

REDUCTION IN MAXIMUM VALUES OF EARTH FAULT LOOP IMPEDANCE IN BS 7671

Editor's note: references to the 'current' version of BS 7671 relate to BS 7671:2008(2011), i.e. the 'green cover' Regulations. This version is current until 30 June 2015. On 1 July 2015, BS 7671:2008+A3:2015 comes into effect.

One of the changes being introduced by BS 7671:2008+A3:2015 (IET Wiring Regulations Seventeenth Edition), which was published in January and comes into effect on 1 July, is a reduction of maximum values of earth fault loop impedance (Z_s) in Tables 41.2, 41.3, 41.4 and 41.6.

Reason for the reduction

The reason for the reduction in the maximum Z_s values is the introduction of the 'minimum voltage factor' given in Technical Report PD CLC/TR 50480:2011 *Determination of cross sectional area of conductors and selection of protective devices*.

Minimum voltage factor

The minimum voltage factor (C_{min}) takes account of the fact that the voltage of the electricity supply to an electrical installation varies depending on time and place, changing of transformer taps and other considerations.

For example, for a low voltage supply given in accordance with The Electricity Safety, Quality and Continuity Regulations 2002 as amended (ESQCR), variations of up to 10 % above or 6 % below the declared voltage at the declared frequency are permitted, unless otherwise agreed in writing by the distributor, the supplier and the consumer (regulation 27(3) of the ESQCR refers).

The minimum voltage factor (C_{min}) always has a value less than 1. C_{min} is applied as multiplier to the nominal line voltage to Earth (U_0) when determining maximum values of earth fault loop impedance (Z_s).

Amendment No. 3 to BS 7671:2008 gives C_{min} the value of 0.95 where the low voltage supply given in accordance with the ESQCR.

One might wonder why 0.95 was chosen rather than 0.94, given that the ESQCR permits the supply voltage to be as much as 6 % below the declared value, as already mentioned. However, 0.94 was thought to be unrealistically low, and Technical Report PD CLC/TR 50480:2011 gives C_{min} the value of 0.95 for the worst-case condition in a low voltage installation.

Tables of maximum earth fault loop impedance

As a result of the C_{min} value of 0.95 mentioned above, all maximum values of Z_s in Tables 41.2, 41.3, 41.4 and 41.6 of BS 7671 have been correspondingly reduced by Amendment No. 3 to 0.95 times (or 5 % lower than) those in the current version of BS 7671.

For example, for a 32 A type B circuit-breaker to BS EN 60898 or the overcurrent characteristics of a 32 A type B RCBO to BS EN 61009-1, Table 41.3 in Amendment No. 3 gives the maximum Z_s value of 1.37 ohms at a nominal voltage (U_0) of 230 V. This compares with 1.44 ohms in the same table of the previous version of BS 7671.

Protective devices and voltages that are not covered in the tables of maximum earth fault loop impedance

Where it is necessary to find the maximum value of Z_s for a protective device not covered in Tables 41.2, 41.3, 41.4 and 41.6 or for a nominal voltage (U_0) other than 230 V, the formula given in Appendix 3 of BS 7671 (as revised by Amendment No. 3) can be used. Examples of protective devices not covered by the tables are fuses of higher current ratings and moulded-case circuit-breakers (MCCBs).

The revised version of the Appendix 3 formula, as given in Amendment No. 3, is reproduced below:

$$Z_s = (U_0 \times C_{\min}) / I_a$$

where:

U_0 is the nominal a.c. rms line voltage to Earth.

C_{\min} is the minimum voltage factor to take account of voltage variations depending on time and place, changing of transformer taps and other considerations.

NOTE 1: For a low voltage supply given in accordance with ESQCR, C_{\min} is given the value 0.95.

I_a is the current causing operation of the protective device within the specified time.

Measured values of Z_s

When Z_s values are measured at ambient temperature, account needs to be taken of the increase in resistance of the conductors with increasing temperature due to load current, as explained in Appendix 14 of BS 7671, before the measured values can be checked for compliance against the maximum values of Z_s referred to in BS 7671.

Appendix 14 has been revised by Amendment No. 3 to BS 7671:2011.