WORKED EXAMPLE NO 1

FINAL CIRCUIT PVC (THERMOPLASTIC) SHEATHED CABLE

Determine the cable size and suitable BS EN 60898 circuit breaker (CB) for a 3.65kW storage heater installed in an office. The heater is to be wired in thermoplastic insulated and sheathed 6242Y cable (PVC sheathed). The circuit length is 20 metres and the cable will be in contact with thermal insulation exceeding 100mm in thickness on one side for a significant part of its run above a plasterboard ceiling.

The characteristics of the supply are as follows:

Nominal Voltage = 230 volts

PFC at origin = 1.75kA

Ze at origin = 0.13 ohms

ANSWER

STEP 1 CALCULATE DESIGN CURRENT (Ib)

Total Ib =

Ib = 15.9 amps

STEP 2 SELECT PROTECTIVE DEVICE (In)

As we have seen Ib $\leq$ In and Ib = 15.9 amps The nearest suitable size of circuit breaker would be a 16 amp Type B from Table 41.3 (Part 4 BS7671: 2008).

In = 16 amps.

STEP 3 DETERMINE MAXIMUM DISCONNECTION TIME

The maximum disconnection time for compliance with 411.3.2 for a final circuit not exceeding 32A is 0.4 seconds.

STEP 4 DETERMINE CORRECTION FACTORS

There are no correction factors applicable but the cable is directly in contact with thermal insulation exceeding 100mm in thickness on one side. This means that the only de-rating required is to choose the sheathed cable size from Table 4D5 referring to Reference Method 101 (column 3).

STEP 5 APPLYING CORRECTION FACTORS

No correction factors to apply.

STEP 6 SELECT THE CABLE SIZE (Iz)

It replaces In

It = 16 amps From Table 4D5 (Appendix 4 BS 7671: 2008 (2011)) Reference Method 101 column 3 the nearest suitable size of thermoplastic insulated and sheathed cable (PVC sheathed) to carry 16 amps is 2.5mm² which can carry 17 amps (in this instance).

Iz = 17 amps

Cable size = 2.5mm²

STEP 7 CHECK SHOCK CONSTRAINTS

The maximum Zs value for a 16 amp Type B circuit breaker from Table 41.3 (Part 4 BS 7671: 2008 (2011)) is 2.87 ohms

Zs = 0.6 ohms where Ze = 0.13 ohms

F = 1.2 from Table 3 (Page 10) of these notes

R1 + R2 = 19.51mohms/M for 2.5/1.5mm2 cable from Table 4 (Page 20) of these notes

L = 20 metres (given in question)

which is acceptable as it is less than 2.87 ohms from Table 41.3.

STEP 8 CHECK THERMAL CONSTRAINTS

The CPC of the thermoplastic insulated and sheathed cable (PVC sheathed) does not comply with Table 54.7 so the adiabatic equation must therefore be applied.

S = 1.05mm2

where I = Fault current

t = Disconnection time of fault current

t = 0.1s from Fig 3A4 Appendix 3 BS 7671: 2008 (2011) for 16 amp BS EN 60898 Type B circuit breaker at 383.3 amps

k = 115 from Table 54.3 (Part 5 BS 7671: 2008 (2011)) for 70°c PVC

As the CPC of the cable is 1.5mm² and the minimum CSA for thermal constraints is 1.05mm² the CPC is adequate.

STEP 9 CHECK VOLTAGE DROP

where mV = 18mV from Table 4D5 (Appendix 4 BS 7671: 2008 (2011))

Ib = 15.9 amps

L = 20 metres

VD = 5.7 volts which is acceptable as 5% of 230 volts = 11.5 volts