Introduction and General Information

General Electric Sub-Miniature lamps are designed to meet extremely small size, extra long life and low cost requirements. They are available with a wide variety of filament constructions, bases and wire terminal leads.

Manufacturers and designers of equipment requiring sub-miniature lamps should select lamps of established design wherever possible for maximum economy as well as ease of replacement through regular trade channels.

Lamps are grouped in this catalog by bulb sizes. They are listed according to design volts in ascending order within the particular size group.

For easy reference, the "Numerical Index" section on page 27 lists lamps in sequence.

The Miniature Lamp Products Department of General Electric offers application engineering assistance to all customers in applying sub-miniature lamps in product design. Contact your local GE district office which is listed on the back cover page for additional and latest technical information.

LINE NUMBER

The line number is used to help find specific lamps. It is not of any technical or ordering significance.

LAMP NUMBER

Lamps are marked with General Electric identification and a trade number. The trade number is recorded with the American National Standards Institute and is uniform throughout industry. It completely identifies a lamp and is sufficient identification for ordering purposes. Wherever applicable, Federal Stock Numbers and/or Military Standards Numbers are shown in their respective columns next to the lamp number.

SPECIAL DESCRIPTION

This column provides description of unique features of the particular lamp: length of leads, whether tinned, bulb coating color, bead color, candlepower variations, etc.

DESIGN VOLTS

Design volts show the voltage at which a lamp is designed for rated ampere, candlepower and laboratory-life characteristics.

DESIGN AMPERES

Design amperes is the current flowing through a lamp when operated at its design voltage. It is subject to nominal manufacturing tolerances.

MEAN SPHERICAL CANDLEPOWER

The value shown in the candlepower column is the approximate initial mean-spherical-candlepower at design voltage. It is subject to manufacturing tolerances. Mean-spherical-candlepower is the generally accepted method of rating the total light output of miniature lamps. To convert mean-spherical-candlepower to lumens, multiply by 12.57 (4π).

LIGHT CENTER LENGTH

Light center length is the average measurement for which the lamp is designed and is subject to nominal manufacturing tolerances. It is measured from the geometric center of the light source to a particular point of the base. This point is shown below for the base types used in sub-miniature lamps:

- Bi-Pin — Bottom of Base
- Flanged — Top of flange
- Grooved — Center of groove
- Screw — End of bottom base contact
- Wire Terminal — Not specified

MAXIMUM OVER-ALL LENGTH

The dimension which includes both bulb and base is designated as the overall length of the lamp. For wire terminal lamps, this dimension applies only to the glass portion. The dimension figures listed here are maximum tolerance limits.

FIGURE NUMBER

The figure number corresponds to the lamp drawing which identifies the lamp with respect to the bulb size and base. Figure numbers appear in the last column of the lamp data on the lamp specifications page.

LAMP LIFE

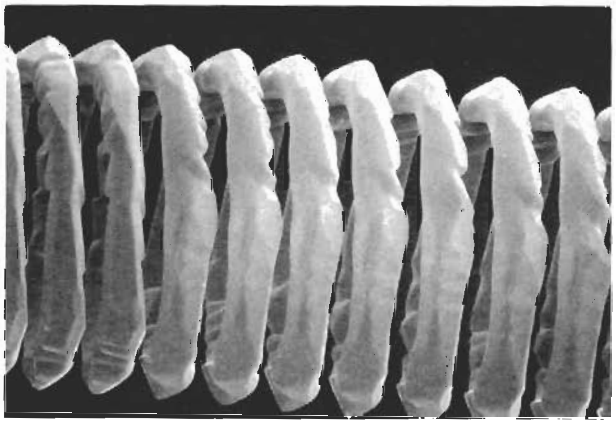
Rated average life is that obtained in closely controlled laboratory testing of lamps on 60 Hertz alternating current at their design voltage. Very long life lamps are generally rated on the basis of extrapolated laboratory test data. Service conditions such as shock, vibration, voltage fluctuations, temperature, etc., may contribute to a shorter average life.

Ordinarily, for still-rack operation, normal tungsten *filament evaporation* is the basic force or mechanism controlling incandescent lamp life. Where normal filament evaporation is the dominant failure mechanism, lamps should reach their design-predicted lifetimes.

In recent years another life-influencing lamp filament mechanism has become more prominent. This is commonly referred to as *"filament notching."* Its prominence is due to at least three factors, primarily associated with sub-miniature type lamps:

1. Low temperature filament operation, less than that for significant normal tungsten evaporation. (Long life lamp designs, such as 10,000, 25,000, 50,000 and 100,000 hour designs. This does not apply to filament temperatures below 1600° C.)
2. Small filament wire sizes, less than one mil (.001") diameter in many cases.
3. Increased use of D.C. voltage operation (generally resulting from advances in solid state technology).

Notching is the appearance of step-like or saw-tooth irregularities, appearing on all or part of the tungsten filament surface, after some burning. These notches reduce the filament wire diameter at various points. In some cases, especially in fine-wire diameter lamps, the notching is so severe as to almost penetrate the entire wire diameter. Thus accelerated spot evaporation due to this notching (as well as reduced filament strength), now becomes the dominant mechanism for influencing lamp life. Because of its abnormal evaporation and/or reduced strength effects, lamp lifetimes due to notching may be *one-half* or less of so-called ordinary or normal, predicted lamp lifetimes.



An example of filament notching.

Consider these factors . . .

when selecting Sub-miniature lamps

1 LIFE VS. LIGHT

For any particular lamp, the light output and life depend upon the voltage at which the lamp is operated. The desirable life of a sub-miniature lamp should be one which produces light most economically. The light output of a lamp varies directly as the applied voltage raised to the 3.6 power while life approximately varies inversely to the 12th power. Chart I (Page 6) illustrates the effect of overvoltage or undervoltage applied to a lamp on its current, life and light (candlepower) output. These characteristics will vary in each application. Consult your local GE Miniature Lamp Representative for technical assistance.

The data (particularly for lamp life) does not apply accurately for lamp operation on half-wave rectified voltage, semi-conductor dimming devices, or constant current operation.

2 STRENGTH AND RELIABILITY

When strength and reliability are of primary importance, it is usually advantageous to use low voltage (6.3 volts or less) sub-miniature lamps. These types have a shorter filament of a larger diameter. Such a filament is inherently stronger because of its physical characteristics. Furthermore, the resonant frequencies of low voltage sub-miniature lamps are such that they may not be in the critical range.

High voltage lamps, in the 10 to 28 volt range, generally have lower resonant frequencies and a greater number of resonant points which result in a greater tendency for shorting between filament turns.

3 INRUSH CURRENT

The initial current through a filament is called the inrush current. Cold resistance of a filament is generally considered to be that of room temperature, while the hot resistance depends on the temperature of the filament which is a variable for different sizes of lamps. Inrush current can be approximately 12 times as great as the normal operating current. This maximum value is seldom reached because of the impedance in the circuit which reduces it. However, equipment designers should take both inrush current and resistance into consideration when choosing a sub-miniature lamp. Chart II (Page 6) displays the general range of inrush current versus time after voltage is applied to a cold lamp. *Inrush current can be reduced by applying a low value of pre-heat voltage.*

4 FLASHING AND PULSING

Sub-miniature lamps have been used successfully in flashing and pulsing circuits. In general, there is no sacrifice in life as long as the light output under the flashing or pulsing condition does not exceed that of the steady burning position.

5 COLOR TEMPERATURE

The radiation from tungsten filaments used in General Electric sub-miniature lamps is similar to that from a "black body" at specific temperatures. This can be determined approximately from Chart III (Page 6).

6 REDUNDANT SYSTEM PHILOSOPHY

Two-filament lamps with the filaments connected in parallel for additional reliability is not a new idea. These lamps have never become really popular because it was found that in many cases the second filament had failed by the time it was needed. Furthermore, unless the brightness difference was quite noticeable, the loss of the first filament may not be noticed. Experience indicates that as long as there is some brightness, the lamp probably will not be changed.

A more reliable system, however, would be to use two or more lamps, operating at the same time. Since they are physically separated from each other, it is easy to see when one has failed. Therefore, it would be replaced immediately and before the second lamp failed.

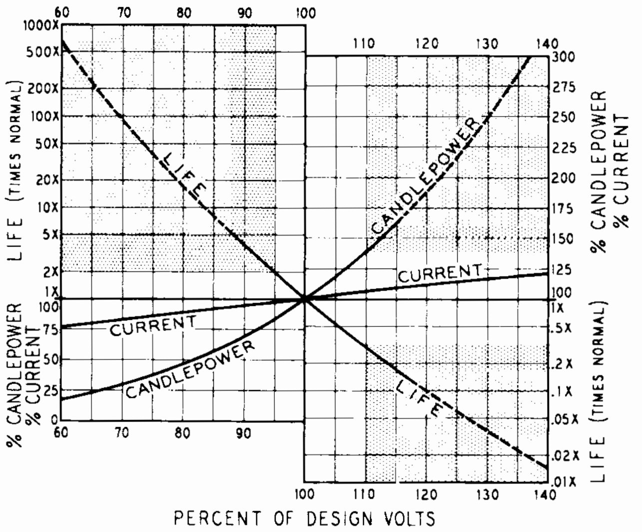
CLEANED AND SOLDERABLE LEADS

All-General Electric butt-seal, wire terminal lamps are now cleaned at the factory and furnished in an easily solderable state. This treatment makes the lamps easily solderable for a period of at least 6 months.

Lead wires used in the manufacture of butt-seal lamps have a borate-coating to insure a good metal-to-glass seal (where the lead wires enter the bulb). This coating interferes with soldering and must be removed where soldering is necessary. In applications where wire terminal lamps are connected by crimping or pressure contact, the cleaned and easily solderable leads eliminate the possibility of a poor connection.

CHART I

TYPICAL CHARACTERISTIC CURVES



THESE CURVES ARE APPROXIMATIONS ONLY

NOTE: Calculations of characteristics shown in Chart I are approximate only between 95% & 110% of rated voltage for lamp types with 5000 hours life or less. Certain lamps will vary widely from calculated values. This chart will not apply to lamps with lives in excess of 5000 hours.

CHART II

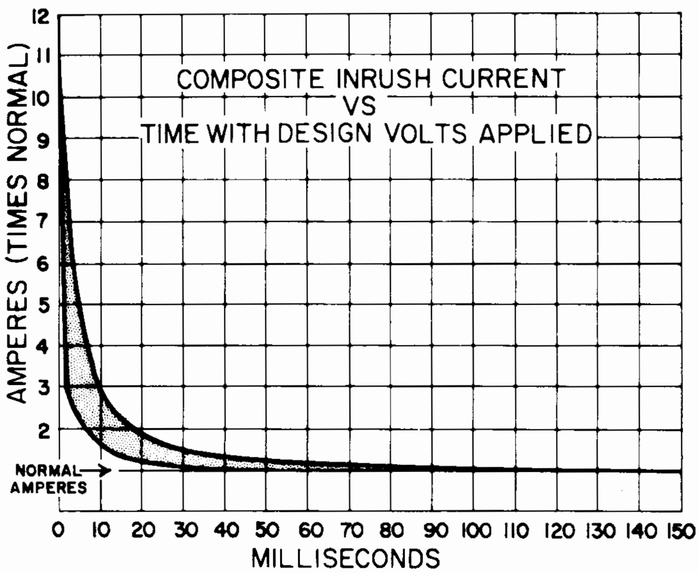
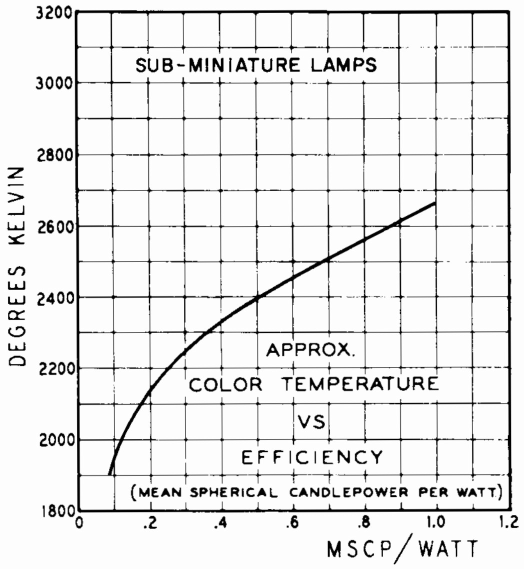


CHART III

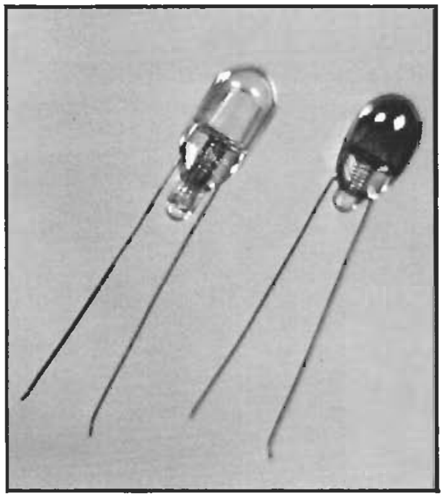


What is a Halogen-Cycle Lamp?

Very high light output from a very small package.

That's because GE halogen-cycle lamps are made with special high-temperature glass or quartz bulbs that can withstand the high temperatures generated by the required wattage. These same high temperatures are necessary to initiate and maintain the "cycling" of the lamps' halogen vapor, such as iodine. The vapor combines with particles of evaporated tungsten from the filament and redeposits the tungsten continuously back onto the filament... instead of the bulb wall. The results are a strong, long-lasting filament and the virtual elimination of bulb blackening.

A member of the long-established incandescent lamp family, GE halogen-cycle lamps are available in miniature (3/8 and 1/2 inch diameter) and subminiature (3/16 and 1/4 inch diameter) bulb sizes, as well as in sealed beams. A typical miniature halogen-cycle lamp rated at 62 watts produces as much light as a familiar 60-watt household lamp. Yet the miniature halogen-cycle lamp is only 1/6 the size of the household lamp.



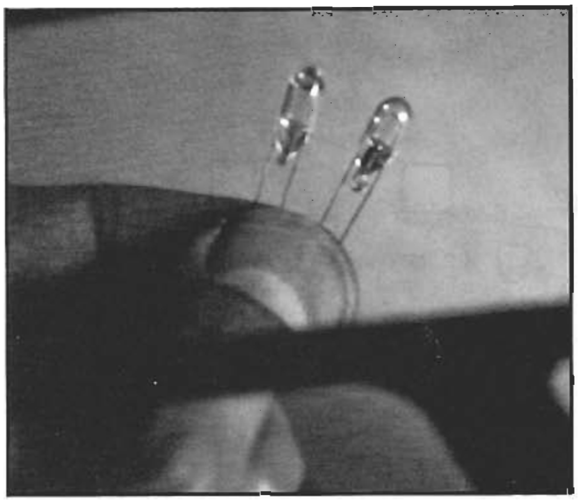
The lamp on the left is a halogen cycle lamp. On the right is a regular incandescent lamp.

Light that maintains its initial output level for virtually the life of the lamp.

A halogen-cycle lamp continues to produce 85 to 95% of its initial light output at least 70% of its life expectancy... and sometimes longer. That's a 50% improvement in total light emitted throughout life compared to conventional incandescent lamps. One reason: virtual elimination of bulb blackening due to recycling of tungsten particles to and from the filament.

Light that is highly efficient.

In addition to their self-cleaning, nonblackening characteristics, GE halogen-cycle lamps are made with filaments that are accurately positioned inside the bulb—consistently from bulb to bulb. High-temperature-glass types have uniform bulb tops, which further enhance light output efficiency, especially for optical system applications.



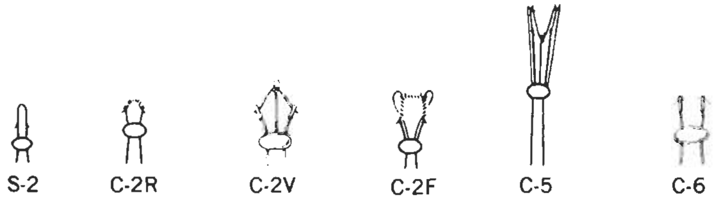
Halogen cycle lamps–note the uniform bulb tops.

Why use Halogen-Cycle lamps?

- For equipment miniaturization through smaller bulbs.
- For lower operating costs through lower electrical power requirements.
- For lower maintenance costs through longer bulb life.
- For better light efficiency through nonblackening bulb, accurate filament placement, and uniform bulb top.

Filaments

The almost universally used lamp filament material is tungsten because of its high melting point, and structural strength at incandescence. The filament may be straight wire (S) or a coil (C). Coiling the wire effectively shortens the filament length so that smaller bulbs can be used. Filament designations consist of a prefix letter to indicate whether the wire is straight or coiled, and a number to indicate its physical configuration on the supports.



Bases

Bases provide electrical contact to the lamp and, in most cases, also support the lamp in the fixture. Based lamps have two advantages over wire terminal lamps: (1) replacement is easier, and (2) bases protect wire and seal contact area.