The *fill gas* in the tube is usually xenon at a cold pressure of 3 kPa, which corresponds to an operating pressure of about 20 kPa. A higher xenon pressure would improve lamp efficacy but make starting harder as it needs a high voltage to break down. Some types of lamp use high pressure xenon and use an ignition wire held close to the tube to help starting. There are also some lamps that use argon as a fill gas; they are much easier to start but are less efficient in term of lumens per watt. A dose of sodium mercury amalgam is used in most high pressure sodium lamps. Mercury is used because its vapour acts as a buffer gas and helps improve the efficiency of the lamp. However, the mercury contributes very little to the output spectrum of the lamp. Some lamps are now made without mercury in them. The absence of mercury makes the disposal of the lamp at the end of life easier as there are no environmentally damaging substances in the lamp. The metal dose in the lamp is never fully vapourised and so the pressure of the sodium and mercury vapours in the lamp is dependent on the temperature of the coolest part of the discharge tube. This makes the output of the lamp temperature dependent and can also give problems associated with the voltage across the tube rising if the lamp gets too hot. The cold spot on most discharge tubes is in the area behind the electrode. As this area of the tube is blackened through the life of the lamp, the cold spot temperature tends to rise through life. This can give rise to problems in old lamps where the pressure in the discharge tube rises to the point where it is no longer possible for the voltage available from the supply to sustain an arc in the lamp.

The discharge tube is mounted into a *support frame* and sealed into an outer bulb. The *outer bulb* is generally made of a borosilicate glass and may be in a number of different shapes, Figure 3.27 shows some of the more common shapes.

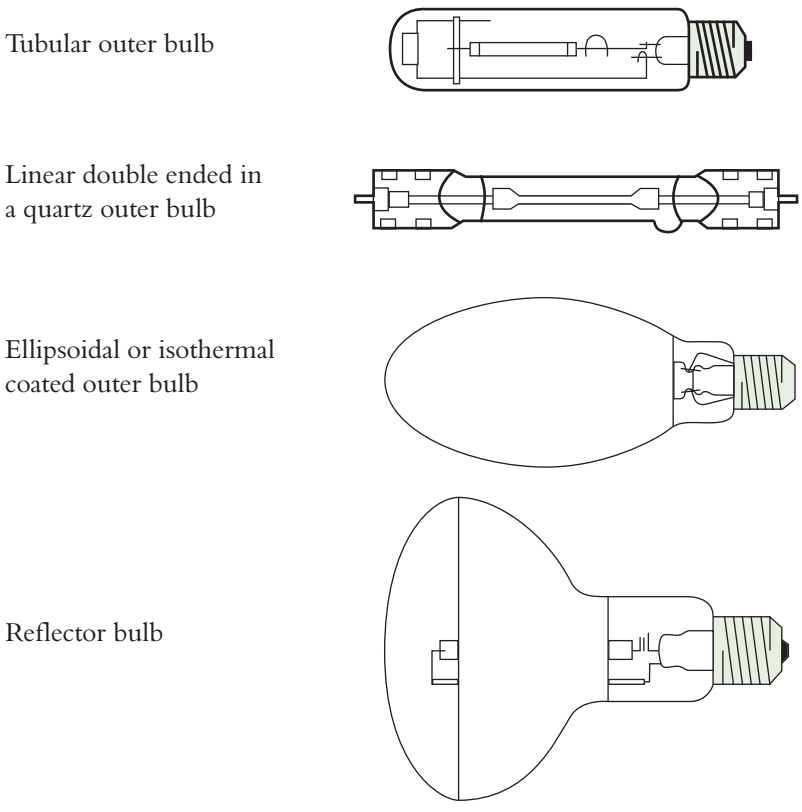

Figure 3.27 Outer bulb shapes for high pressure sodium lamps