One further complication with some lamp types is that the voltage and current waveforms are not exactly in phase with one another. Thus the volts multiplied by the amps in the circuit may be higher than the watts. The power factor of the circuit is defined by the following equation:

$$power\ factor = \frac{watts}{volts \cdot amps}$$

Most high wattage lamp circuits are designed to have a power factor greater than 0.85. The other factor that may affect the sizing of the cables that supply a lighting installation is the current required during the run-up of the lamps. With some types of lamp this can be over double the nominal running current. When using lighting controls the power demand is more difficult to predict as the power consumed may be reduced at times when full output is not required from the lamp.

3.3 Luminous Efficacy

Luminous efficacy is usually expressed in terms of lumens per watt. Many lamp manufacturers produce lumens per watt Figures for their lamps. However, for discharge lamps and other lamps requiring some form of control gear, these Figures may be misleading as they refer to the power consumed in the lamp only and do not consider the power lost in the control gear. All the values provided in this Chapter for efficacy are based on total circuit watts. Efficacy is a primary concern when selecting a lamp. In general, if a range of lamps is suitable for a particular installation then it is the most efficient that should be used.

NOTE 1 Luminous efficacy is a measure of how well a light source produces visible light. It is the ratio of luminous flux to power. Depending on context, the power can be either the radiant flux of the source's output, or it can be the total power (electric power, chemical energy, or others) consumed by the source. Which sense of the term is intended must usually be inferred from the context; sometimes the technical data of the manufacturers are not clear in this matter. The former sense is sometimes called luminous efficacy of radiation, and the latter luminous efficacy of a source.

NOTE 2 Not all wavelengths of light are equally visible, or equally effective at stimulating human vision, due to the spectral sensitivity of the human eye; radiation in the infrared and ultraviolet parts of the spectrum is useless for illumination. The overall luminous efficacy of a source is the product of how well it converts energy to electromagnetic radiation, and how well the emitted radiation is detected by the human eye.

NOTE 3 In lighting design, 'efficacy' refers to the amount of light (luminous flux) produced by a lamp (a lamp or other light source), usually measured in lumens, as a ratio of the amount of power consumed to produce it, usually measured in watts. This is not to be confused with efficiency which is always a dimensionless ratio of output divided by input which for lighting relates to the watts of visible power as a fraction of the power consumed in watts.