discharge; the discharge tubes are small. High-pressure discharge lamps – similar to incandescent lamps – are point sources with high lamp luminance. As a rule the actual discharge tubes are surrounded by an additional outer envelope, which stabilises the operating temperature of the lamp, or, if necessary, serves as a UV filter and can be used as a means of containing the fluorescent coating.

2.3.2.1 Fluorescent lamps

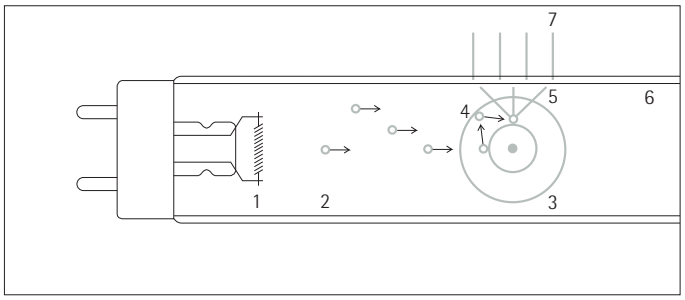
The fluorescent lamp is a low-pressure discharge lamp using mercury vapour. It has an elongated discharge tube with an electrode at each end. The gas used to fill the tube comprises inert gas, which ignites easily and controls the discharge, plus a small amount of mercury, the vapour of which produces ultraviolet radiation when excited. The inner surface of the discharge tube is coated with a fluorescent substance that transforms the ultraviolet radiation produced by the lamp into visible light by means of fluorescence.

To facilitate ignition of the fluorescent lamp the electrodes usually take the form of wire filaments and are coated with metallic oxide (emissive material) that promotes the flow of electrons. The electrodes are preheated at the ignition stage, the lamp ignites when the voltage is applied.

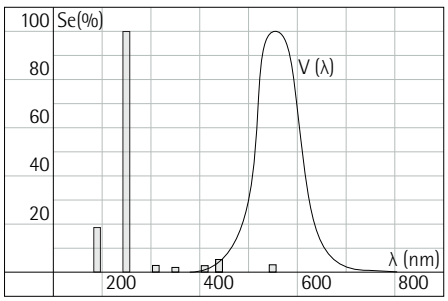
Different luminous colours can be achieved through the combination of appropriate fluorescent materials. To achieve this three different luminous substances are frequently combined, which, when mixed together, produce white light. Depending on the composition of the luminous substances, a warm white, neutral white or daylight white colour is produced.

In contrast to point sources (see incandescent lamps, above) the light from fluorescent sources is radiated from a larger surface area. The light is predominantly diffuse, making it more suitable for the uniform illumination of larger areas than for accent lighting.

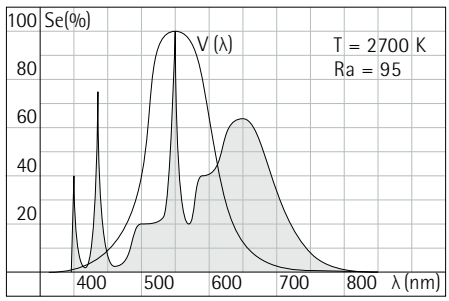
The diffuse light of the fluorescent lamp gives rise to soft shadows. There are no sparkling effects on glossy surfaces. Spatial forms and material qualities are therefore not emphasised. Fluorescent lamps produce a spectrum, which is not continuous, which means that they have different colour rendering compared with incandescent lamps. It is possible to produce white light of any colour temperature by combining fewer fluorescent materials, but this light still has poorer colour rendering properties than light with a continuous spectrum due to the missing spectral components. To produce fluorescent lamps with very good colour rendering properties more luminous sub-

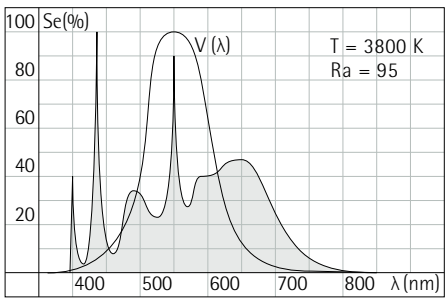


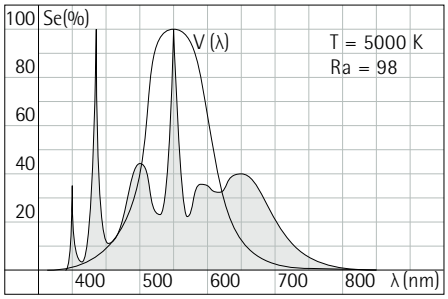
When leaving the electrode (1) the electrons (2) collide with mercury atoms (3). The mercury atoms (4) are thus excited and in turn produce UV radiation (5). The UV radiation is transformed into visible light (7) in the fluorescent coating (6).



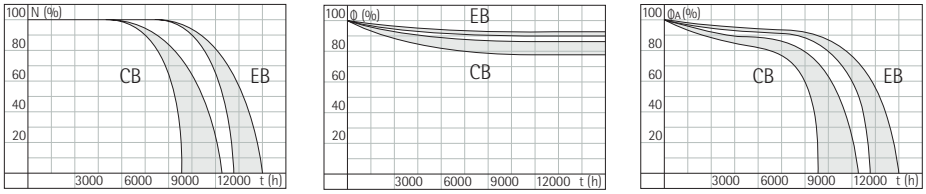
Relative spectral distribution S_e (λ) of low-pressure discharge of mercury vapour. The radiation produced is to a large extent beyond the spectral sensitivity of the eye V (λ).



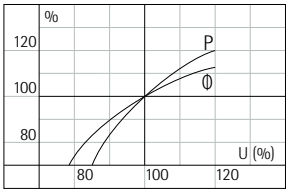




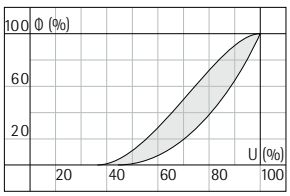
Relative spectral distribution S_e (λ) of standard fluorescent lamps with very good colour rendering in warm white (above), neutral white (centre) and daylight white (below).



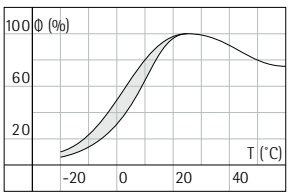
Proportion of operating lamps N, lamp lumens Φ and luminous flux of total installation Φ_A (as the product of both values) as a function of the operating time t. Through the application of electronic control gear (EB) the operating quality of the lamps is improved by comparison with the operation with conventional control gear (CB).



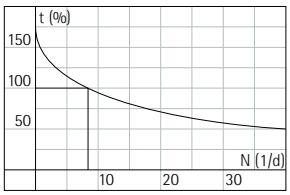
Effect of overvoltage and undervoltage on relative luminous flux Φ and electrical power P.



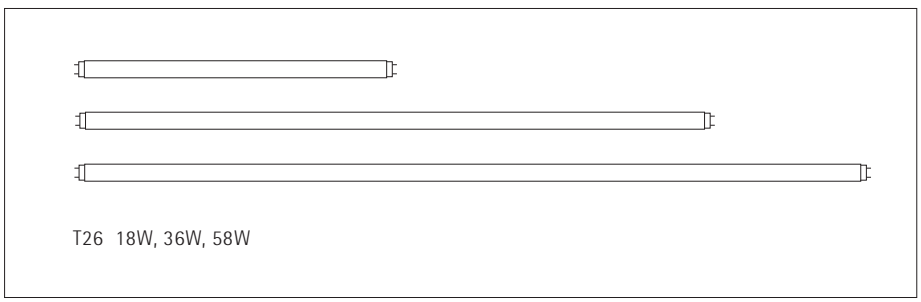
Relative luminous flux Φ of fluorescent lamps as a function of voltage.



The effect of ambient temperature T on lamp lumens Φ.



Lamp life t as a function of switching frequency per day N. Nominal lamp life of 100 % is achieved at a switching rate of 8 times every 24 hours.



Comparison of lengths of standard T26 fluorescent lamps.

stances have to be combined in such a way that the spectral distribution corresponds as closely as possible to that of a continuous spectrum.

Fluorescent lamps have a high luminous efficacy. They have a long lamp life, but this reduces considerably the higher the switching rate. Both ignitors and ballasts are required for the operation of fluorescent lamps. Fluorescent lamps ignite immediately and attain full power within a short period of time. Instant reignition is possible after an interruption of current. Fluorescent lamps can be dimmed. There are no restrictions with regard to burning position.

Fluorescent lamps are usually tubular in shape, whereby the length of the lamp is dependent on the wattage. U-shaped or ring-shaped fluorescents are available for special applications. The diameter of the lamps is 26 mm (and 16 mm). Lamp types with a diameter of 38 mm are of little significance.

Fluorescent lamps are available in a wide range of luminous colours, the main ones being warm white, neutral white and daylight white. There are also lamps available for special purposes (e.g. for lighting food displays, UV lamps) and coloured lamps. The colour rendering properties of fluorescents can be improved at the cost of the luminous efficacy; enhanced luminous efficacy therefore means a deterioration in the colour rendering quality.

Fluorescent lamps are usually ignited via an external starting device and preheated electrodes. Some models have integrated ignition, which means that they can do without a starting device altogether. These are mainly used in enclosed luminaires, for environments where there is a risk of explosion.

2.3.2.2 Compact fluorescent lamps

Compact fluorescent lamps do not function any differently from conventional fluorescent lamps, but they do have a more compact shape and consist of either one curved discharge tube or the combination of several short ones. Some models have an outer glass envelope around the discharge tube, which changes the appearance and the photometric properties of the lamp.

Compact fluorescent lamps basically have the same properties as conventional fluorescents, that is to say, above all, high luminous efficacy and a long lamp life. Their luminous efficiency is, however, limited due to the relatively small volume of the discharge tube. The compact form does offer a new set of qualities and fields of application. Fluorescent lamps in this form are not only confined to application in louvred luminaires, they can also be used in compact reflector luminaires (e.g. downlights). This means that concentra-