LAMPS - information

Various types of lamps and sockets

This sheet is to provide information and training about the various types of lamps and sockets.

TYPES OF LAMPS:

INCANDESCENT: An incandescent lamp is what we know as the normal type as used at home and in motor vehicles. It is one that creates light by passing current through a coil of metal wire so that it heats to a very high temperature until it glows brightly and gives off light. This type of lamp becomes hot while running, therefore it is very inefficient and about 95% of the energy is wasted as heat to obtain a small percentage of light.

The coil can easily be seen through the glass and the metal used for the filament is usually Tungsten. Tungsten metal can be heated to bright white-hot without melting. When first invented, the filaments were made from carbon and platinum, but over time many other materials were tried until the technique for drawing very fine tungsten wire was developed.

Many years ago, the glass envelopes (bulbs) were evacuated (all the air sucked from them) but they required thicker glass to be strong enough not to 'implode' (explode inwards). Today,. the glass envelope is filled with a gas that allows the filament to glow bright white but without burning (oxidising). The gases used must contain no oxygen and the gases used are mainly Nitrogen and Argon. These are used because both are plentiful in the atmosphere, they are 'inert' (do not easily react with other chemicals), they are safe to use and they are relatively low in cost.

During the life of the normal lamp, the tungsten metal slowly evaporates from the very hot filament and it deposits on the inside surface of the glass bulb to slowly darken the glass. The thinning filament then eventually breaks or the glass becomes so dark that the light becomes too dim.

This type of lamp can run on AC or DC and the Alternating Current rising, falling and reversing 100 time per second causes a very slight change in the brightness 100 times per second. This slight change in brightness in not easily noticed with the naked eye but can be demonstrated with an optical sensor.

HALOGEN or QUARTZ - IODINE (QI) lamp: 'Quartz' is the material that the glass the lamp is made from. Iodine is the gas that is used to fill the glass envelope. Iodine, Fluorine, Bromine and Chlorine are known as the 'Halogen' gases. This is why the lamps are often called Halogen Lamps. Actually, in many cases, bromine vapour is used in these lamps rather than iodine.

The Halogen lamps are an incandescent style of lamp but with several advantages. In a normal incandescent lamp, the very hot filament, over time, boils metallic vapour from the filament. The filament slowly becomes thinner and the boiled-off vapour condenses on the cooler glass. The lamp is also becoming more likely to burn out and the whole lamp begins to get darker to reduce the light available.

It is quite remarkable, but when the QI lamp heats, a chemical reaction takes place between the metal and the gas to re-deposit the evaporated metal back to the filament and it does not become thinner. The metal does not deposit on the surface of the glass and therefore the lamp does not become darker, but for this to occur, the lamp must run much hotter than a normal lamp.

HANDLING: It is recommended to hold the glass envelope in plastic and not with fingers. The reason is that body oil and sweat will remain on the glass and when heated to high temperatures will stain the glass and will cause 'hot spots' that can actually soften and melt the glass in the spots where the heat cannot escape freely. The surface of the quartz glass envelope must be clean all over.

In the case of the Quartz Iodine lamp:

- They are usually very small in size with usually 2 pins that push tightly into a ceramic socket. There are several different sizes of QI lamp, but they are similar in shape with similar 2 pin method of connection.

- The metallic filament can run much hotter than the normal incandescent lamp and this provides a brighter and whiter light. The glass being made from quartz can withstand much higher temperatures than normal glass. The temperature of the lamps can reach the point where the glass is almost glowing red.

- The metal that is boiled from the very hot filament condenses back on to the filament and there is no loss of filament thickness (refer incandescent lamps).

- There is no deposit of metal on the inside of the glass and the glass remains clearer.

In homes and shops it is very common to see Halogen lamps built into a small 50mm diameter glass reflectors. These are a convenient form of modern lighting that normally run on 12 volts. They are available with slightly different shaped reflectors to provide various spreads of light from 10 degrees up to perhaps about 45 degrees.

OTHER TYPES: There are many styles of Lamps. The automotive industry has many styles of lamps for door locks and for instrument clusters where they push into miniature sockets or sometimes into holes in circuit boards. The Telephone industry has many other different styles of Lamp to fit special sockets and with special designs for very long life etc..

LED LAMPS: In modern times, the LED (Light Emitting Diode) has changed the lamp industry. The super efficiency and brightness of the solid state LED is replacing the traditional filament lamp in many areas. Advantage are:

- Physical size can be quite large down to ultra miniature.
- Very low cost.
- Low voltage operation
- Many different colours available.
- Very high electrical efficiency
- Almost cold running
- Can be turned on and off thousands of times per second without damage.
- Very long service life

LEDs are now being used for traffic lamps and for speed signs on the side of the road. They are very reliable and have a life of hundreds of thousands of hours. As time passes, it will be seen that many of the Lamps of today will gradually be replaced with LEDs of tomorrow.

FLUORESCENT TUBES: A fluorescent lamp is often called a "Fluoro". It is a long thin glass tube, usually white in colour, often used in homes and commonly used in industry and shops etc.. The sealed glass tube contains mercury vapour and other gases so that as current passes through the gas, ultra violet radiation occurs. The inside of the glass tube is coated with a 'phosphor' which glows when excited by ultra violet light. Different types of phosphor provide different colours from the tube.

There is a small heating filament at each end of the tube which initiated the IONISATION of the gas to make it conductive. A STARTER in the circuit pulses the heating element and when the gas is partially ionised, the applied voltage continues to ionise the gas in the tube and the electric current begins to flow through the gas.

This type of lamp is designed for AC. The electrical circuit has a 'ballast' or a 'choke' in series with the lamp. This permits maximum voltage to be applied to the tube for starting when zero current is flowing and it drops the voltage and therefore limits the current to the correct value when the lamp begins to conduct current. There is some heat generated in the choke due to the resistance of the winding and almost no heat generated in the tube, therefore this type of lamp is much more efficient than the incandescent lamp.

The Alternating Current rising, falling and reversing 100 time per second causes a considerable change in the brightness 100 times per second. This 'flickering' is greatly reduced by the action of the glowing fluorescent coating on the inside of the tube, but it is quite easily noticed with the naked eye. A 'Stroboscopic' effect is usually seen with a rotating wheel under a fluorescent lamp. An optical sensor to an oscilloscope will show the light varying its intensity as a 50Hz sine wave ….. the same shape as the voltage applied.

LAMP SOCKETS:

There are several common styles of lamp socket and here is a listing and explanation of some of them.

NAME	FULL NAME	USES	SIZE
LES	Lilliput Edison Screw	Very small lamps for pilot lamps, p/buttons, instruments.	5mm D
MES	Miniature Edison Screw	Small lamps and pilot lamps	10mm D
CES	Candelabra Edison Screw	Small light fittings	12mm D
SES	Small Edison Screw	Sewing machine lamps, small light fittings.	14mm D
ES	Edison Screw	Normal domestic lamps	27mm D
GES	Giant Edison Screw	Industrial and road lighting.	40mm D
SBC	Small Bayonet Cap	Automotive lamps, 15mm diameter base.	15mm D
BC	Bayonet Cap	Normal domestic lamps used in most houses.	22mm D
BA9S	Bayonet, 9mm diameter, single contact	Small lamps, instrument pilot lamps.	9mm D
BA15S	Bayonet, 15mm diameter, single contact	Automotive type lamps, single connection in centre of base.	15mm D
BA15D	Bayonet, 15mm diameter, double contact	Automotive type lamps, double connection in the base. Often 2x filaments in the one lamp. (stop light & tail lamp)	15mm D
FESTOON	This is the tubular lamp often used in tail lamps of cars. Glass tube with contact each end.	Usually automotive tail and indicator lamps. Filament connects between each end.	Various diameters and lengths.
QI 2pin	Various sizes available, but with 2x pins to push into ceramic socket. Many other types of mountings.	Instruments, domestic lighting with reflector, industrial lighting, Automotive headlights.	G4 = 4mm G6 = 6.3mm Between pins

The 'Edison Screw' family has a metal thread that screws into a socket.

The 'Bayonet' family has a smooth metal base with a short pin each side that allows the lamp to be pushed into the socket and turned slightly clockwise to lock into the socket. The bayonet style can have one or two contacts at the underside of the metal base. Sometimes two contacts join to the filament and sometimes (usually in motor vehicles) the filament is connected between a single central contact and the outside wall of the base. In other cases, there can be two filaments in the one lamp (automotive stop & tail lamp) and each filament can be connected to a contact with the other end of both filaments connected to the outside of the base.

The Quartz Halogen family normally has two pins that are separated by either 4mm or 6.3mm and which push tightly into a simple ceramic socket with two contacts.

The Festoon family normally fit between two flat spring contact strips that press on each end of the festoon lamp to make electrical connection.

I hope you find all this information interesting and useful…….

Bernard l. Hodson

Industrial Equipment & Control Pty.Ltd.

Melbourne Australia