



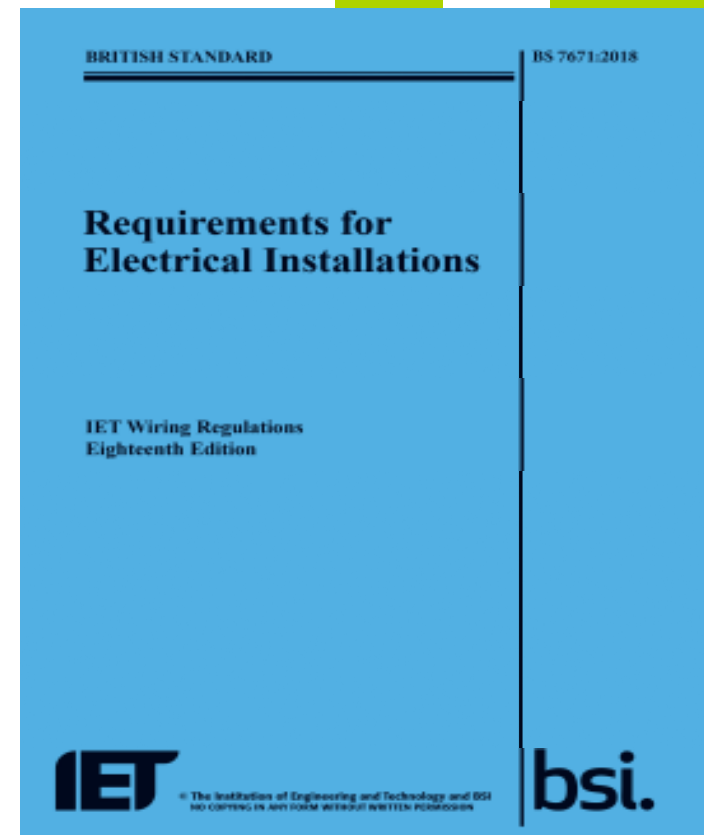
# 18<sup>th</sup> Edition Wiring Regulation BS 7671: 2018

The introduction of the 18<sup>th</sup> Edition Wiring Regulations BS 7671 were released on draft in July this year and will come into force on the 1<sup>st</sup> January 2019

There have been 2 major areas of interest within this publication

- 1) The introduction of Surge protection devices in domestic installations(**SPD**)
- 2) Arc Fault Detection Devices in domestic installations(**AFDD**)

The following slides will give an overview of the product, basic usage and clause numbers



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## Requirements for Electrical Installations

IET Wiring Regulations  
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# 18<sup>th</sup> Edition Wiring Regulations

Guide to Surge protection  
Devices (SPD)

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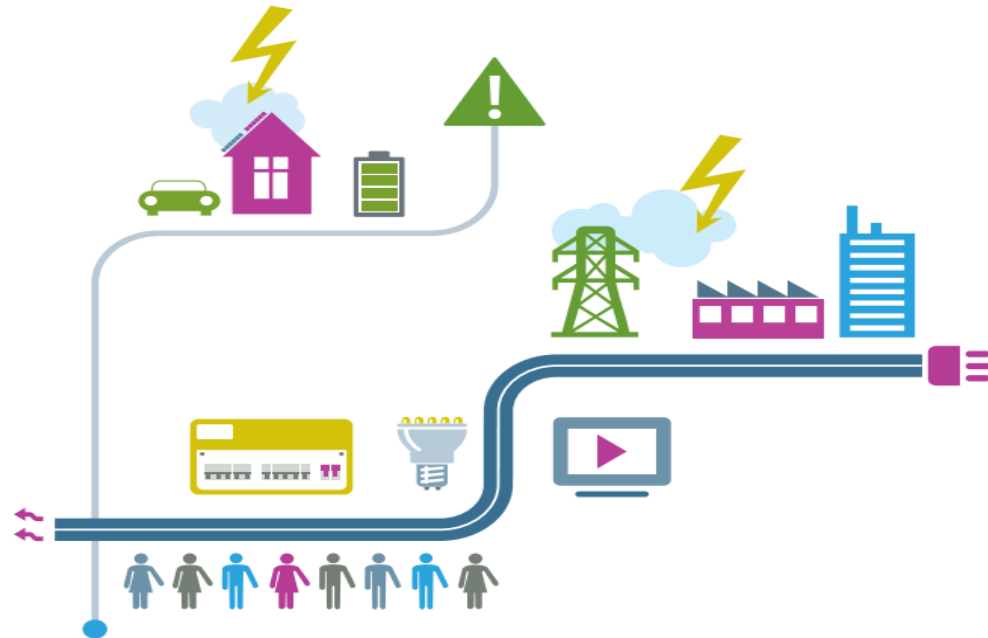
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## SPD Definition

Surge Protection Device – component of the electrical installation protection system. This device is connected to the power supply in parallel with the loads (circuits) that it is intended to protect



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# 18<sup>th</sup> Edition Risk Assessment

- Currently SPD devices are installed if written into the installation specifications or if the installation is deemed to be in a high risk area e.g., high rise buildings, overhead cables etc.. and normally only at the intake position of the building, not at secondary distribution points, but things are about to change.....
- SPD's have now been introduced as a mandatory requirement into the 18<sup>th</sup> edition wiring regulations for **domestic installations**.
- The Installer now has to carry out a localised risk assessment of the property and its electrical supply, this exercise will determine if the SPD is a requirement or not.
- The risk assessment is based upon the properties geographical location, the amount of lightning flashes per year and how the incoming electrical supply enters the building. All of these factors have an outcome which determines if an SPD is a requirement.



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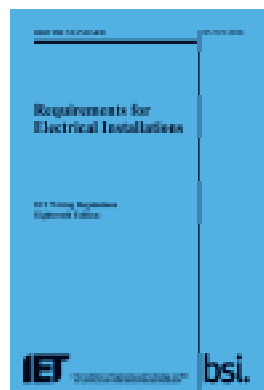
# 18<sup>th</sup> Edition Risk Assessment Criteria

Calculated risk level (CRL) is used to determine if protection against transient overvoltage of atmospheric origin is required. The CRL is found by the following formula

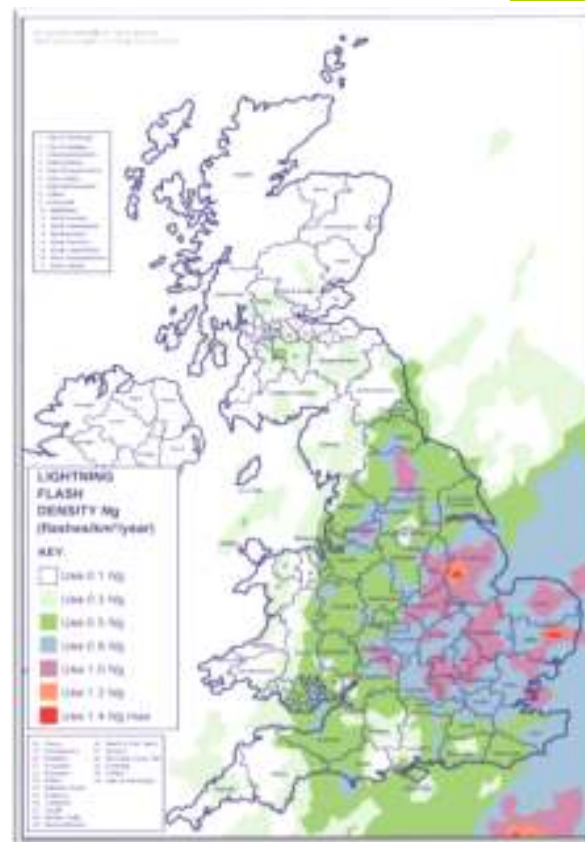
$$CRL = f_{env}/L_p \times N_g$$

KEY:

- $f_{env}$  – environmental factor Table 443.1 pg. 103
- $L_p$  – risk assessment length(km) pg. 103
- $N_g$  – lightning flash density(km<sup>2</sup> per yr.) pg. 102 relevant to the location of the power line and connected construction - Tables 443.1 & 443.2 pg. 105



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Lightning flashes per year/Km<sup>2</sup> or the  $N_g$  value

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## SPD types



1



2



Suitable for domestic consumer unit protection



3

### Type 1 SPD

The Type 1 SPD is recommended in the specific case of **service-sector and industrial buildings**, protected by a lightning protection system or a meshed cage.

It protects electrical installations against direct lightning strokes. It can discharge the back-current from lightning spreading from the earth conductor to the network conductors.

Type 1 SPD is characterized by a 10/350  $\mu$ s current wave.

### Type 2 SPD

The Type 2 SPD is the main protection system for all low voltage electrical installations. **Installed in each electrical switchboard**, it prevents the spread of overvoltage's in the electrical installations and protects the loads.

Type 2 SPD is characterized by an 8/20  $\mu$ s current wave.

### Type 3 SPD

These SPDs have a low discharge capacity. They must therefore mandatorily be installed as a **supplement to Type 2 SPD and in the vicinity of sensitive loads**.

Type 3 SPD is characterized by a combination of voltage waves (1.2/50  $\mu$ s) and current waves (8/20  $\mu$ s).



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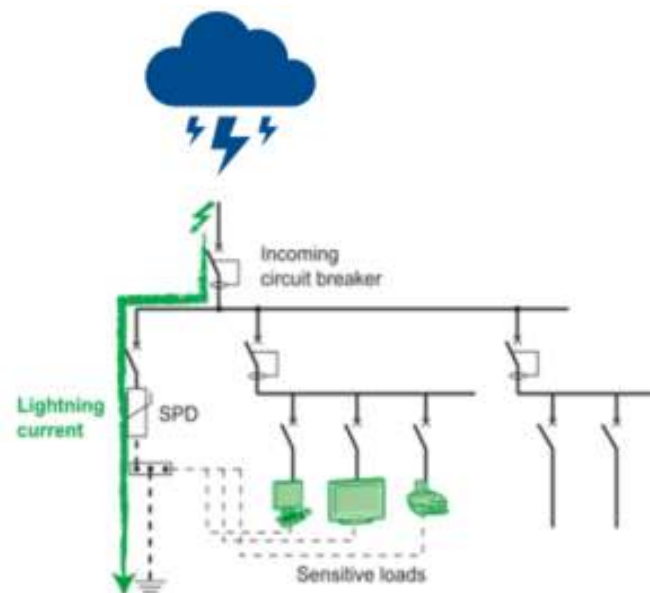
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# How SPD's work

## Principle of Surge Protection Operation

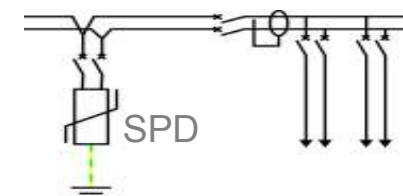
- SPD's are designed to limit transient overvoltage due to lightning strikes or switching, and divert the associated surge currents to earth, so as to limit this overvoltage to levels that are unlikely to damage the electrical installation or equipment
- The role of the SPD is to drive the lightning/surge current to earth in a very short time <350 microseconds



Basic SPD Operating Diagram

However the SPD is not intended to be exposed to a permanent overvoltage (in this case it would be short circuited and may damage the consumer unit) A device protecting the SPD against short circuits is therefore required to ensure safety of the electrical installation

The SPD **must** be **protected upstream** by a **disconnection circuit breaker** (MCB)



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# What is a transient overvoltage

- A transient overvoltage or surge is a short duration increase in voltage measured between two or more conductors.
- In this context short means anything from microseconds (millionths of a second) to a few milliseconds (thousandths of a second) in duration.
- The increase in voltage will vary from a few volts to thousands of volts.
- This voltage exists between two or more conductors.
- For a mains power supply, these conductors would be the line, neutral and earth.
- These can be created from atmospheric (lightning) or switching (Industrial) occurrences.

**‘Transient overvoltage’, is technically and descriptively the best terminology. However, transients are also referred to as surges, spikes and glitches.**

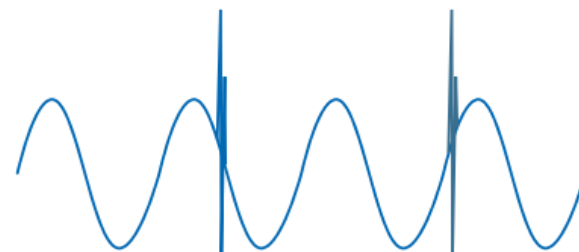


FIGURE 1 – Transient Overvoltage (Surges)

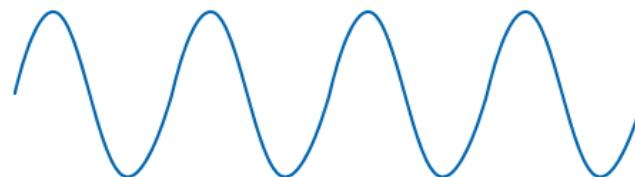


FIGURE 2 – Normal Mains Supply Waveform

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**Surge Protection Devices**





# 18<sup>th</sup> Edition clause number

## SPD - Surge Protection Device

### 443.4 Overvoltage control

Protection against transient overvoltage shall be provided where the consequence caused by overvoltage

- a) Results in serious injury to , or loss of , human life or;
- b) Results in interruption of public services/or damage to and cultural heritage or;
- c) Results in interruption of commercial or industrial activity or;
- d) Affects a large number of co-located individuals

For all other cases, a risk assessment according to Regulation

For all other cases, a risk assessment according to regulation **443.5** shall be performed to determine if protection against transient overvoltage is required. If the risk assessment is not performed, the electrical installation **Shall** be provided with protection against transient overvoltage, except for single dwelling units where the total value of the installation and equipment therein, does not justify such protection

**443.5** shall be performed in order to determine if protection against transient overvoltage is required. If the risk assessment is not performed, the electrical installation **shall** be provided with protection against transient overvoltage, except for single dwelling units where the total value of the installation and equipment therein, does not justify such protection.

So in basic terms an **SPD** device will need to be fitted if the installation falls under **clause 443.4** or if not sure, the risk assessment **clause 443.5** should be undertaken to determine the requirement for the installation.

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# 18<sup>th</sup> Edition Wiring Regulations

Guide to Arc Fault Detection  
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Arc Fault Detection Devices



## ARC FAULT DETECTION DEVICE (AFDD)

### AFDD Definition

Arc Fault Detection Device – device intended to mitigate the effects of arcing faults by disconnecting the circuit when an arc fault is detected



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Arc Fault Detection Devices



1

Figure 1 - AFDD integrated with an RCBO



2

Figure 2 - AFDD integrated with an MCB



3

Figure 3 - AFDD add-on Module

## AFDD's are selected based on Method of construction

1: AFDD as one single device, comprising an AFD unit and opening means and intended to be connected in series with a suitable short circuit protective device declared by the manufacturer complying with one or more of the following standards BS EN 60898-1, BS EN 61009-1 or BS EN 60269 series.

2: AFDD as one single device, comprising an AFD unit integrated in a protective device complying with one or more of the following standards BS EN 60898-1, BS EN 61008-1, BS EN 61009-1 or BS EN 62423.

3: AFDD comprising of an AFD unit (add-on module) and a declared protective device, intended to be assembled on site

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Arc Fault Detection Devices



## How AFDD's work



- Unlike an MCB which detects overloads and short circuits and RCD's which detect current imbalance, an AFDD utilises electronic technology to analyse the signature (waveform) of an arc to differentiate between normal arcing and arcing faults between **L-L** , **L-N** & **L-E**. Upon detection of an arcing fault, the AFDD disconnects the final circuit from the supply.
- In electrical circuits there are numerous cases of normal arcs appearing that correspond to a typical operation such as switches, contactors, portable tools and vacuum cleaner motors.
- To differentiate between normal arcing and arcing faults the parameters monitored are varied and numerous such as the signature (waveform) of the arc, duration of the arc & irregularity of the arc.
- AFDD's are designed and tested to not respond to arcing under normal operation of equipment, but to respond to arc faults while the equipment is in operation.

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**Arc Fault Detection Devices**



# Fault types & associated protection



## Overcurrent

- Short-term , no damage
- Long-term , thermal overload

## Originates from

- Insulation Faults
- Connections between L-L L-N
- Protection is provided by MCB,RCBO's or Fuses

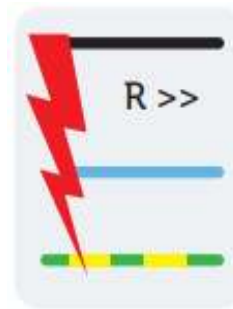


## Short Circuit Current

- Fault current may offer a very low impedance
- High Magnitude of Fault Current

## Originates from

- Mechanical Damage, water ingress
- Connections between L-L L-N
- Protection is provided by MCB , RCBO'S or Fuses



## Leakage current

- Typically Earth Leakage Current
- Typically much smaller than nominal current approx. 1-500mA

## Originates From

- Insulation Ageing
- Mechanical Stress
- Dirt & Dust
- Connections between L-PE
- Protection is provided by RCCB's or RCBO's

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# Types of arc fault



Parallel arc fault current L-E originates from

- Fault between L-E
- High impedance due to damaged insulation, fault current is too low to operate MCB's or Fuses
- Protection is provided by AFDD's



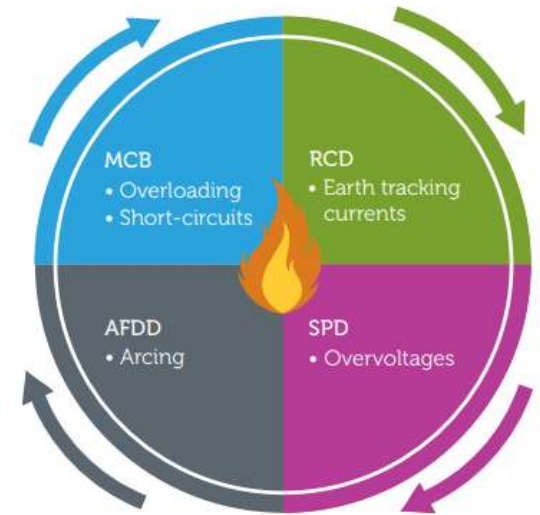
Parallel arc fault current(L-N) originates from

- High impedance due to damaged insulation, fault current is too low to trip other protection devices
- Protection is provided by AFDD'S



Series arc fault current originates from

- Damaged cable (e.g. crushed, broken etc)
- Loose connections
- Protection is provided by AFDD's



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## Arc Fault Detection Devices



# 18<sup>th</sup> Edition clause number

## AFDD - Arc Fault Detection Device

A new Regulation clause **421.1.7** has been introduced recommending the installation of arc fault detection devices. (AFDDs complying to BS EN 62606) to mitigate the risk of fire in AC final circuits of a fixed installation due to the effects of arc fault currents. These are **only recommended** and the areas that they should only be considered for as an example are .

- Premises with sleeping accommodation
- Locations with risk of fire due the nature processed or stored materials (barns, wood-working shops, stores of combustible materials)
- Fire propagating structures (high rise blocks)
- Locations with endangering of irreplaceable goods

However most of the areas listed excluding sleeping accommodation and some buildings ,will be mostly three phase installations, due to the type of machinery or the use of the building.

**Area's that have been exempt for the use of this type of device are hospitals.**

Since the introduction of the regulation there have been many questions raised by the installers as to whether these devices are a necessary piece of equipment, mainly due to the lack of confidence in the devices and the initial cost of the product (£150 Approx.)

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**Arc Fault Detection Devices**

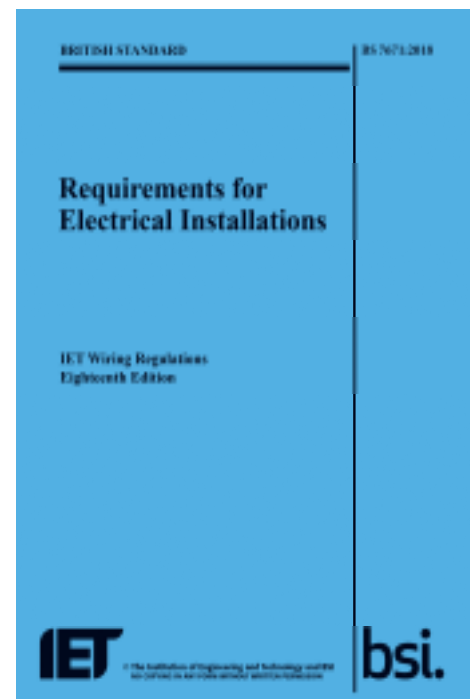




# 18<sup>th</sup> Edition summary

The 2 major product related changes for the 18<sup>th</sup> edition wiring regulations are listed below

- The introduction of SPD (surge protection device) as a requirement based on the risk assessment criteria for domestic installations refer to clause number – 443
- The recommended use of AFDD (arc fault detection device) in certain areas of domestic /commercial & industrial buildings refer to clause number - 421.1.7



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# Thank You

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