Product

Product | Catalogue | General Information

General Information

§ Lamp Construction

An incandescent lamp changes electrical energy to radian energy. The light generated results from the filament being resistant heated to a temperature high enough to produce visible light.

Filaments cannot be operated in an oxygen atmosphere, so they must be vacuum sealed (or gas filled) in a glass bulb. The vacuum acts like an insulator and holds the heat at the filament.

The basic materials used in manufacturing Sub-Miniature Lamps are soft lime glass, tungsten, molybdenum, and Dumet. The soft glass is easy to work with and will tolerate temperatures up to 370 degrees Celsius. Dumet, a copper clad nickel iron core, is used for the lead wires and supports (electrodes) because it has the closest expansion and contraction rate to glass and offers an excellent hermetic seal. This seal is important in maintaining a high vacuum level which is critical in the overall reliability of lamps and to guarantee long life and MSCd stability.

Tungsten is used for the filaments because of its low rate of evaporation at temperatures of incandescence and its high melting point (3655K). There are grades of tungsten purity and different grain structures. Oshino will use only the highest grade of an elongated grain structure to guarantee maximum life and reliability during shock and vibration.

Heat treatment of the tungsten filaments is one of the most critical factors of lamp manufacturing. Proper heat treatment prevents filament sag, abnormal coil shorting or premature breakage.

Molybdenum is used for the hangers (if applicable) and as a mandrel when winding the filaments.

Oshino Sub-Miniature Lamps fall into the "T" category. The letter indicates the straight sides of the lamp and the number after the "T" indicates the diameter in eighth inch increments.

Oshino utilizes the bead seal type of lamp construction which is superior to the other methods offered, such as hand sealed or butt sealed. One advantage of the bead seal construction is the thick bead used for the seal to prevent the possibility of air leaks during lamp manufacturing and in final applications. There is also more volume inside the glass envelop, which makes it easier to mount a more reliable high voltage filament.
(Figure I)

Bead-sealed lamp construction

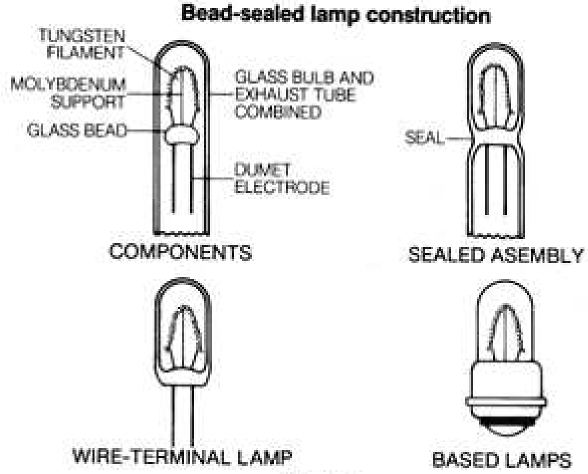

FIGURE I

Any sealed lamp can then be used as a wire terminal lamp or for a variety of silicone rubber, nylon or metal basing applications. It is recommended that wire terminal lamps that are to be soldered have their leads tin (TPL) or gold (GPL) plated.

TOP

§ Lamp Design Characteristics

The basic characteristics of a lamp are operating voltage, current, intensity and life. From these characteristics, efficacy, watts, and Kelvin temperature can be derived. A change in any one of these characteristics will result in a change in at least one of the other characteristics.

TOP

§ Voltage

Voltage is directly related to the uncoiled length of the filament. The higher voltage lamps will have longer filaments. Due to the limited space inside the lamp envelope, the tungsten is coiled and mounted into various filament shapes. Depending on the length of the filament, it might be necessary to coil the filament twice and/or use support wires for maximum reliability.

Figure II Shows the typical filament shapes used:

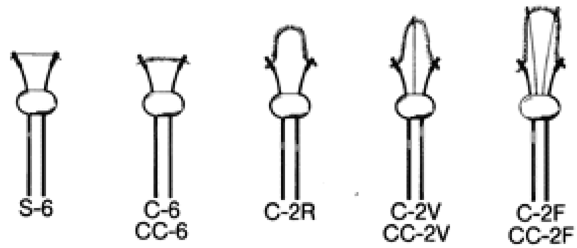

FIGURE II

Lamp will have design ratings based on their operational voltage. They can be operated at higher or lower voltages if the other effects resulting from the voltage variation can be tolerated. Figure III (Nomograph) can be used as a guide to show the changes in lamp properties as a result of the voltage change. The Nomograph should be used only as a reference and should not be considered as an absolute indication of what will happen to a lamp that has been re-rated. The greater the difference between application voltage and rated voltage, the greater the percentage of error. The Nomograph is based on the following formulas that can be used to determine the application life, amperage and MSCd:

APPLICATION LIFE=

$$\left(\frac{\text{RATED VOLTS}}{\text{APPLICATION VOLTS}}\right)^{12} \times \text{RATED LIFE}$$

APPLICATION AMPERAGE=

$$\left(\frac{\text{APPLICATION VOLTS}}{\text{RATED VOLTS}}\right)^{.55} \times \text{RATED AMPERAGE}$$

APPLICATION MSCd=

$$\left(\frac{\text{APPLICATION VOLTS}}{\text{RATED VOLTS}}\right)^{3.5} \times \text{RATED MSCd}$$

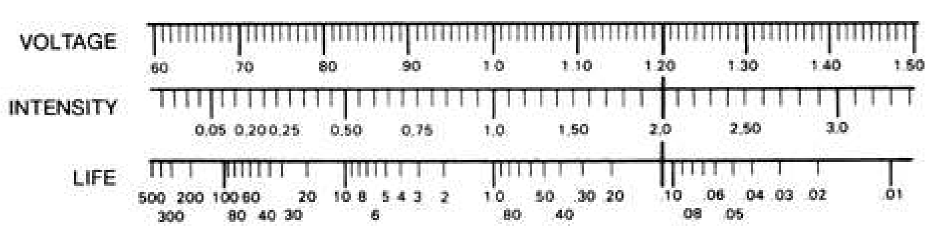

FIGURE III

TOP

§ Amperage

Amperage is the amount of current flowing through a lamp filament when operated at a given voltage. Current is determined by the resistance of the tungsten; the higher amperage lamps use a larger diameter tungsten and will have a lower resistance.

The lower current lamps use small diameter tungsten and will have a higher resistance. The standard tolerance for amperage shown in our catalog is plus or minus 10%.

TOP

§ Inrush Current

When a Sub-Miniature Lamp is energized, there is an inrush of current because of the low resistance of the cold filament. The filament color temperature (Kelvin) at which the lamp is designed to operate determines the inrush current (Figure IV).

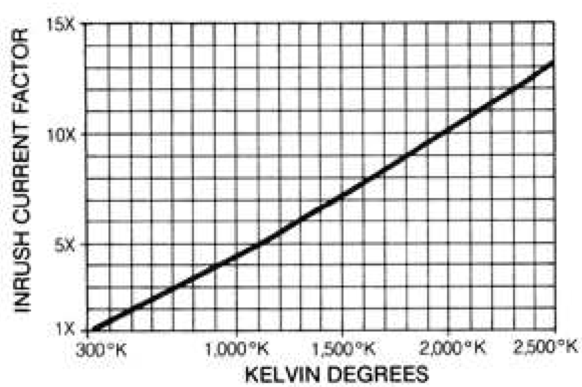

FIGURE IV

The inrush current will be 8-12 times the rated current and the "rise time", or the amount of time takes the current to stabilize at its rated value, will be approximately 30-100 milliseconds.

Measuring the cold resistance of the lamp and dividing it into the rated voltage can determine inrush current.

The inrush current can be reduced by using a "keep alive" voltage, which should keep the filament warm, but below the level of incandescence (below 1000 degrees Kelvin). The keep alive voltage can reduce the inrush current by as much as 50%.

TOP

§ Mean Spherical Candelas (MSCd)

Mean Spherical Candelas or MSCd is the unit of measurement used to indicate the intensity of a Sub-Miniature Lamp. MSCd is the total quantity of flux (lumens) emitted from a lamp when it is measured in the center of an integrating sphere. The sphere is attached to a photometer and then calibrated with an NBS (National Bureau of Standards) traceable candlepower to the lamps that are being measured.

The MSCd ratings shown in this catalog can be converted into lumens by multiplying the rated MSCd times 4 π (12.57).

Our standard MSCd tolerance is plus or minus 25%. Custom or tighter tolerances of plus or minus 15%, or 10%, or lamps selected to just the plus or minus side of the nominal, are also available.

TOP

§ End Foot Candles (EFC)

End Foot Candles (EFC) is the illuminance measurement off of the end of the lamp and is used for lamps with a flat end or a lens end.

TOP

§ Aging

Aging is a very important process to stabilize quality after production. Aging is used to eliminate the early failures due to broken or shorted filaments, vacuum leaks and to "clean up" the filament and offer MSCd stability. Vacuum clean up is evident by decrease in current and increase in brightness. In general, the filament goes through changes within the first 16 hours and then stabilizes.

TOP

§ Efficacy And Kelvin

Efficacy is the conversion of watts of electrical energy to visible radiant energy (MSCd/watt). When comparing lamps with similar voltages, the lower the efficacy, the longer the life.

Kelvin is the color temperature of the filament. The chromatic ties of a filament are very close to the chromatic ties of a blackbody radiator.

The typical Kelvin's of the standard Sub-Miniature Vacuum Lamps are between 1800 Kelvin to 2400 Kelvin. A filament must be heated to a temperature of at least 1000 - 1200 Kelvin to produce visible light. (Zero degrees Celsius equals 273 degrees Kelvin).

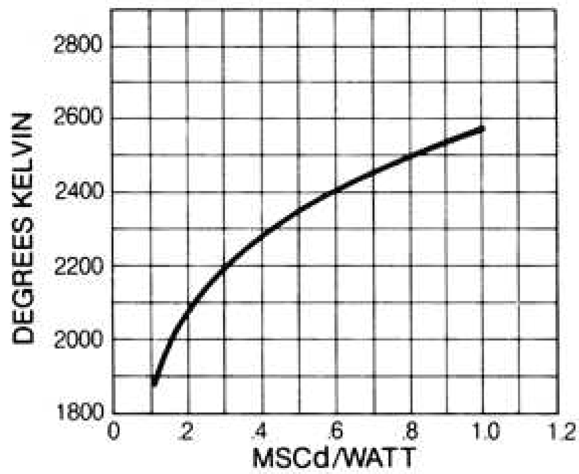

Figure V

The relationship between efficacy and Kelvin is illustrated in Figure V.

It is possible to have lamps with the same voltage and amperage and have different intensity values and life. Making small changes in the filament length and diameter does this. An example of this can be illustrated by comparing the following two lamps:

OL-330BP
14V 80mA .50MSCd 1,500 hrs.
.446 efficacy 2300 Kelvin

OL-382BP
14V 80mA .30MSCd 15,000 hrs.
.268 efficacy 2100 Kelvin

The lower MSCd of the OL-382BP is achieved by increasing the tungsten diameter and length, or changing the loaded density (watts per unit area) of the filament. The results prove to be a lower efficacy and Kelvin and an increase in life.

TOP

§ Life

Lamp life is inversely proportional to the 12th power of the applied voltage and is the most difficult characteristic to give absolute information about.

Average lamps life is based on when 50% of a large group of lamps, operating at rated voltage burn out. In some cases, rated life tests are not practical, so life is based on a theoretical calculation of the burn off rate of the tungsten when operating at the rated Kelvin.

Life may vary due to the individual manufacturer's materials and processes, DC voltage, shock and vibration, voltage variations, temperatures exceeding 100 degrees Celsius, series operations, flashing or switch operations or a lack of controls on the electronics used to drive the lamps.

It is recommended to operate a lamp at a derated voltage to increase life. This will reduce the operating Kelvin and evaporation rate.

TOP

<-BACK