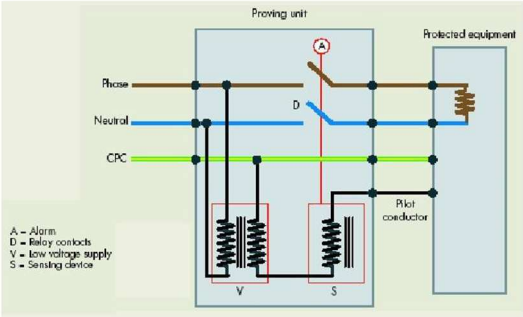
PELV and IT systems

IT systems and earth monitoring equipment



The earth conductor is not separated with PELV but monitored

Basic and Fault Protection

FELV Systems 411.7

Designed where SELV and PELV are not fulfilled (414)

Basic Protection 411.7.2

1. Insulation
2. Barriers and/or enclosures

Fault Protection 411.7.3

Exposed conductive parts shall be connected to the primary earthing system to provide Automatic disconnection in the event of a fault Methods of reducing voltage for a FELV system do not include

1. Autotransformers
2. Semiconductor devices
3. Potentiometers

Basic and Fault Protection

Reduced Low Voltage Systems (RLV) 411.8

(Voltage range < 110V AC 55V to earth single phase, 63.5V AC to earth three phase)

Basic Protection

Insulation

Barriers and Enclosures

Fault Protection

Automatic Disconnection < 5secs by OPD or RCD

For RCD: $50V \geq I\Delta N \times Zs$ ($I\Delta N \times Zs \leq 50V$) See Table 41.6

Protection against Thermal effects 420.1

Scope: electrical installations and equipment with regard to measures for the protection of persons, livestock and property against:

(i) the harmful effects of heat or thermal radiation developed by electrical equipment

(ii) the ignition, combustion or degradation of materials

(iii) flames and smoke where a fire hazard could be propagated from an electrical installation to other nearby fire compartments, and

(iv) against safety services being cut off by the failure of electrical equipment.

NOTE 1: For protection against thermal effects and fire, statutory requirements may be applicable. Refer to Appendix 2.

Protection against thermal effects

421.1.201 Domestic Switchgear

assemblies including consumer units shall comply with BSEN61439-3:

(i) have their enclosure manufactured from non-combustible material, or

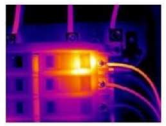
(ii) be enclosed in a cabinet or enclosure constructed of non-combustible material and complying with reg. 132.12

NOTE 1: Ferrous metal e.g. steel is deemed to be an example of a non-combustible material

NOTE 2: implementation date is January 2016 but does not preclude compliance before this date

Protection against thermal effects

421.2 protection against hot surface temperatures



Mounted on a surface of low thermal conductance

Be screened by low thermal materials

Positioned to allow dissipation of heat

421.3 protection against arcs and sparks

Totally enclosed in arc resistant material

Screened by arc resistant material

Mounted to allow safe extinguishing of sparks in compliance with its standard

Protection against Thermal effects

422.3.200 Flexible cables shall be of the following construction:

(i) Heavy duty type having a voltage rating of not less than 450/750 V,

or

(ii) suitably protected against mechanical damage. **422.3.201**

A heating appliance shall be fixed. **422.3.202**

A heat storage appliance shall be of a type which prevents the ignition of combustible dusts or fibres by the heat storing core.

Protection against Thermal effects

422.3 and 422.4 Lamps and luminares must be positioned away from combustible structures and materials

< 100W = 0.5m

> 100W < 300W = 0.8m

> 300W < 500W = 1.0m

422.3.9 where MIMS, busbar, powertrack, are not used then:

TT,TN systems should be protected by <300mA RCD

Where overheating and fire are high use a <30mA RCD

IT systems use IMD

Protection against Thermal effects

423.1 Protection against burns

TABLE 42.1
Temperature limit under normal load conditions for an accessible part of equipment within arm's reach

Accessible part	Material of accessible surfaces	Maximum temperature (°C)
A hand-held part	Metallic Non-metallic	55 65
A part intended to be touched but not hand-held	Metallic Non-metallic	70 80
A part which need not be touched for normal operation	Metallic Non-metallic	80 90

Protection against overheating

424.1 Forced air heating systems

Forced air heating systems shall be such that their heating elements, other than those of central storage heaters, cannot be activated until the prescribed air flow has been established and are deactivated when the air flow is less than the prescribed value.

In addition, they shall have two temperature limiting devices independent of each other which prevent permissible temperatures from being exceeded in air ducts.

Supporting parts, frames and enclosures of heating elements shall be of non-combustible material.

Note: comply with Building regs (CIBSE code H,C and M)

Problem Currents

Examples:

Fault current (434)

Overload currents (***433***)

Overcurrents (***435***)

Short Circuit Current (434)

Earth Fault currents (***435***)

Shock Currents

Prospective Fault Current

Protective device's Operating current

Overcurrent Protective Devices

Types of Protective Devices (In) – 432.1, 433.3, 434.3

– **BS 3036 Rewireable** fuse links

– ***BS1361 Cartridge*** Fuse links

– ***BS 88 pt 2 & pt6 HRC or HBC*** Fuses

Fuses

– *BS 3871 MCBs -*

Miniature Circuit Breakers (old type)

• *No longer included in BS7671*

– **BS EN 60898** New type **MCB**

– ***BS-EN 60947-2 MCCB*** 10kA+

– ***BS EN 61009 RCBO*** Residual Current Breaker with overload protection

Overcurrent Protective Devices

Fusing Factor – 533.1.2.2

$$\text{Fusing Factor} = \frac{\text{Actual Fusing Current } (I_2)}{\text{Rated Fusing Current (In)}}$$

Typical Fusing Factors for:

- **BS88** Pt2 & pt6 = **1.25 - 1.75**
- **BS3036** = **2**.0
- **BS1361/2** = **1.3 - 1.5**
- **BS3871 / BS EN 60898** = **1.1 - 1.4**

Appendix 3 Time current characteristics

Coordination of Protective Devices

Coordination of Protective Devices and Current Carrying Capacities of Conductors for overload and short circuit – 433.1.1, 435.1

(a) $I_B \le I_n$ ∴ $I_B \le I_n \le I_z$ $\quad I_B \le I_n \le I_z$

I_B = Amperage load

I_n = Circuit Breaker size

I_z = Current rating for cable/wire

(b) $I_2 \le 1.45 \times I_z$ **>>Overload Conditions**

– Note: It is the tabulated current after taking external factors into consideration $I_B \le I_n \le I_t \le I_z$

- Note: It is the tabulated current after taking external factors into consideration
- Compliance with 433.1.1 (i), (ii), (iii)
- HBC BS88pt2.1, pt6
- BS1361 Cartridge Fuse
- Circuit Breaker to BS EN 60898 and BS EN 60947-2
- RCBO to BS EN 61009-1

Fusing Current = Fusing Factor x Fuse Rating

$I_n \le 0.725\, I_z$ $= \frac{2}{} \times I_n$

$I_2 = \frac{2}{} \times I_n$ and $I_2 \le 1.45\, I_z$

and $\frac{2}{} \times I_n \le 1.45\, I_z$

$\therefore I_n \le \frac{1.45}{2} \times I_z \le 0.725\, I_z$

The tripping current rule $I_2 <= 1.45 I_z$

I_2 is the... I_n x 2 fusing current of a device within conventional time

Iz = current carrying capacity of the cable for continuous service.

Coordination of Protective Devices

$I_n \le 0.725\, I_z$

To Comply with BS7671 using **BS 3036 - 433.1.3**

The tripping current rule $I_2 <= 1.45 I_z$

I_n = Protective Device e.g., Circuit Breaker or rewirable fuse size

In order to satisfy the terms in **433.1.1 (ii)** then: $I_n \le 0.725\, I_z$

To satisfy the fact that rewirables have a fusing factor up to 2 times

Fusing Current = Fusing Factor x Fuse Rating

$= \frac{2}{} \times I_n$

$I_2 = \frac{2}{} \times I_n$ and $I_2 \le 1.45\, I_z$

and $\frac{2}{} \times I_n \le 1.45\, I_z$

$\therefore I_n \le \frac{1.45}{2} \times I_z \le 0.725\, I_z$

I_2 is the... I_n x 2 fusing current of a device within conventional time

Iz = current carrying capacity of the cable for continuous service.

The use of Semi-enclosed or re-wireable fuses to BS3036 is not recommended for untrained persons – 533.1.1

The tripping current rule $I_2 <= 1.45 I_z$

Coordination of Protective Devices

$I_n \leq 0.725\ I_z$

To Comply with BS7671 using **BS 3036 - 433.1.3**

I_n = Protective Device e.g., Circuit Breaker or rewirable fuse size

In order to satisfy the terms in **433.1.1 (ii)** then: $I_n \leq 0.725\ I_z$

To satisfy the fact that rewirables have a fusing factor up to 2 times

Fusing Current = Fusing Factor x Fuse Rating

$= 2 \times I_n$

$I_2 = 2 \times I_n$ and $I_2 \leq 1.45\ I_z$

and $2 \times I_n \leq 1.45\ I_z$

$\therefore\ I_n \leq \frac{1.45}{2} \times I_z \leq 0.725\ I_z$

I_2 is the... I_n x 2 fusing current of a device within conventional time

Iz = current carrying capacity of the cable for continuous service.

The use of Semi-enclosed or re-wireable fuses to BS3036 is not recommended for untrained persons – 533.1.1

Coordination of Protective Devices

Energy Let through (434)

– All electromechanical devices have a maximum breaking capacity

– Maximum amount of energy that the component will allow through without exploding or disintegrating

– General Equation $E = I^2t$ *where* $P = \frac{E\ \textit{joules}}{t\ \textit{seconds}}$

Note: The Resistance of the conductor can be regarded as negligible (but not zero) for the short time period and very high fault currents

Coordination of Protective Devices

Short Circuit Protection

Regulation 434.5.2 States that:

The regulation is satisfied if the time for disconnection is equal to or less than:

$$t = \frac{S^2 k^2}{I^2}$$

The fault current must be cleared before the time given in the above equation

Note: This is for short circuits between live conductors and earth fault currents

Coordination of Protective Devices

434.5.2 and **543.1.1** states that for the time that the earth fault exists the Live conductors and/or CPC must be able to dissipate the heat generated without damage to the other cables

434.5.2 $t = \frac{S^2 k^2}{I^2}$

543.1.1 $S = \frac{\sqrt{I^2 x\ t}}{k}$

Adiabatic Equation and k. The term adiabatic applies to a process where there is no heat transfer. For cable faults, we are assuming that all the heat generated during the fault is contained within the cable (and not transmitted away). Obviously this is not fully true, but it is on the safe side.

So long as: $S^2 k^2 \geq I^2 t$ **Then the thermal characteristics of the cable are protected from the energy let through of the protective device**

The size of the cpc usually works out to be much smaller than anticipated, if regulation 543.1.4 is applicable then this must be sized up according to Table 54.7