RCD.s in TN and TT earthing systems.

A look at the difference between an RCD for “Fault” protection, or “additional” protection.

The difference is crucial but often misunderstood.

Regulation 411.4.4 states:

The characteristics of the protective devices (see Regulation 411.4.5) and the circuit impedances shall fulfil the following requirement:

$$Z_s \, x \, I_a \leq U_0 \, x \, C_{min}$$

The equation is the re-arranged to make Z_s the subject:

$$Z_s = \frac{U_0 \, x C_{min}}{I_a}$$

This equation is used to produce the Z_s tables in Chapter 41 of BS 7671. This in turn means that the circuit will have sufficient current to cause automatic disconnection of the breaker in the event of a fault of negligible impedance between the line conductor and an exposed conductive part or a protective conductor.

A B32 breaker requires 160 A to operate, and providing the impedance is below 1.37Ω at 70^0C or 1.1Ωat 10^0C, 160 A will be available, and the breaker will disconnect.

The RCD (Residual current device) is then used to provide “additional” protection in accordance with Regulation 415.1.

This means that the RCD must have rated residual operating current not exceeding 30 mA. Most RCD’s that are available are 30 mA and this is given the symbol $I_{\Delta N}$

The RCD cannot be used as the sole means of protection because it is unable to detect overload. The device monitors the live conductors and will only trip if there is an imbalance. This could result from from leakage to earth, or if a person comes into contact with a live conductor.

RCD’s and breakers can be combined in an RCBO: “Residual Current Breaker Overload”

Either way, all the above describes an RCD/RCBO for “additional” protection, because there is enough current to operate the breaker during a fault, and the RCD is there for additional protection. The RCD is many times more sensitive than a circuit breaker, which means that the RCD will generally disconnect first and protect the user of the installation.

This situation changes when we have a TT earthing system. If the earth rod resistance in just below, for example 100Ω, there will clearly be insufficient current to operate the breaker within the required time, if at all! This means that the status of the RCD changes from additional, to fault protection, meaning it is effectively doing the job of the breaker in the event of a fault between live conductors and earth.