minous efficacy. Due to the fact that it is so expensive, krypton is only used in special applications.

A characteristic feature of incandescent lamps is their low colour temperature - the light they produce is warm in comparison to daylight. The continuous colour spectrum of the incandescent lamp provides excellent colour rendition.

As a point source with a high luminance, sparkling effects can be produced on shiny surfaces and the light easily controlled using optical equipment. Incandescent lamps can therefore be applied for both narrow-beam accent lighting and for wide-beam general lighting.

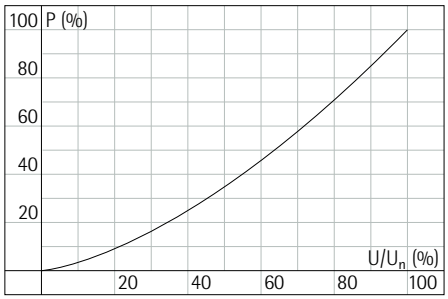
Incandescent lamps can be easily dimmed. No additional control gear is required for their operation and the lamps can be operated in any burning position. In spite of these advantages, there are a number of disadvantages: low luminous efficacy, for example, and a relatively short lamp life, while the lamp life relates significantly to the operating voltage. Special incandescent lamps are available with a dichroic coating inside the bulb that reflects the infrared component back to the wire filament, which increases the luminous efficacy by up to 40 %.

General service lamps (A lamps) are available in a variety of shapes and sizes. The glass bulbs are clear, matt or opal. Special forms are available for critical applications (e.g. rooms subject to the danger of explosion, or lamps exposed to mechanical loads), as well as a wide range of special models available for decorative purposes.

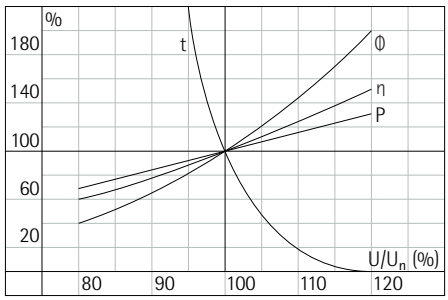
A second basic model is the reflector lamp (R lamp). The bulbs of these lamps are also blown from soft glass, although, in contrast with the A lamps, which radiate light in all directions, the R lamps control the light via their form and a partly silvered area inside the lamp. Another range of incandescents are the PAR (parabolic reflector) lamps. The PAR lamp is made of pressed glass to provide a higher resistance to changes in temperature and a more exact form; the parabolic reflector produces a well-defined beam spread.

In the case of cool-beam lamps, a subgroup of the PAR lamps, a dichroic, i.e. selectively reflective coating, is applied. Dichroic reflectors reflect visible light, but allow a large part of the IR radiation to pass the reflector. The thermal load on illuminated objects can therefore be reduced by half.

Relative power P of incandescent lamps as a function of voltage.



Effect of overvoltage and undervoltage on relative luminous flux Φ, luminous efficacy η, electrical power P and lamp life t.



Luminous flux $\frac{\Phi}{\Phi_n} = \left(\frac{U}{U_n}\right)^{3.8}$

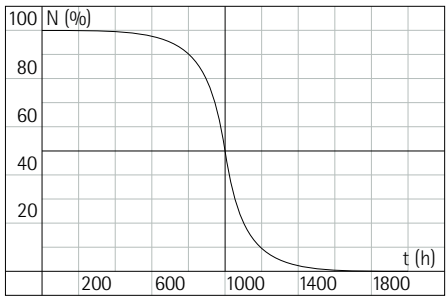
Luminous efficacy $\frac{\eta}{\eta_n} = \left(\frac{U}{U_n}\right)^{2.3}$

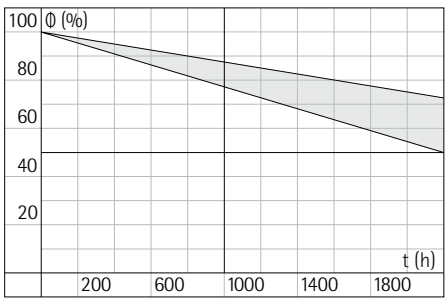
Power $\frac{P}{P_n} = \left(\frac{U}{U_n}\right)^{1.5}$

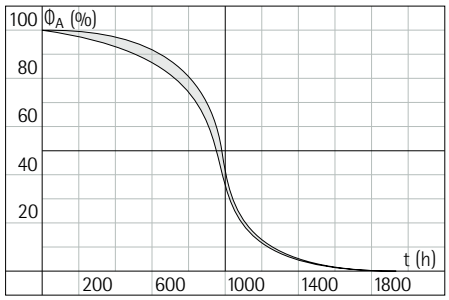
Lamp life $\frac{t}{t_n} = \left(\frac{U}{U_n}\right)^{-14}$

Colour temperature $\frac{T_f}{T_{fn}} = \left(\frac{U}{U_n}\right)^{0.4}$

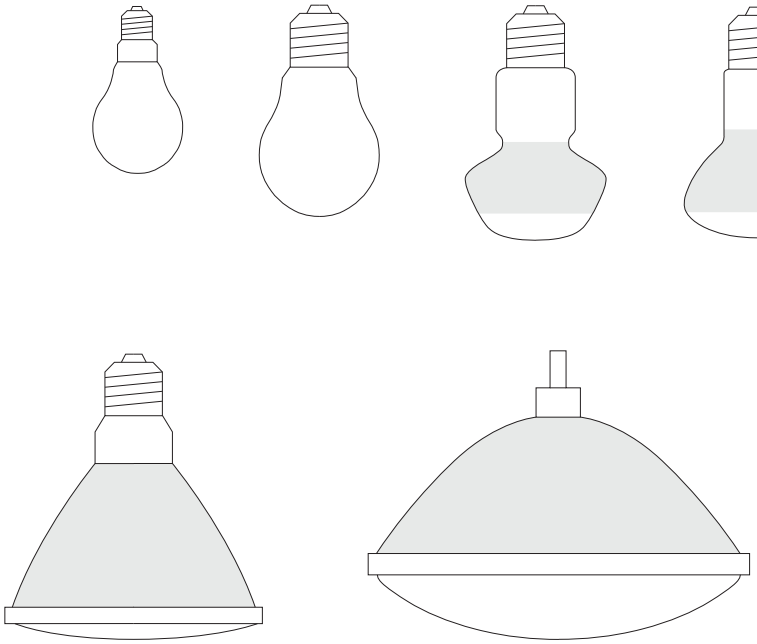
Exponential correlation between the relative voltage U/U_n and electrical and photometric quantities.





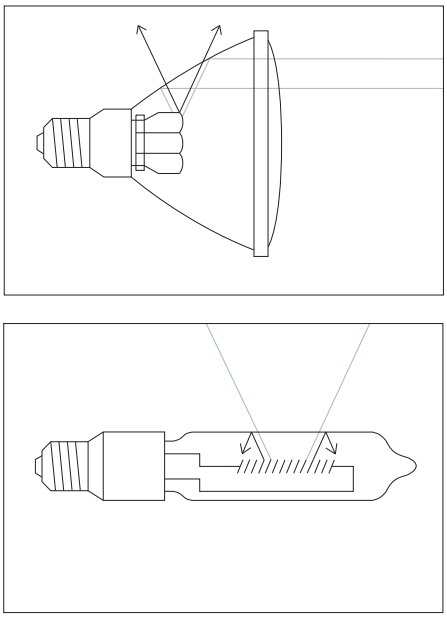


Proportion of operating lamps N, lamp lumens Φ and luminous flux of total installation Φ_A (as the product of both values) as a function of the operating time t.



Top row (from left to right): decorative lamp, general service lamp, reflector lamp with soft glass bulb and ellipsoidal or parabolic reflector, producing medium beam characteristics. Bottom row (from left to right): reflector lamp with pressed glass bulb and efficient parabolic reflector (PAR lamp), available for narrow-beam (spot) and wide-beam (flood), also suitable for exterior application due to its high resistance to changes in temperature; high-power pressed-glass reflector lamp.

PAR lamp with dichroic cool-beam reflector. Visible light is reflected, infrared radiation transmitted, thereby reducing the thermal load on the illuminated objects.



Incandescent lamp with glass bulb coated with dichroic material (hot mirror). This allows visible light to be transmitted; infrared radiation is reflected back to the filament. The increase in the temperature of the filament results in increased luminous efficacy.