the minimum value of I_t required of the conductor to be protected. In this case also, the choice of conductor size is dictated by the overload conditions and the current-carrying capacity (I_z) of the conductors cannot be fully utilised.

The tabulated current-carrying capacities for cables direct in ground or in ducts in the ground, given in this appendix, are based an ambient temperature of 20 °C. The factor of 1.45 that is applied in Regulation 433.1.1 when considering overload protection assumes that the tabulated current-carrying capacities are based on an ambient temperature of 30 °C. To achieve the same degree of overload protection when the tabulated current-carrying capacity is based on an ambient temperature of 20 °C a factor of 0.9 is applied as a multiplier to the tabulated current-carrying capacity.

5 DETERMINATION OF THE SIZE OF CABLE TO BE USED

Having established the design current (I_b) of the circuit under consideration, the appropriate procedure described in paragraphs 5.1 and 5.2 below will enable the designer to determine the size of the cable it will be necessary to use.

As a preliminary step it is useful to identify the length of the cable run and the permissible voltage drop for the equipment being supplied, as this may be an overriding consideration (see Section 525 and paragraph 6 of this appendix). The permissible voltage drop in mV, divided by I_b and by the length of run, will give the value of voltage drop in mV/A/m which can be tolerated. A voltage drop not exceeding that value is identified in the appropriate table and the corresponding cross-sectional area of conductor needed on this account can be read off directly before any other calculations are made.

The conductor size necessary from consideration of the conditions of normal load and overload is then determined. All rating factors affecting I_z (i.e. for factors for ambient temperature, grouping and thermal insulation) can, if desired, be applied to the values of I_t as multipliers. This involves a process of trial and error until a cross-sectional area is reached which ensures that I_z is not less than I_b and not less than I_n of any protective device it is intended to select. In any event, if a rating factor for protection by a semi-enclosed fuse is necessary, this has to be applied to I_n as a divisor. It is therefore more convenient to apply all the rating factors to I_n as divisors.

This method is used in items 5.1 and 5.2 and produces a value of current and that value (or the next larger value) can be readily located in the appropriate table of current-carrying capacity and the corresponding cross-sectional area of conductor can be identified directly. It should be noted that the value of I_t appearing against the chosen cross- sectional area is not I_z. It is not necessary to know I_z where the size of conductor is chosen by this method.

5.1 Where overload protection is afforded by a device listed in Regulation 433.1.2 or a semi-enclosed fuse to BS 3036

5.1.1 For single circuits

(i) Divide the rated current of the protective device (I_n) by any applicable rating factor for ambient temperature (C_a) given in Tables 4B1 and 4B2.

(ii) Then further divide by any applicable rating factor for thermal insulation (C_i).

(iii) Then further divide by the applicable rating factor for the type of protective device or installation condition (C_c).

$$I_t \geq \frac{I_n}{C_a\, C_i\, C_c} \qquad \text{Equation 1}$$

a) Where the protective device is a semi-enclosed fuse to BS 3036, $C_c = 0.725$

b) Where the cable installation method is 'in a duct in the ground' or 'buried direct', $C_c = 0.9$.

c) If both a) and b) apply, $C_c = 0.725 \times 0.9$, $C_c = 0.653$

d) For all other cases $C_c = 1$

The size of cable to be used is to be such that its tabulated current-carrying capacity (I_t) is not less than the value of rated current of the protective device adjusted as above.

5.1.2 For groups

(i) In addition to the factors given in 5.1.1 divide the rated current of the protective device (I_n) by the applicable rating factor for grouping (C_g) given in Tables 4C1 to 4C5:

$$I_t \geq \frac{I_n}{C_g\, C_a\, C_i\, C_c} \qquad \text{Equation 2}$$

Alternatively, I_t may be obtained from the following formulae, provided that the circuits of the group are not liable to simultaneous overload:

$$I_t \geq \frac{I_b}{C_g\, C_a\, C_i\, C_c} \qquad \text{Equation 3}$$

$$I_t \geq \frac{1}{C_a C_i}\sqrt{\frac{I_n^2}{C_c^2} + 0.48\, I_b^2\left(\frac{1 - C_g^2}{C_g^2}\right)} \qquad \text{Equation 4}$$

The size of cable to be used is to be such that its tabulated single-circuit current-carrying capacity (I_t) is not less than the value of I_t calculated in accordance with equation 2 above or, where equations 3 and 4 are used not less than the larger of the resulting two values of I_t.

5.2 Where overload protection is not required

Where Regulation 433.3.1 applies, and the cable under consideration is not required to be protected against overload, the design current of the circuit (I_b) is to be divided by any applicable rating factors, and the size of the cable to be used is to be such that its tabulated current-carrying capacity (I_t) for the installation method concerned is not less than the value of I_b adjusted as above, i.e.:

$$I_t \geq \frac{I_b}{C_a\, C_g\, C_i} \qquad \text{Equation 5}$$

5.3 Other frequencies

Current ratings stated in the tables are for d.c. and 50/60 Hz a.c. The current-carrying capacity of cables carrying, for example, balanced 400 Hz a.c. compared with the current-carrying capacity at 50 Hz, may be no more than 50 %. For small cables and flexible cords (e.g. as may be used to supply individual loads), the difference in the 50 Hz and the 400 Hz current-carrying capacities may be negligible. Current ratings and voltage drop vary with frequency. Suitable ratings should be obtained from the manufacturer.

5.4 Effective current-carrying capacity

The current-carrying capacity of a cable corresponds to the maximum current that can be carried in specified conditions without the conductors exceeding the permissible limit of steady-state temperature for the type of insulation concerned.

The values of current tabulated represent the effective current-carrying capacity only where no rating factor is applicable. Otherwise, the current-carrying capacity corresponds to the tabulated value multiplied by the appropriate factor or factors for ambient temperature, grouping and thermal insulation, as applicable.

Irrespective of the type of overcurrent protective device associated with the conductors concerned, the ambient temperature rating factors to be used when calculating current-carrying capacity (as opposed to those used when selecting cable sizes) are those given in Tables 4B1 and 4B2.

6 TABLES OF VOLTAGE DROP

In the tables, values of voltage drop are given for a current of one ampere for a metre run, i.e. for a distance of 1 m along the route taken by the cables, and represent the result of the voltage drops in all the circuit conductors. The values of voltage drop assume that the conductors are at their maximum permitted normal operating temperature.

The values in the tables, for a.c. operation, apply to frequencies in the range 49 to 61 Hz and for single-core armoured cables the tabulated values apply where the armour is bonded to Earth at both ends. The values of voltage drop for cables operating at higher frequencies may be substantially greater.

For a given run, to calculate the voltage drop (in mV) the tabulated value of voltage drop per ampere per metre for the cable concerned has to be multiplied by the length of the run in metres and by the current the cable is intended to carry, namely, the design current of the circuit (I_b) in amperes. For three-phase circuits the tabulated mV/A/m values relate to the line voltage and balanced conditions have been assumed.