2.3.1.1 Halogen lamps

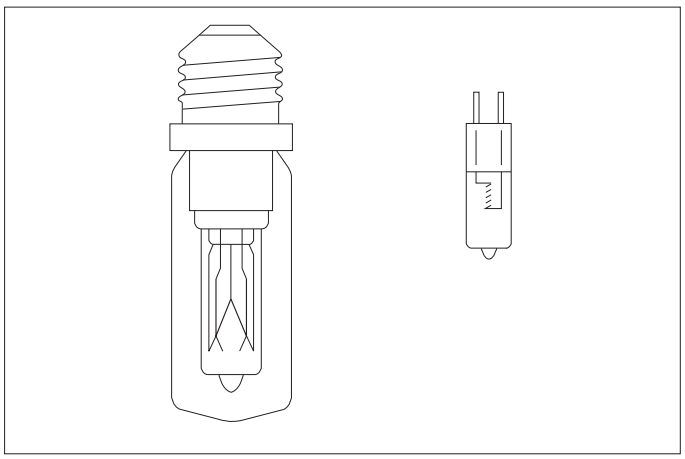
It is not so much the melting point of the tungsten (which, at 3653 K, is still a relatively long way from the approx. 2800 K of the operating temperature of incandescents) that hinders the construction of more efficient incandescent lamps, but rather the increasing rate of evaporation of the filament that accompanies the increase in temperature. This initially leads to lower performance due to the blackening of the surrounding glass bulb until finally the filament burns through. The price to be paid for an increase in luminous efficiency is therefore a shorter lamp life.

One technical way of preventing the blackening of the glass is the adding of halogens to the gas mixture inside the lamp. The evaporated tungsten combines with the halogen to form a metal halide, which takes on the form of a gas at the temperature in the outer section of the lamp and can therefore leave no deposits on the glass bulb. The metal halide is split into tungsten and halogen once again at the considerably hotter filament and the tungsten is then returned to the coil.

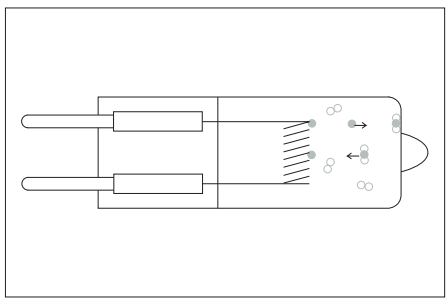
The temperature of the outer glass envelope has to be over 250° C to allow the development of the halogen cycle to take place. In order to achieve this a compact bulb of quartz glass is fitted tightly over the filament. This compact form not only means an increase in temperature, but also an increase in gas pressure, which in turn reduces the evaporation rate of the tungsten.

Compared with the conventional incandescent the halogen lamp gives a whiter light – a result of its higher operating temperature of 3000 to 3300 K; its luminous colour is still in the warm white range. The continuous spectrum produces excellent colour rendering properties. The compact form of the halogen lamp makes it ideal as a point-source lamp; its light can be handled easily and it can create attractive sparkling effects. The luminous efficacy of halogen lamps is well above that of conventional incandescents – especially in the low-voltage range. Halogen lamps may have a dichroic, heat-reflecting coating inside the bulbs, which increases the luminous efficacy of these lamps considerably.

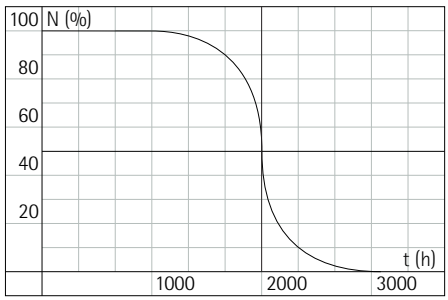
The lamp life of halogen lamps is longer than that of conventional incandescents. Halogen lamps are dimmable. Like conventional incandescent lamps, they require no additional control gear; low-voltage halogen lamps do have to be run on a transformer, however. In the case of double-ended lamps, projector lamps and special purpose lamps for studios the burning position is frequently restricted. Some tungsten halogen lamps have to be operated with a protective glass cover.



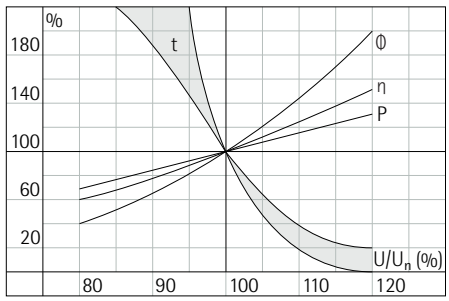
Halogen lamp for mains voltage with screw cap and outer envelope (left). The outer envelope means that the lamp can be operated without a protective glass covering. Low-voltage halogen lamp with pin base and axial filament in a quartz glass bulb (right).



Halogen cycle: combination of evaporated tungsten and halogen to produce tungsten halide in the peripheral area. Splitting of the tungsten halogens back to the filament.



Proportion of operating lamps N as a function of the operating time t.



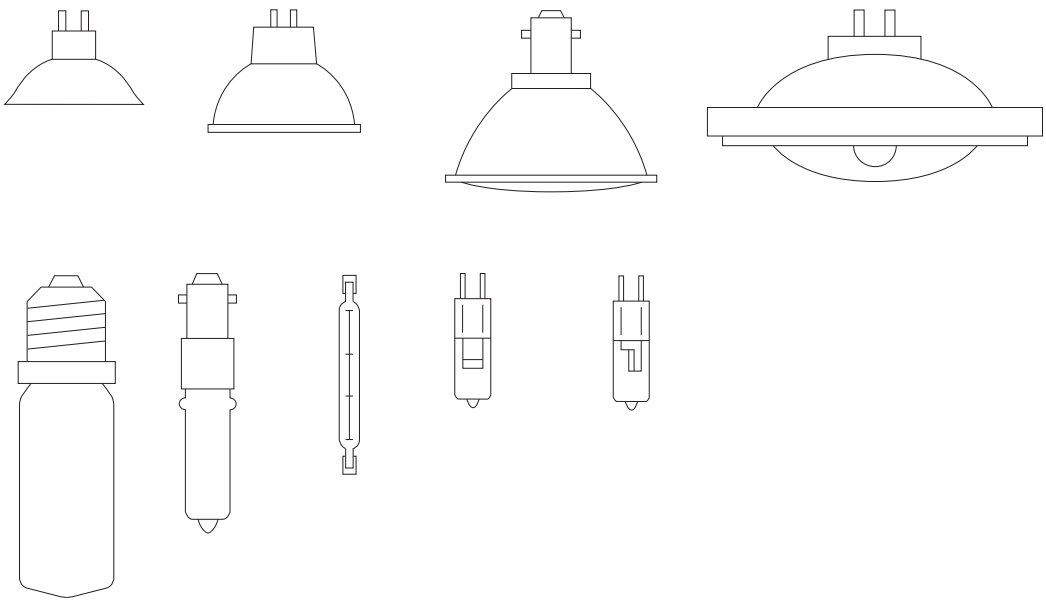
Influence of overvoltage and undervoltage on relative luminous flux Φ, luminous efficacy η, electrical power P and lamp life t.

Like almost all conventional incandescent lamps, halogen lamps can be run on mains voltage. They usually have special caps, but some are equipped with an E 27 screw cap and an additional glass envelope and can be used in the same way as conventional incandescents.

As well as mains voltage halogen lamps, low-voltage halogen lamps are also gaining in importance. The advantages of this latter light source – high luminous efficiency in a small-dimensioned lamp – resulted in wide application of low-voltage halogen lamps in the field of architectural lighting.

The lamp's small size allows compact luminaire designs and concentrated spread angles. Low-voltage halogen lamps are available for different voltages (12/ 24 V) and in different shapes. Here too a selection can be made between clear lamps and various lamp and reflector combinations, or cool-beam reflector versions.

The halogen and low-voltage halogen lamps most commonly used in interior lighting.



Above (from left to right): low-voltage halogen bi-pin lamp and aluminium reflector, bi-pin and cool-beam glass reflector, with bayonet connection and aluminium reflector, with an aluminium reflector for increased power.

Below (from left to right): halogen lamp for mains voltage with an E 27 cap and outer glass envelope, with a bayonet cap, and the double-ended version. Low-voltage halogen lamp with transverse filament and axial filament.