

The operation of the lamp is quite complex and needs to be considered in three phases: ignition, run-up and stable running.

First *ignition*; when power is first applied to the lamp the voltage is not high enough to strike an arc between the two main electrodes. Ignition is achieved using an auxiliary electrode placed close to one of the main electrodes. The auxiliary electrode is connected via a resistor (typically 25,000 ohms). This limits the size of the current in the arc formed by the auxiliary electrode so the voltage across the starting arc is reduced as the current increases. This means that the ions in the arc are drawn towards the main electrode at the other end of the lamp and these ions allow the main arc to start.

The next stage is the *run-up*. Once the arc has started between the main electrodes very little light is given out because the mercury pressure is too low as the tube is cool. The arc in the gas slowly warms up the tube and so the mercury vapour pressure rises and the light output increases. Typically it takes about 4 minutes for the lamp to achieve 80% of the final light output.

When the lamp reaches *stable running* and normal operating pressure all the mercury in the lamp is in the vapour phase. This means that the vapour pressure of the mercury is controlled by the amount of mercury put into the lamp rather than the temperature of the lamp.

High pressure mercury lamps are made from the following main components.

The *discharge tube* is generally made of quartz and has the main electrodes and the starting electrode sealed into it.

The *main electrodes* are usually made of tungsten rods which have coil of tungsten wire wrapped round them. This coil is usually impregnated with emitter material similar to that used in fluorescent lamps. The auxiliary electrode is generally wire made out of molybdenum or tungsten.

The *fill gas* in the discharge tube is commonly argon and a very carefully controlled dose of mercury is also added. The discharge tube is fitted into a support frame and the whole assembly is sealed into the outer bulb. The gas fill in the outer bulb is usually nitrogen or argon or a mixture of the two. The pressure of this fill gas is controlled to ensure that the arc tube operating temperature is correct.

The *outer bulb* is made out of a soft soda lime glass for low wattage lamps (up to 125 W). High power lamps use a borosilicate glass outer. There are two common shapes for the outer bulb the ovoid or isothermal bulb, and the reflector bulb. Figure 3.20 show these two shapes.