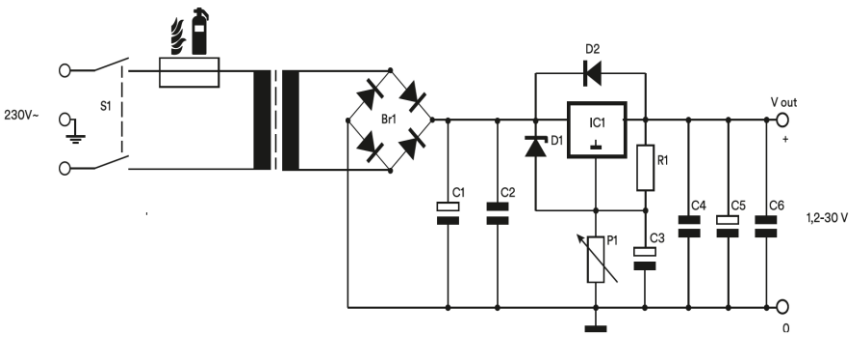
- MPA and VDE tested
- E-Bulb is UL listed (E484622)
- REACH compliant

✓ MPA verified
✓ VDE tested
✓ UL listed
✓ VdS certified

✓ 3D / 2D models
✓ Footprint model
✓ Datasheets
✓ Electrical graphical symbol
✓ Design-in guide

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.



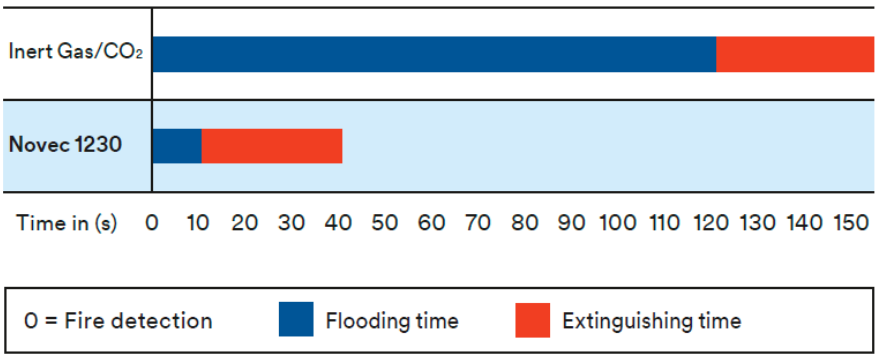
Very short extinguishing times

Once the E-Bulb is activated, the device is rapidly flooded with 3M™ Novec™ Fire Protection Fluid. Depending on the size of the E-Bulb, it takes 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.

Novec™ Engineered Fluid extinguishes fires much faster than an 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.



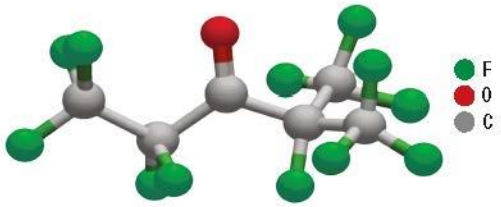
Applications for stationary fire extinguishing systems:

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



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.

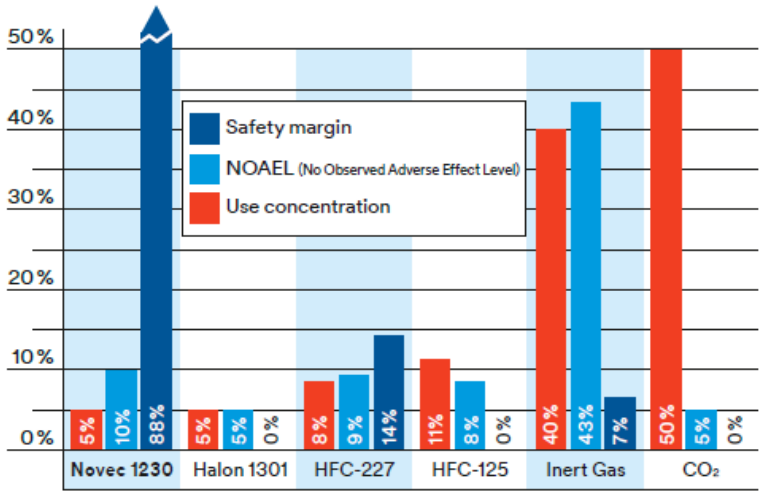
The **safety margin for people** is calculated on the basis of the difference between the use concentration and the specific NOAEL value. The use concentration is the amount of extinguishing agent required to safely extinguish the fire.

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

E-Bulb System Testing:

UL report Mitigating the Risk of Appliance Printed Wiring Board Fires
successfully ceased arcing fires with CIFEAs

CIFEA UL listing based on UL 60692 (2018)
aging, temperature rise and current-carrying capacity test, transient overload test, short circuit, …

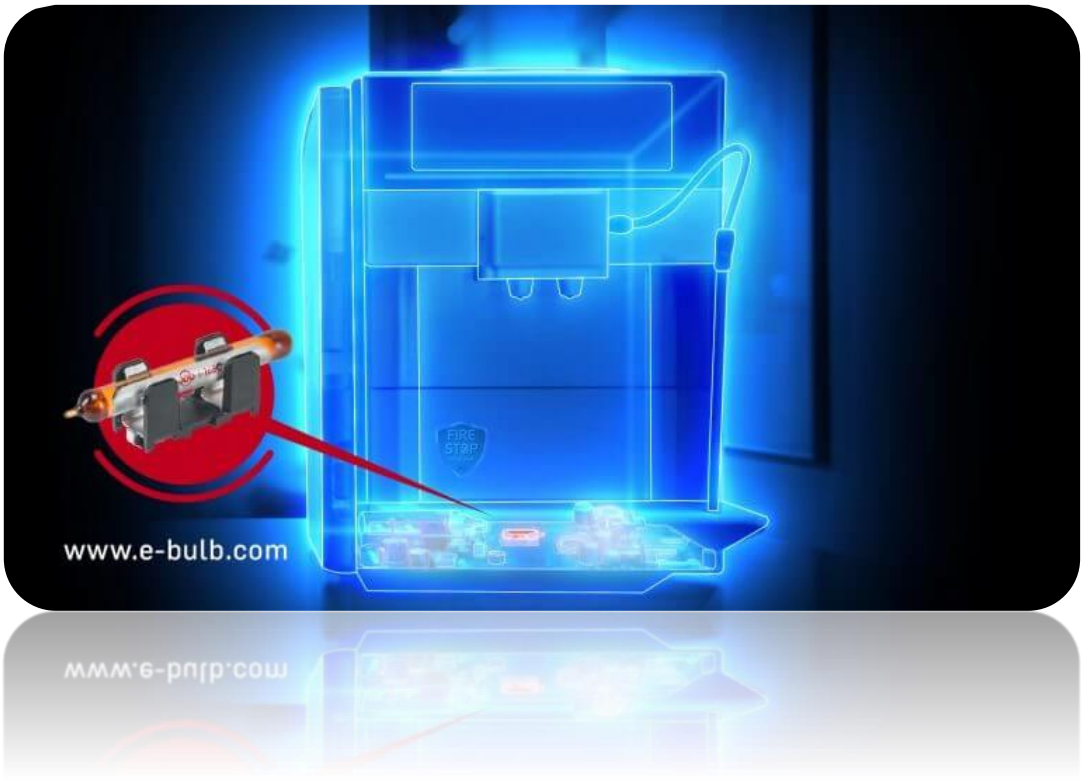
VdS extinguishing capability tests (2019)
extinguishing capability tests

Aging testing
"85/85 test" (85°C, 85% humidity, DC, several days), cycle tests, …

Extinguishing capability and power cut off tests by MPA Dresden (2013, update 2019)

Safety and reliability tests by VDE Germany (2016)
comprehensive electrical and mechanical strength tests, performance safety

Salt spray, shock and vibration tests by Paconsult (2017, 2019, 2020)



Disclaimer

The E-Bulb product line is manufactured by **JOB GmbH**

The E-Bulb is **"MADE IN GERMANY"** and manufactured in accordance with all applicable standards and laws for the place of manufacturing

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