

Electrical Fires Explained



What are electrical fires?

Under **BS EN 2:1992 Classification of Fires** electrical fires do not have an official fire class designation.

Not a fuel: Electricity is an energy source, not a burning material or fuel.

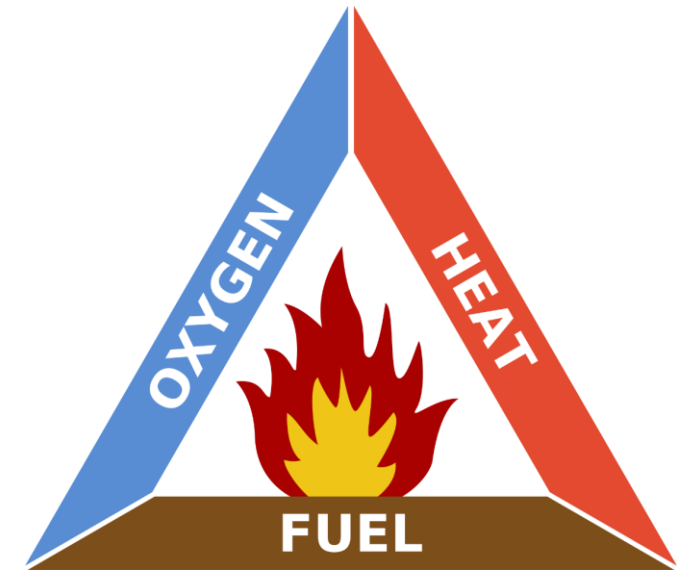
Underlying material: When electrical equipment catches fire, the actual fuel is usually surrounding plastic casing, insulation (Class A), or surrounding liquids (Class B).

What we are interested in is **electricity as a source of ignition**.

Pre-requisites for ignition to be from an electrical source are:

1. That the electrical installation must have been energised. Sufficient **heat** must have been generated by means of electrical energy at a point close enough to ignite combustible material.
2. The requirement for ignition is that the temperature of the electrical source be maintained long enough to bring the adjacent **fuel** up to its ignition temperature with **oxygen** present to allow combustion.

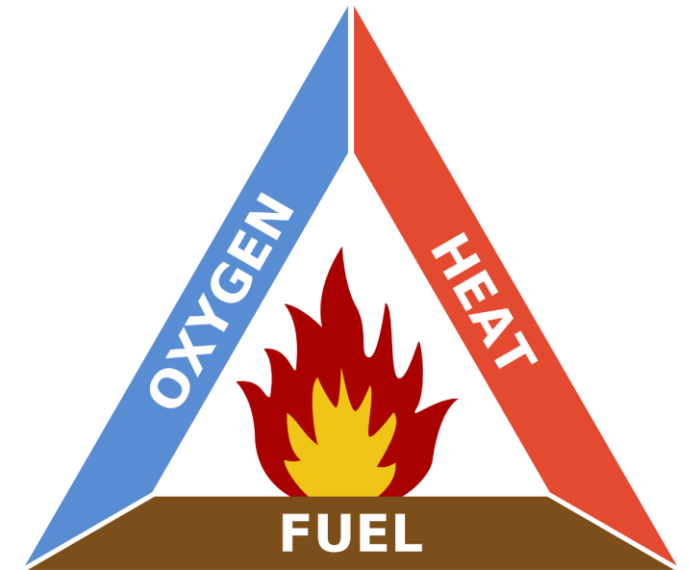
This is expressed simply as the Fire Triangle.



Ignition Sequence

Electrical fires typically follow this progression / stages:

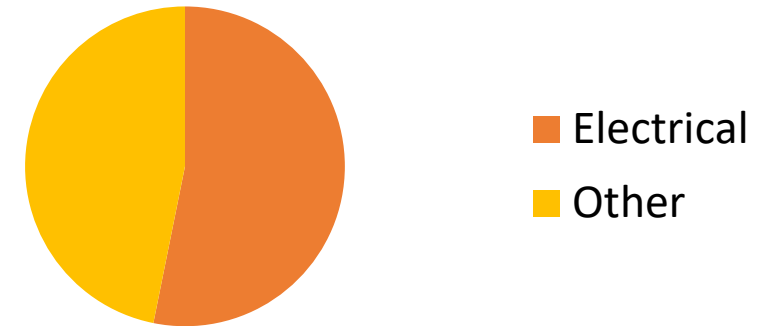
1. High-resistance fault
2. Localised heating
3. Pyrolysis / Carbonisation
4. Arcing
5. Ignition
6. Fire



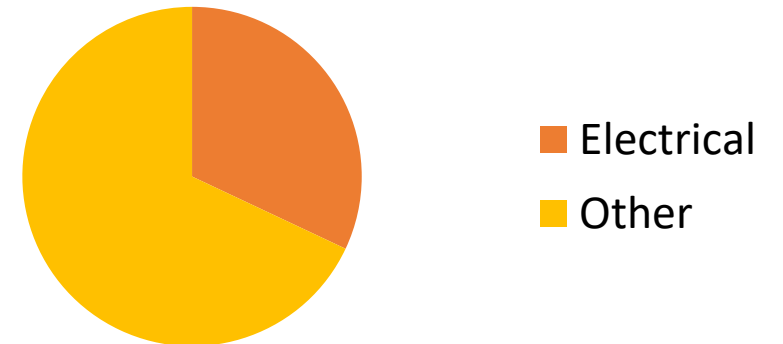
How big a problem is it?

The total number of fire incidents attended to by Fire and Rescue Services (FRS's) in the England in year 2025-2026 was 39,859

In Domestic premises 53.4% were electrical in origin



In 'Other Buildings' (i.e. Workplaces and Commercial) between 17% to 32% were electrical in origin



Causes of Electrical Fires

Three categories to consider



A. Faults and Overload currents.



B. Arcing.

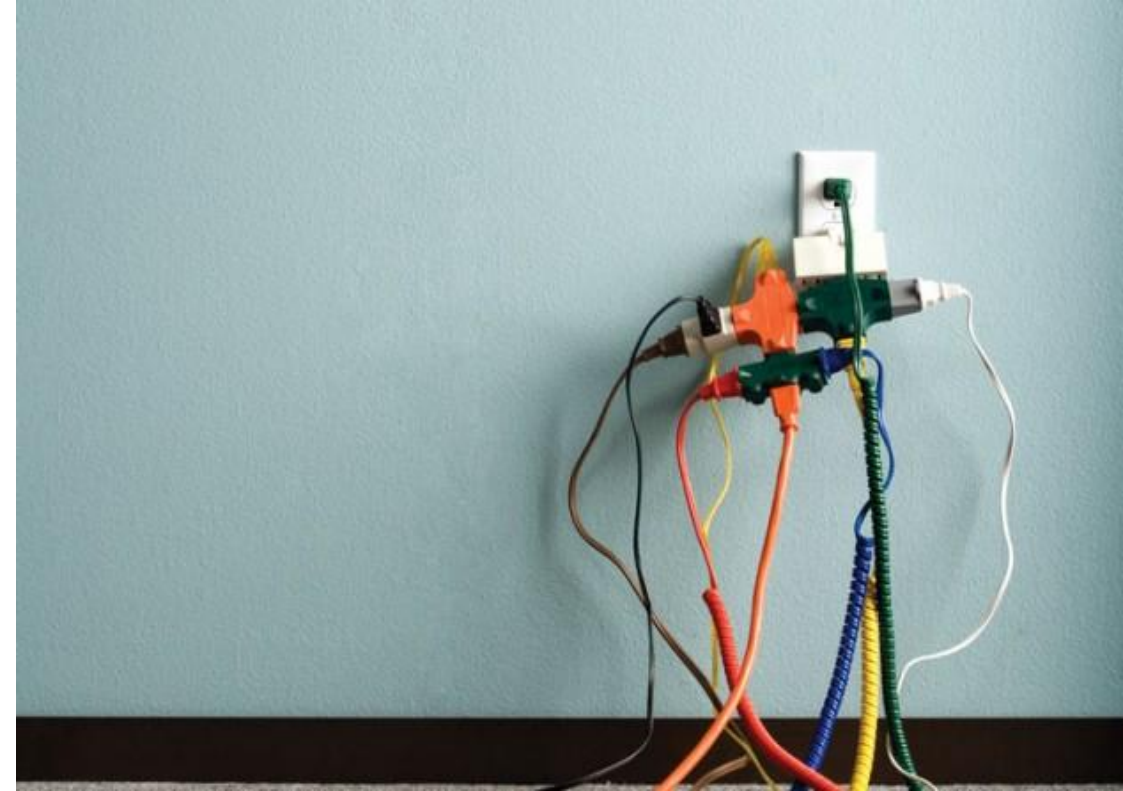


C. High Resistance Connections (HRC)

Causes of Electrical Fires – Faults and Overload Currents.

These can occur at any point in the system.

Too much demand placed on the system or an imbalance of the system.

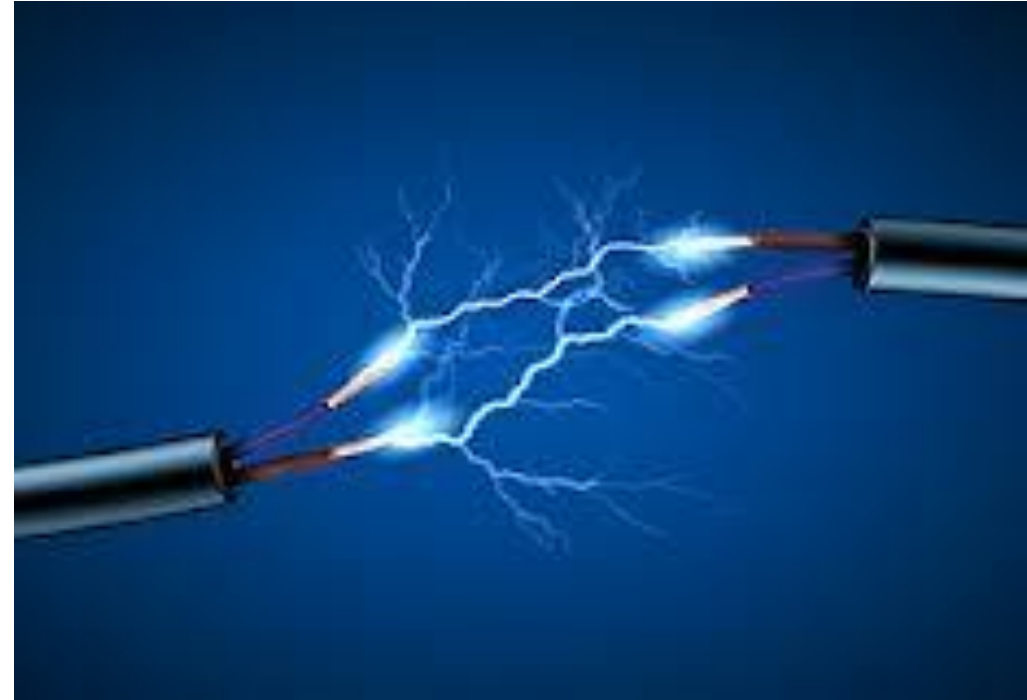


Causes of Electrical Fires – Arcing

An arc is a high temperature luminous discharge of electrical energy across a gap – instantaneous temperatures in the range of several thousand degrees

For an arc to jump even the smallest gap in air there must be a potential of at least 327 Volts, so arcs are not present in normal circumstances in 230 Volt systems. They are more of a problem in high voltage installations

Can cause localized heating which can be hazardous



Solutions - For Arcing

Arc Fault Detection Device – AFDD

Electronic devices that look for specific signature characteristics rather than current magnitude.

Can detect sudden bursts of current lasting milliseconds that a normal protective device would not.

Can be combined into a protective device that offers protection against earth leakage, overcurrent and arc detection.

Limitations

Only provide protection against Arcing - don't provide protection against HRC as they do not sense heat.

Possibility of nuisance tripping.

Cost - Relatively expensive.

These devices can mitigate the effects of arcing but **cannot** eliminate them completely.

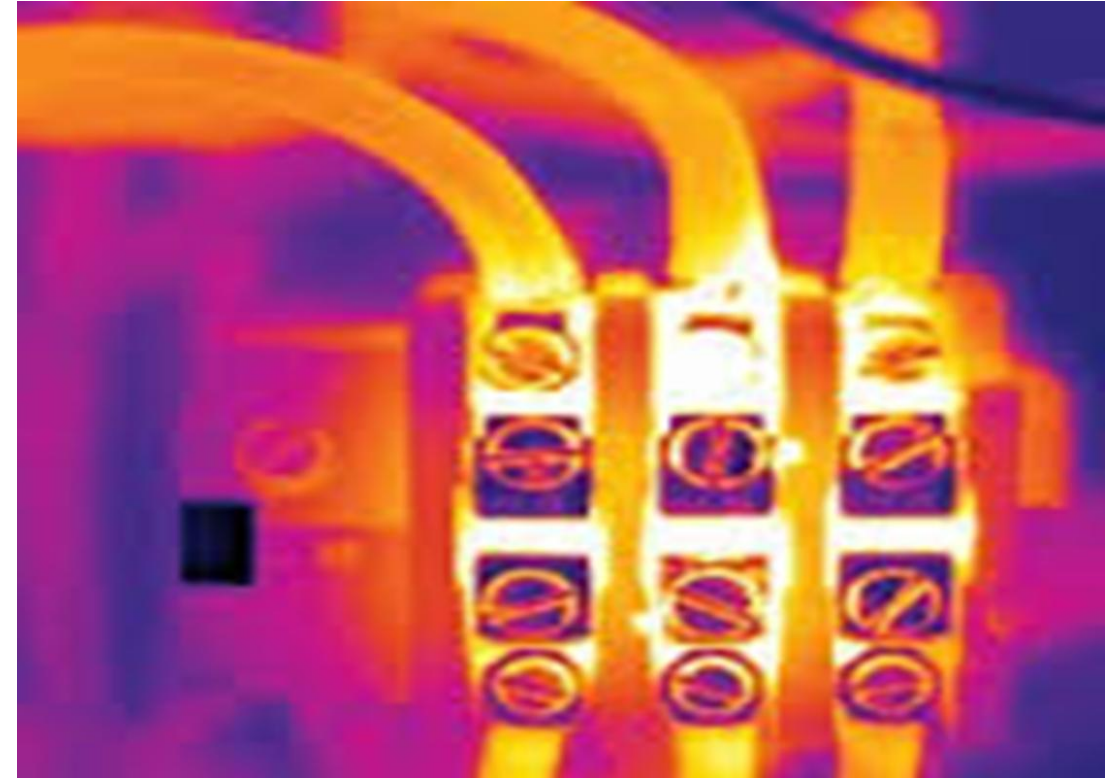


Electrical Causes of Fire – High Resistance Connections - 1

HRC simply refers to a connection between two or more contacts that resist the flow of electricity

This fault can occur in a circuit at any point where a cable or wire is terminated

The most common cause of HRC is simply a loose screw terminal connection either not sufficiently well made in the first place or else having worked loose over a period of time due to thermal cycling (thermal creep)

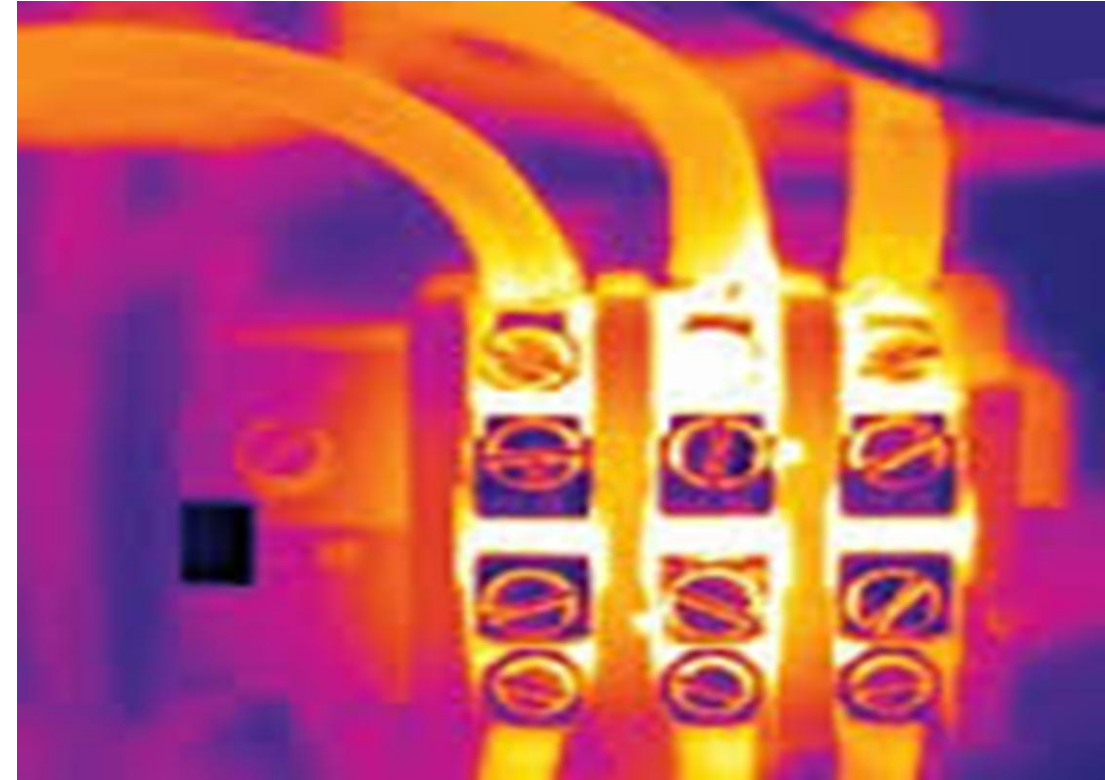


Electrical Causes of Fire – High Resistance Connections - 2

Why is HRC potentially dangerous? Because anything that impedes the flow of electricity acts as a load and generates heat (“resistive” or “ohmic” heating) with this heat being confined to a relatively small area

When a copper conductor heats up, it oxidises – a layer of non-conducting copper oxide builds up which, in turn, increase resistance, leading to more heat

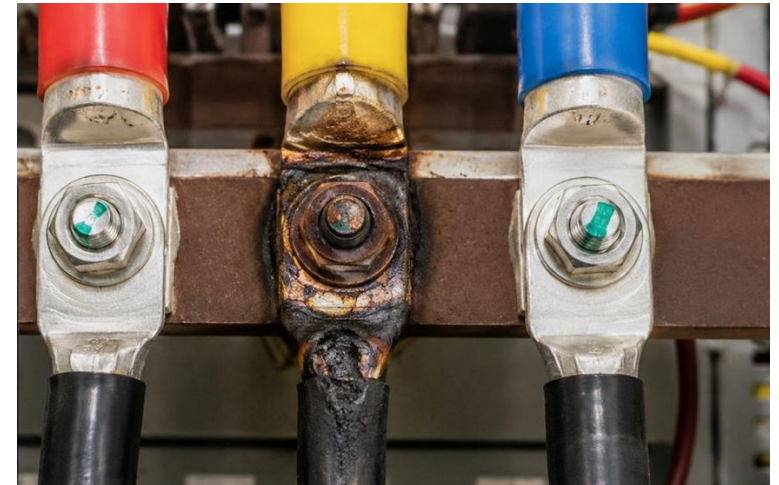
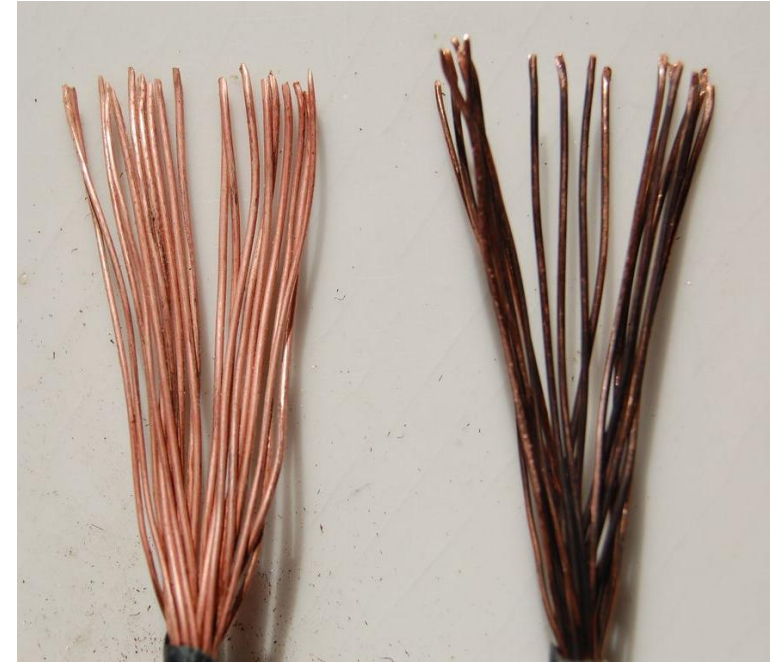
Over a period of time – and left unnoticed - HRC can reach a point whereby thermal runaway occurs – the heat generated cannot be dissipated quickly enough and continues to increase



Electrical Causes of Fire – High Resistance Connections - 3

Eventually, the heat generated may result in temperatures in excess of 1300°C – enough to ignite adjacent combustible materials.

Circuit protection devices such as MCB's and RCD's are unable to protect against HRC because they cannot sense heat



Solutions - For High Resistance Connections

Using components which can detect heat

Detects abnormal heating of connections which may be prone to the effects of HRC or prolonged overload

Ensures that a connection can be prevented from reaching a temperature which could result in a fire i.e. **a pre-ignition solution**

Alternative Technologies -LHD

Temperature sensing Analogue, Digital Linear Heat sensing cables and Linear Fibre Optic Heat Sensing tapes are intended to protect long 'straight' lengths of cable, such as submains cabling for power stations and infrastructure in tunnels.

These are used heavily in mining applications for cabling and conveyor belts when damage is likely, or the processes cause a risk of fire.

Typical lengths are 1000-3000m for cable and up to 16KM for Fibre

All require a controller per length, an interface per length, a power supply per length and an external system to connect to per unit.

As a specialist product it attracts a premium purchase price.

All the systems need specialist installers.



Alternative Technologies – Thermocouple Sensors

Many Thermocouple sensors require direct contact to measure.

For electrical connections this is not practical



Alternative Technologies – Linear Pneumatic Systems

Linear Pneumatic Tubing reacts to the heat of flame, triggering the operation of a gas extinguishant.

This is a POST-IGNITION solution

Links are required to a 3rd Party system to give remote indication of a fire event.



Alternative Technologies

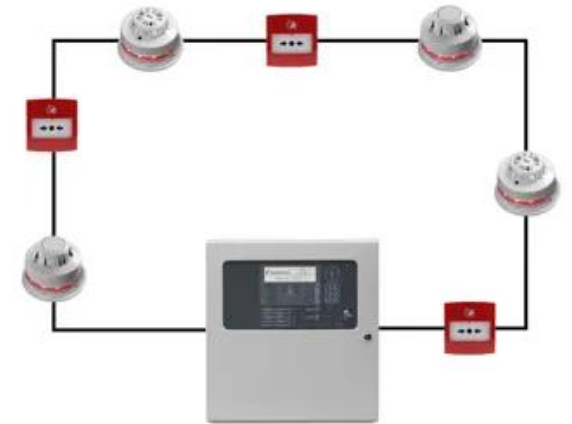
Traditional Fire Alarm Systems

Traditional fire alarm systems are POST-IGNITION sensing

Operation of point Smoke, Heat and Flame detectors rely on a contained space, such as rooms

They offer no specific protection to electrical connections

Addressable Fire Alarm System

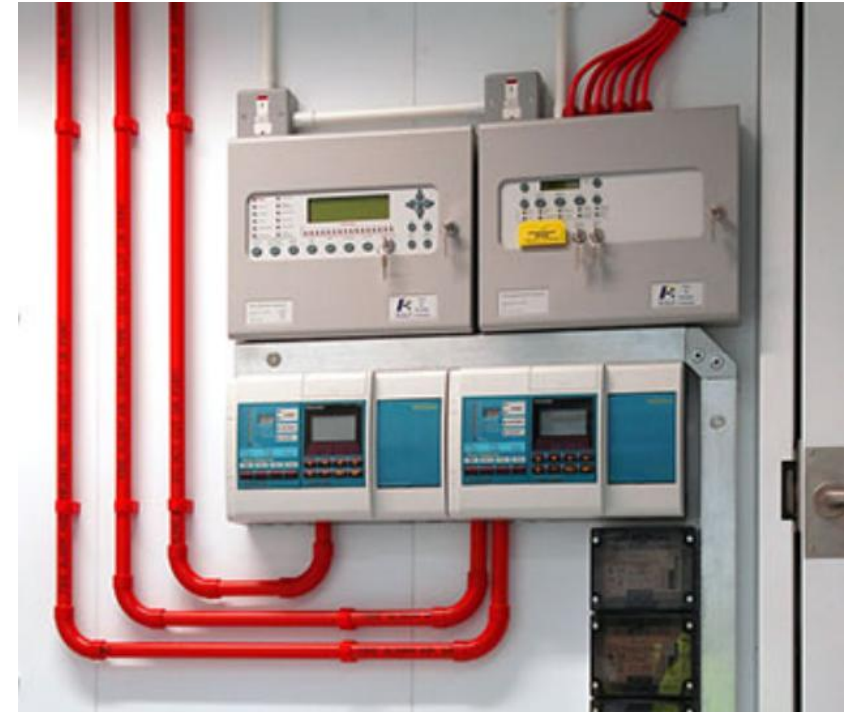


Alternative Technologies – Very Early Smoke Detection Apparatus (VESDA)

VESDA systems are POST-IGNITION sensing

VESDA systems are applicable for specific environments, involving space, i.e. rooms, inaccessible spaces (top of lift shafts / atriums etc)

They offer no specific protection to electrical connections



Alternative Technologies – Beam Detectors

Beam Detector systems are POST-IGNITION sensing

They are a fire detection solution for large or high spaces, such as warehouses and atriums, where standard smoke detectors can be uneconomical and ineffective.

They offer no specific protection to electrical connections



Alternative Technologies – Switchgear Manufacturers Specialist Systems

Switchgear manufactures specialist systems may provide 'heat' detection in certain instances however they require further infrastructure

As with point smoke detectors and VESDA systems they are sensing burning and can only be described as a POST-IGNITION sensing device

They are intended for installation in switchgear panels where space (and power) is available

They offer no specific protection to electrical connections



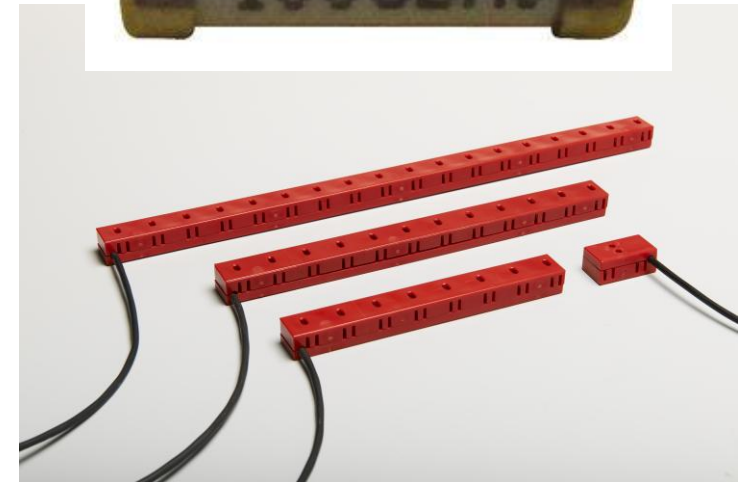
Alternative Technologies – Thermarestor®

Thermarestor is a Normally Open circuit switch which closes at a set temperature of 80degC (+/-5degC) and remains closed, this prevents circuits from being re-energised until such time that the fault has been investigated and rectified by a competent person

Sensors are installed in close contact with the connection point to be monitored, for early detection of an issue.

SinglePoint Sensors are selected for individual connections or MultiPoint Sensors for adjacent terminations.

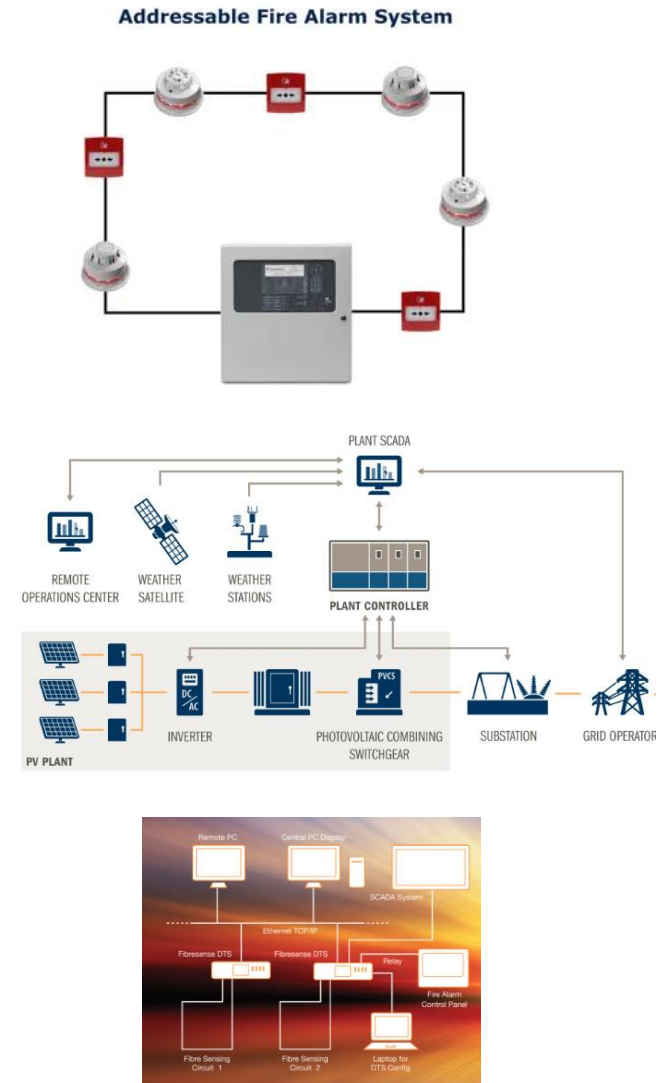
Sensors can be retrofitted to existing equipment and to new installations



Signalling of Alarm

All sensors require a system / method to communicate the activation

These can be simple systems to large site wide sense and control systems such as BMS or SCADA

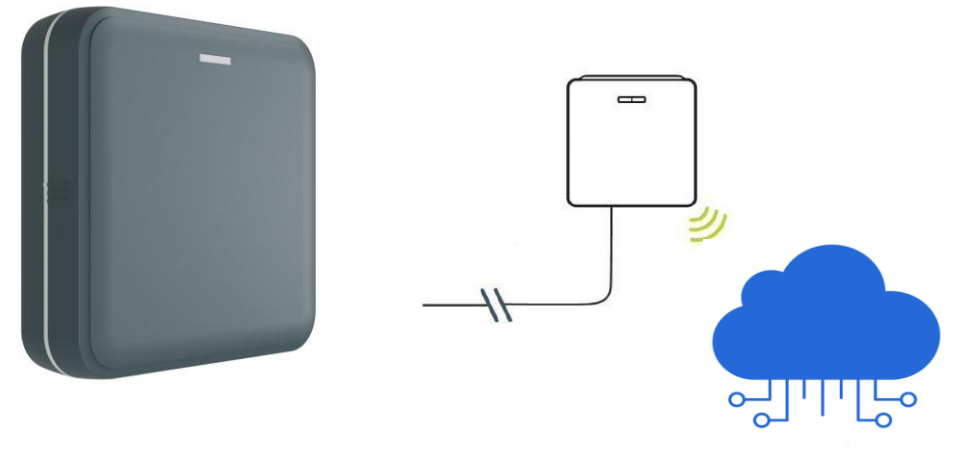


Signalling of Alarm – Thermarestor®

Thermarestor communicators are a standalone, battery operated, 4G device, linked to a web-based portal, that then message to maintenance engineers and management via mobile phone app and emails

No need for a local power supply or data connection / Wi-Fi

The automatic functions of the Portal and App negate the need for monitoring of the system



THERMARESTOR®
innovation transforming fire safety

Account Add Device Support

Dashboard

Name	Location	Status	Communication
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC2 STRING INVERTOR 2	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC3 STRING INVERTOR 3	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC4 STRING INVERTOR 4	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC5 STRING INVERTOR 5	✓	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC6 STRING INVERTOR 6	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC7 STRING INVERTOR 7	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC8 STRING INVERTOR 8	✓	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC9 STRING INVERTOR 9	✓	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC10 STRING INVERTOR 10	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC11 STRING INVERTOR 11	✓	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC12 STRING INVERTOR 12	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC13 STRING INVERTOR 13	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC14 STRING INVERTOR 14	✓	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC15 STRING INVERTOR 15	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC16 STRING INVERTOR 16	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC17 PLANT ROOM	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC18 PLANT ROOM	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC19 STRING INVERTOR 19	✗	✗
Main Energy Break- Raisen	Ukita Costa Photo SP13419-150 MC1 STRING INVERTOR 1	✓	✗



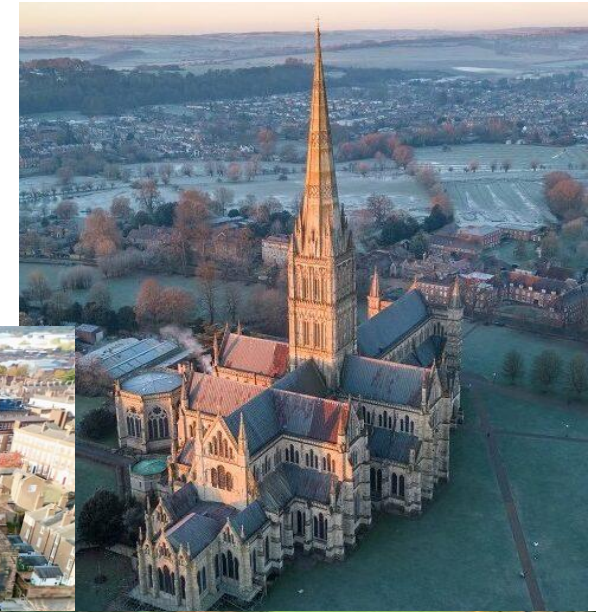
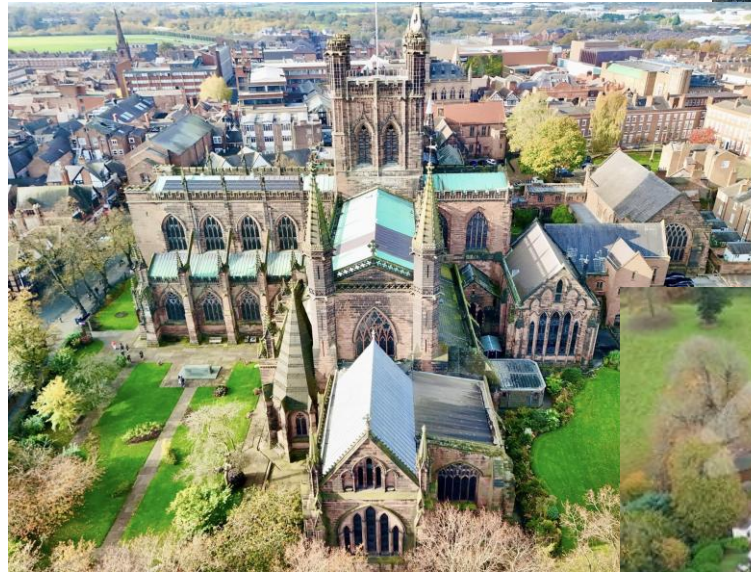
Which markets are Thermarestor® Suitable - all electrical connections especially in Heritage Buildings

Thermarestor currently protect the following
buildings

Salisbury Cathedral

Chester Cathedral

Scotney Castle



Conclusion

Thermarestor offers a complete, simple, targeted PRE-IGNITION product with the communicator and portal for end-to-end sensing and reporting. It is economic. It does not require specialist installers.

All alternative Technologies offer products that do not address the issues of proximity to High Resistance Connections directly.

Alternative Technologies do not offer a complete system or rely on compatible systems to provide head end controls.

Alternative Technologies require additional power supplies, some in areas where none are available.

Alternative Technologies require specialist installers.

