

SIZING OF PROTECTIVE CONDUCTORS BY SELECTION

Regulation Group 543.1 of *BS 7671* requires that a protective conductor other than protective bonding conductor is sized either by calculation or selection. This guide covers the sizing of protective conductors by selection, using Table 54.7.

It should be noted that where the choice of the cross-sectional-area (csa) of the line conductors has been determined by considerations of short-circuit current, and if the earth fault current is expected to be less than the short-circuit current, the csa of the protective conductor must be calculated (543.1.1).

MINIMUM PROTECTIVE CONDUCTOR SIZES

Certain lower limits apply to the csa of a protective conductor. The size of the protective conductor used must be not less than the appropriate limiting value (see below) and not less than that determined by selection (see later).

Where a protective conductor is not an integral part of a cable (such as a 'twin & earth' cable or an armoured cable); or formed by conduit, ducting or trunking; or contained in an enclosure formed by a wiring system, the csa of the protective conductor must not be less than 2.5 mm² copper equivalent if protection against mechanical damage is provided (such as by a sheath), and not less than 4 mm² copper equivalent if protection against mechanical damage is not provided (543.1.1).

Where PME conditions apply, a protective conductor used as an earthing conductor must have a csa not less than that required by Regulation 544.1.1 (refer to NICEIC Pocket Guide 13).

A protective conductor buried in the ground must have a csa not less than that required by Table 54.1 of *BS 7671*.

SELECTING THE SIZE OF THE PROTECTIVE CONDUCTOR

The process of selection uses the csa (S) of the associated line conductor and Table 54.7 of *BS 7671* (Data reproduced below in part). Where the protective conductor is common to several circuits, its csa should be based on the csa of the largest line conductor of the circuits (543.1.2). Where selection produces a non-standard size, a conductor having at least the nearest larger standard csa should be used.

DATA FROM TABLE 54.7 OF *BS 7671*

CSA of line conductor S (mm ²)		S ≤ 16	16 < S ≤ 35	S > 35
Minimum csa of the corresponding protective conductor (mm ²)	A	S	16	$\frac{S}{2}$
	B	S	$\frac{k_1}{k_2} \times 16$	$\frac{k_1}{k_2} \times \frac{S}{2}$

The csa of the protective conductor must be not less than required by Row A or Row B of the above table, as applicable.

Row A should be used where the protective conductor is of the same material as the associated line conductor.

Row B should be used where the protective conductor is not of the same material as the associated line conductor.

SIZING MAIN PROTECTIVE BONDING CONDUCTORS BY SELECTION

Where row B is used (overleaf), values of k_1 for the line conductor and k_2 for the protective conductor are required. The values of k_1 can normally be determined from Table 43.1 of BS 7671, and of k_2 from Tables 54.2 to 54.6, as applicable (data reproduced in part below).

DATA FROM TABLE 43.1 Values of k for common conductors

Conductor	Insulation material	K
Copper	70 °C thermoplastic	115/103*
	90 °C thermoplastic	100/86
	60 °C thermosetting	141
	90 °C thermosetting	143
Copper - Forming part of a mineral insulated cable	Sheath material	
	- thermoplastic sheath	115
	- bare (unsheathed)	135/115**

DATA FROM TABLES 54.2 TO 54.6

Material of conductor	Insulation of protective conductor or cable covering		
	70 °C thermoplastic	90 °C thermoplastic	90 °C thermosetting

54.2 Values of k for insulated protective conductor not incorporated in a cable and not bunched with cables, or for separate bare protective conductor in contact with cable covering but not bunched with cables.

Copper	143/133*	143/133*	176
Aluminium	95/88*	95/88*	116
Steel	52	52	64

54.3 Values of k for protective conductor incorporated in a cable or bunched with cables, where the assumed initial temperature is 70 °C or greater.

Copper	115/103*	100/86*	143
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54.4 Values of k for protective conductor as a sheath or armour of a cable.

Aluminium	93	85	85
Steel	51	46	46
Lead	26	23	23

54.5 Values of k for steel conduit, ducting and trunking as the protective conductor

Steel conduit, ducting and trunking	47	44	58
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* Indicates a conductor of greater than 300 mm²

** value for bare exposed to touch

Note: The data from Table 54.6 is outside the scope of this Pocket Guide.