Appendix B
Resistance of copper and aluminium conductors

434.5.2 543.1.3 To check compliance with Regulation 434.5.2 and/or Regulation 543.1.3, i.e. to evaluate the equation

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

it is necessary to establish the impedances of the circuit conductors to determine the fault current, I, and hence the protective device disconnection time, t.

Fault current, $I = \frac{U_0 \times C_{min}}{Z_s}$

where:

U_0 is the nominal 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: For low voltage supplies given in accordance with the ESQCR, C_{min} is given the value 0.95.

Z_s is the earth fault loop impedance, and

$Z_s = Z_e + R_1 + R_2$

where:

Z_e is that part of the earth fault loop impedance external to the installation

Note: If the distribution board is not at the origin of the installation, Z_e is replaced in the above equation by Z_{db}, that part of the earth fault loop impedance on the supply side of the distribution board.

R_1 is the resistance of the line conductor from the origin of the circuit to the point of utilization

R_2 is the resistance of the protective conductor from the origin of the circuit to the point of utilization.

Similarly, in order to design circuits for compliance with the limiting values of earth fault loop impedance given in Tables 41.2 to 41.4 of BS 7671, it is necessary to establish the relevant impedances of the circuit conductors when the line conductor is at the appropriate maximum permitted operating temperature, as given in Table 52.1 of BS 7671, and the circuit protective conductor is at the appropriate 'assumed initial temperature', as given in Tables 54.2 to 54.5.

Table B1 gives values of $(R_1 + R_2)$ per metre for various combinations of conductors up to and including 50 mm^2 cross-sectional area. It also gives values of resistance (milliohms) per metre for each size of conductor. These values are at 20 °C.

▼ **Table B1** Values of resistance/metre for copper and aluminium conductors and of $(R_1 + R_2)$ per metre at 20 °C in milliohms/meter

Cross-sectional area (mm^2)		Resistance/metre or $(R_1 + R_2)$/metre (mΩ/m)	
Line conductor	Protective conductor	Copper	Aluminium
1	–	18.10	
1	1	36.20	
1.5	–	12.10	
1.5	1	30.20	
1.5	1.5	24.20	
2.5	–	7.41	
2.5	1	25.51	
2.5	1.5	19.51	
2.5	2.5	14.82	
4	–	4.61	
4	1.5	16.71	
4	2.5	12.02	
4	4	9.22	
6	–	3.08	
6	2.5	10.49	
6	4	7.69	
6	6	6.16	
10	–	1.83	
10	4	6.44	
10	6	4.91	
10	10	3.66	
16	–	1.15	1.91
16	6	4.23	–
16	10	2.98	–
16	16	2.30	3.82
25	–	0.727	1.20
25	10	2.557	–
25	16	1.877	–
25	25	1.454	2.40
35	–	0.524	0.87
35	16	1.674	2.78