MINIATURE HALOGEN LAMPS *LAMP TYPES*

Welch Allyn manufactures a wide variety of gas-filled and halogen based type lamps. Provided below are descriptions of each type of lamp. Performance characteristics are described in other technical data sheets. For further assistance, please complete the Lamp Application Data Sheet or call our staff of experienced application engineers.

Summary of Lamp Types and Typical Performance Characteristics

Lamp Performance	**Gas Fill Type**		**Halogen Fill Type**	
	Krypton	**Xenon**	**Krypton**	**Xenon**
Efficacy (LPW)	18	21	24	27
Color Temp. (K)	3125	3150	3300	3350
Maintenance	85%	85%	98%	98%
Average Life	up to 30,000 hours		up to 10,000 hours	

HALOGEN

The halogen lamp achieves light output through the incandescence of a tungsten lament. Similar in construction to the gas-filled lamp, the halogen lamp contains an inert gas combined with an active halogen compound. The inert gas suppresses tungsten evaporation, while the halogen chemically combines with the tungsten evaporated from the lament preventing deposition of the tungsten on the lamp wall. Through a chemical regenerative cycle, the tungsten is redeposited on the lament and halogen is then freed from the tungsten to repeat its active role.

For the halogen regenerative cycle to work, the lamp must be maintained at a certain temperature. For higher wattage halogen lamps this critical temperature is approximately 250^{o}C; for some of Welch Allyn's miniature and subminiature halogen lamps, the critical temperature is less than 250^{o}C. This is because of our unique gas chemistries and lamp designs. Check with Welch Allyn for the critical temperature for your chosen lamp. These lamps are very application dependent, with duty cycle and heat sinking being prime considerations.

Halogen lamps generally offer the distinct advantages of highest color temperature, highest luminous efficacy, superior maintenance and longest life. Color temperatures typically range from 2700K to 3350K, and current draw is less than 3.0 amperes. The surface temperature of a halogen lamp runs slightly higher than a vacuum lamp of comparable size and wattage, but similar to a comparable gas-filled lamp. Maintenance is generally superior due to the halogen regenerative cycle. Despite the limitation on duty cycle and heat sinking, halogen lamps can be readily designed to meet most lamp application requirements. See page 10 for a discussion on duty cycle and heat sinking.

Welch Allyn manufactures high quality, long life lamps.

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GAS-FILLED

The gas-filled lamp is similar in appearance to the vacuum lamp. However, there are significant differences in its construction, operation and performance. Gas-filled lamps achieve light output through the incandescence of a tungsten lament in a pressurized, inert gas atmosphere that suppresses the evaporation of tungsten. This lamp design offers higher color temperatures, higher luminous efficacy, better maintenance and longer life. Gas-filled lamps are not adversely affected by short duty cycles or heat sinking. Color temperatures typically range from 2600K to 3200K, and current draw is less than 2.0 amperes.

Surface temperatures run slightly higher than vacuum lamps of comparable size and wattage due to the internal gas atmospheres and higher allowable current draw. Light output will decrease somewhat over the life of the lamp. However, this loss of maintenance is slight compared to a corresponding vacuum lamp. These characteristics offer distinct application advantages _ and gas-filled lamps can be easily customized into a unique design.

Welch Allyn halogen lamps offer superior maintenance and are easily customized.
(See maintenance definition on page 6).

VACUUM

Vacuum lamps achieve light output through the incandescence of a tungsten lament in a vacuum environment within the lamp glass envelope. They are a good general purpose light source where lower luminous efficacy is acceptable and are not adversely affected by short duty cycles. Color temperatures typically range from 2400K to 2700K and current draw is less than .800 amperes. Since these lamps lack an internal gas atmosphere, the surface temperature will be cooler and luminous stability is more easily achieved.

Light output decreases over the life of the lamp due to tungsten evaporation and its deposition on the interior glass surface, darkening the lamp wall over time. The rate of darkening increases as the color temperature increases, and is typically referred to as the loss of maintenance _ the ability of the lamp to maintain its initial level of light output. Lamp failure is ultimately caused by the evaporation of tungsten from the lament and subsequent thinning of the lament wire to the point of burn through. Another form of failure occurs when the level of light output diminishes to the point at which it is insufficient for the application.

Vacuum and gas-filled lamps are especially well suited for short duty cycles.

MINIATURE HALOGEN LAMPS
Lamp Electrical Characteristics

This section describes the effect of various electrical characteristics on the performance of a lamp in a given application.

VOLTAGE

Welch Allyn lamps are designed to operate from 2 to 28 volts, AC or DC power. We recommend the use of regulated DC power supplies to yield the best life-span.

The Rerating Information, to the right, shows the relationship of voltage to lamp life. For example, a 10% increase or decrease in applied voltage will cause a 50% decrease or increase respectively in lifespan. This clearly shows the value of voltage control and why unregulated AC power supplies are not recommended.

In any application, a lamp may be purposely derated to extend its life as long as light output remains sufficient for the application. We do not recommend derating halogen lamps by more than 10%. There are no restrictions on derating gas-filled or vacuum lamps. If derating a halogen lamp over 10% is one of your requirements, please speak with a Welch Allyn sales engineer.

Sometimes constant current sources are used successfully for lamp operation. Actual testing should be done to confirm benefits. A constant current power source will increase voltage as the filament wire thins. This may cause an apparent premature failure as the lamp is being gradually over-voltaged.

When one of the standard lamps shown in our catalog does not meet your requirements, the lamp may be rerated to produce a new set of specifications. The following three equations can be used for rerating purposes. Factors may be read from the graphs above and used in the equations, or for more accurate results, the factors may be computed directly.

Vd = Design Voltage   Va = Applied Voltage

Rerated Life = $[Vd/Va]^{12.0}$ x Life at Design Voltage

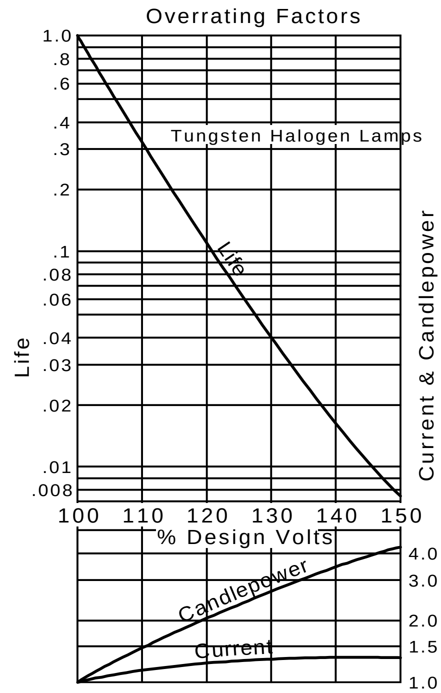
Rerated Current = $[Va/Vd]^{0.55}$ x Current at Design Voltage

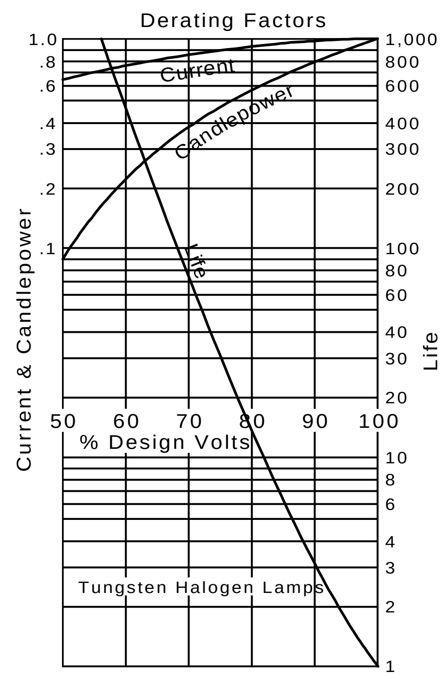
Rerated Candlepower = $[Va/Vd]^{3.5}$ x Candlepower at Design Voltage

These equations serve only as a general rule under ideal conditions. The greater the deviation from the design voltage, the greater the percentage of error in the results from the equations.

Welch Allyn maintains consistency in their lamp manufacturing.

Rerating Information





LIFE

The life of a lamp is generally defined as the point at which the lamp fails to light. It is a function of how fast the tungsten evaporates from the filament. This is a result of many things, such as lamp type, color temperature, duty cycle and end-use qualifications.

This definition does not take into account the degradation of light output over the life of the lamp (as described in the section on Maintenance, technical datasheet ISL 298). If the lamp is still functioning electrically, but not providing the original output, the lamp may have effectively failed.

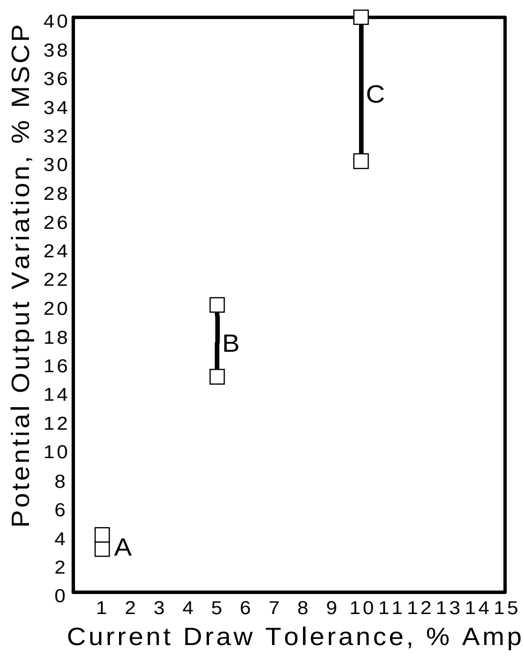
All Welch Allyn lamps are rated for life based on rack testing at a constant DC voltage until burnout. Actual life may vary depending upon environmental conditions such as thermal shock, vibration, duty cycle or voltage control. The effect of voltage underrating or overrating on lamp life can be estimated according to the Rerating Information.

CURRENT DRAW

Our standard range of current draw by design is 0.180 amperes to 3.3 amperes. The industry standard for tolerance on current draw is +/-10%. *One way Welch Allyn insures product precision is to control the current draw to within +/-5% of the specified current. The Welch Allyn design specification for current draw of +/-5% allows us to produce lamps that significantly outperform lamps with wider tolerances.*

Lamp output can vary as much as 3% to 4% for each 1% variation in current draw. The figure below shows the relationship between current draw tolerance and potential lamp output variation. Tighter specifications are available on request. Numerous variables must be controlled in design and manufacturing to achieve this.

Current draw will vary according to the applied voltage as shown in the Rerating Information. Therefore, when the power supply varies in voltage or when the voltage is purposely rerated to alter life or output, the change in current draw must be considered. The wattage (the product of applied voltage times the current draw) also needs to be considered to ensure that the power supply is adequate.



Variation

Current Draw	Output
(A) 1%	3%-4%
(B) 5%	15%-20%
(C) 10%	30%-40%

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MINIATURE HALOGEN LAMPS
Lamp Optical Characteristics

Maintenance

Maintenance is the ability of the lamp to maintain its initial level of light output. It is often expressed as a percentage of the lamp's original output at 70% of the rated lamp life. Maintenance is an important consideration in selecting a lamp because while the lamp may still light, its light output could degrade to a point at which there is insufficient energy for the application. Figure A shows the relationship of the three lamp types to initial light output levels and maintenance.

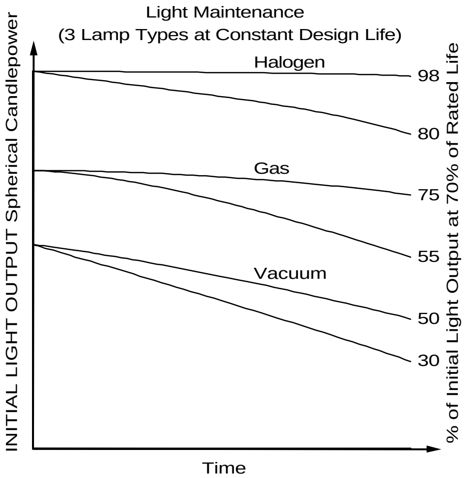


Figure A.. Light Maintenance (3 Lamp Types at Constant Design Life)

Halogen lamps not only have a higher output at a given wattage, they also have superior maintenance. Gas-filled lamps have superior maintenance to vacuum lamps and in some applications, where there is a short duty cycle or significant heat sinking, they are superior to halogen lamps. *Superior maintenance is a distinct advantage of Welch Allyn halogen and gas-filled lamps.*

Light Output & Efficacy

Light output is commonly measured and expressed in terms of mean spherical candlepower (MSCP). This measurement is made by placing an unbased, wire terminal lamp in an integrating sphere, (calibration is traceable to the National Institute of Standards and Technology) and powered at rated voltage. The MSCP value is a photopic measure and may be converted to another commonly used measure, lumens, through the following formula:

Lumens = MSCP x 4π

MSCP, and therefore lumens, is a function of the wattage, color temperature and filament coil configuration. Lamp efficacy increases dramatically with increased color temperature. Figure B illustrates this relationship. The efficacy of a lamp is its luminous output per watt expressed by the following formula:

Lamp Efficacy = Lumens ÷ Watts

These measurements are characteristics that generally describe how a lamp performs. In some applications, a lamp's performance must be defined relative to output in a conned area or spot. When this is required, we use a photometer to measure the lamp's output over a defined area (spot) at a certain distance. This output is normally stated in candlepower or another unit incorporating light per unit area. This is described in the Spot Projection technical datasheet ISL 299.

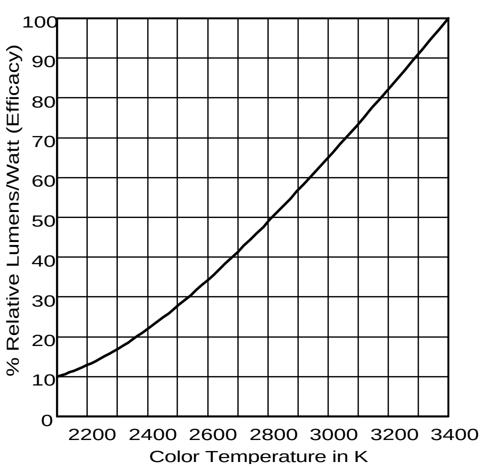
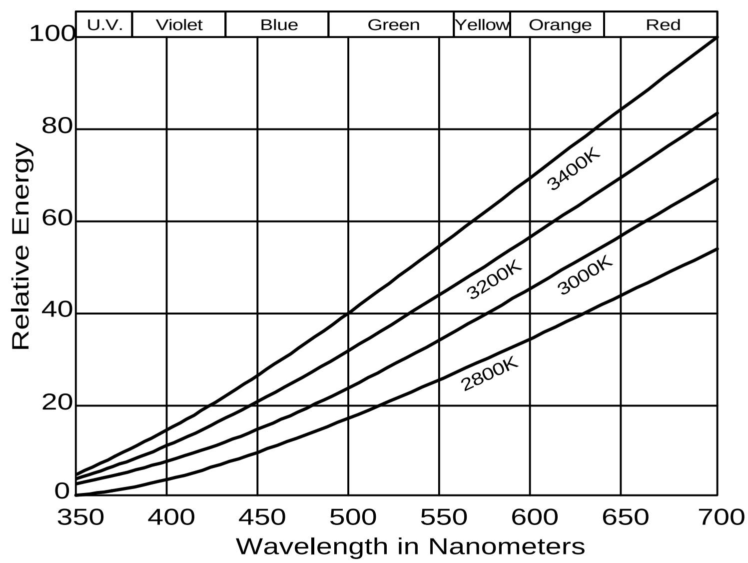


Figure B. Special Energy Distribution for Tungsten Lamps at Various Color Temperatures.

Color Temperature

Color temperature is a rating used to measure filament temperature, usually in degrees Kelvin (K). By definition, color temperature is the temperature at which a blackbody must operate to produce the exact color match of the filament of a lamp. Color temperature can be better understood when relating it to sunlight, which is the highest color temperature source available 5500 K.

This is an important performance characteristic for a lamp from several significant standpoints. Higher color temperature will give higher energy levels in all wavelength regions of the emission spectrum. As shown in the Figure below, a lamp operating at 3400K will have nearly three times the relative energy at 400 nanometers and nearly two times the relative energy at 700 nanometers than a lamp operating at 2800K.



Higher color temperature also contributes to higher luminous efficacy as measured in terms of lumens per watt. Lamps with higher color temperature provide greater efficacy in applications sensitive to near IR or IR (heat) and/or power consumption. High color temperature lamps are best in applications utilizing visible light and the human visual response. They offer more light in the green and blue spectral regions making the light appear whiter. See Figure above. In fact, an individual will be able to distinguish all colors better in higher color temperature light.

Typically, a higher color temperature will generally be indicative of shorter lamp life to burnout. However, by utilizing our experience at design and production, we can limit and control this trade-off. *Welch Allyn Miniature Halogen Lamps offer the best combination of high luminous efficacy with high color temperature and long life.*

MINIATURE HALOGEN LAMPS

Lamp Mechanical Characteristics

Welch Allyn lamps are also unique in their mechanical design. This section describes the effect of various mechanical design characteristics on the performance of a lamp in a given application. The Welch Allyn advantage: tight electrical specifications and tight control of light output.

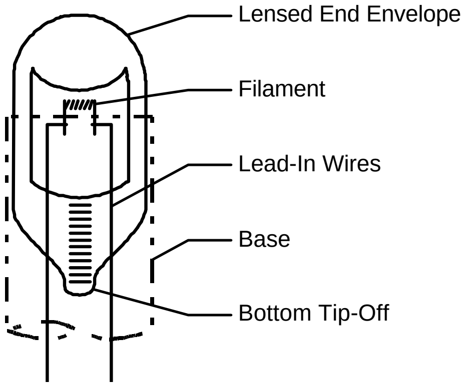


Figure 1. Design for the lensed Lamp

Bottom Tip-Off

The tip-off is the area of the envelope where atmospheric air and contaminants are extracted or exhausted from the lamp during manufacture. A secondary process can backfill the lamp with gas, producing the gas-filled lamps and gas-halogen compounds to create the halogen-type lamps described earlier.

Welch Allyn lamps incorporate a bottom tip-off, as in Figures 1 and 2. A bottom tip-off leaves the top of the lamp clear for an unobstructed view. This gives the user a 270^{o} view of the filament projected light. The lamp can be viewed from the top or the sides, making it easier to use in precision systems and systems where space may be at a premium.

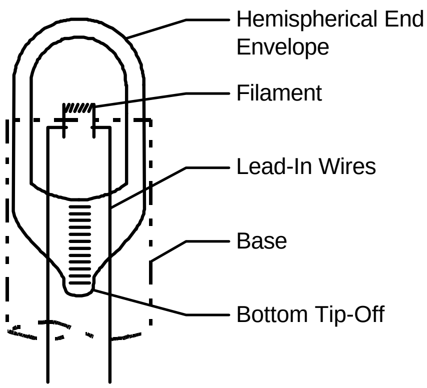


Figure 2. Design for the Non-Lensed Lamp

Lensed and Non-Lensed Envelopes

For our envelopes, we use a high temperature optical grade glass material. There are two basic envelope end configurations: lensed (also referred to as flame-formed) and non-lensed (also referred to as hemispherical).

The lensed-end envelope in Figure 1 will project a well-defined spot, at given distances, from the end of the lamp. The spot can be adjusted and controlled through various means (as described in the Spot Projection data sheet). A lensed-end lamp is often used in applications to illuminate a fiber optic, aperture or image plane and where an external lens is not desirable.

The non-lensed envelope in Figure 2 provides an unobstructed view of the filament. This is commonly used in filament imaging applications when external lensing is typically used in the optics.

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Spot Projection

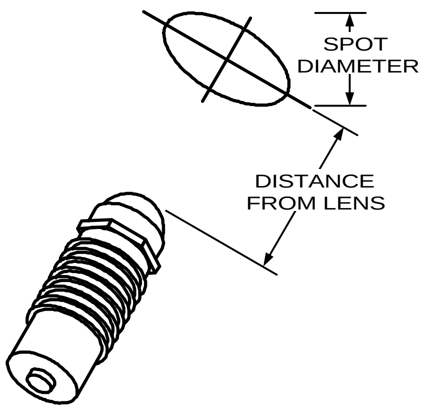


Figure 3. Precision Spot Alignment

The output of a lensed-end lamp can be specified as a spot (diameter) in a plane tangent to the lens and/or a plane perpendicular to the lamp cylindrical axis, and at a defined distance from the lens. See Figure 3. Some applications require a better control of spot size, spot location and output intensity.

We refer to the combination of these characteristics as spot projection. If required, Welch Allyn can employ equipment in its manufacturing process to better control spot projection. Lensed-end lamps project a diverging spot often used to illuminate a fiber optic, aperture, image plane or sensor.

Standard lamps which have reasonable spot projection can be used when the system optics are flexible enough to be modified to the lamp's specifications. When the system optics are fixed, a lamp can be designed to provide the spot projection necessary to meet the full requirements of the application.

Filament Optical Basing

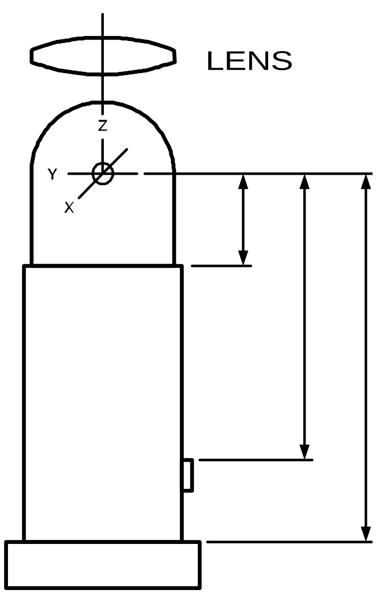


Figure 4. Tolerance on Filament Position (x, y, z)

In applications where imaging of the filament is important and external optics are used, Welch Allyn can control the filament position by filament optical basing. These applications, including reflectors, projectors and other optical systems, demand that the actual light source, the filament, be on the optical center of the system. Welch Allyn has the capability to place the filament on center to within ±.005" (.127 mm) with respect to the lamp base. We refer to this capability as filament optical basing.

This provides the necessary mechanical control over the filament placement so as not to compromise the system optics. Better control over the filament position provides a more precise and repeatable system. See Figure 4. Filament optical basing also can reduce total lamp replacement costs by minimizing the necessity for adjustment or technical intervention.

Since optically based lamps manufactured by Welch Allyn will have an identical filament position, lamp output is repeatable in intensity and position. When this is demanded by the application, Welch Allyn lamps can provide the necessary precision.

Welch Allyn provides high quality engineering service to meet customer requirements.

MINIATURE HALOGEN LAMPS
Environmental and Operational Conditions

The following factors, in addition to electrical and mechanical considerations, also have an impact on lamp performance:

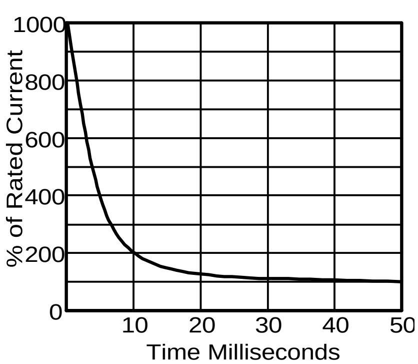
OPERATING TEMPERATURE / HEAT SINKING

It is generally thought that all halogen lamps must maintain an envelope temperature of 250^{o}C minimum to insure operation of the halogen cycle. Welch Allyn has developed the most efficient halogen gas chemistry in the industry, allowing operation in many applications at temperatures below 250^{o}C. This is application and lamp dependent and should be evaluated per application.

The amount of heat generated by a lamp is a direct function of the lamp wattage. A 6W vacuum lamp will generate as much heat as a 6W halogen lamp. The only difference may be that the halogen lamp has a smaller envelope and thus less area to dissipate the heat. Heat sinking then becomes a factor. The design engineer must be certain that the halogen lamp, when heat sunk, does not drop below its required operating temperature. Our design engineers are available to assist you. Heat sinking does not affect the operation of vacuum or gas-filled lamps.

SHOCK & VIBRATION

In all incandescent lamps, the filament becomes brittle as it ages with use. This makes the filament more susceptible to shock/vibration, especially when cold. If shock or vibration is considered a potential problem, the lamp should be mechanically isolated. Cold start also needs to be evaluated, since most lamps fail at this time. Soft starts and idle voltage are two ways to reduce these effects (as described in the section on In-Rush Current).



Typical In-Rush Curve

In-Rush Current: The resistance of the filament (tungsten) wire is significantly less at room temperature than when hot during lamp operation. Therefore, when a lamp is energized, there is an initial current surge, commonly referred to as the in-rush current. This in-rush current may exceed the actual operating or steady state current by as much as 1000% for several milli-seconds (See figure to the left). There are design techniques that can be used to control the in-rush current. Contact our application engineers for more information.

DUTY CYCLE

The lamp's actual duty (On/Off) cycle can affect the performance of any lamp. There are no concrete rules establishing the effect of a short On cycle; however, the halogen lamp is the most susceptible to a short duty cycle. Each application should be evaluated in terms of all its requirements, including heat sinking, wattage, in-rush current, etc.

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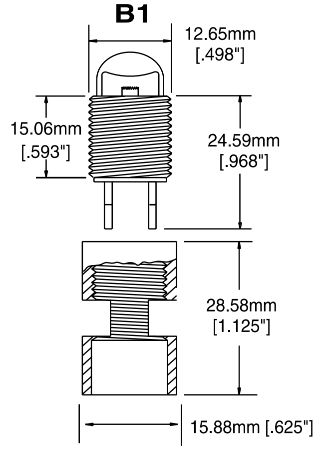
MINIATURE HALOGEN LAMPS
LAMP BASE & SOCKET CONFIGURATIONS

GENERAL DESCRIPTION: Welch Allyn miniature halogen lamps can be supplied with various base configurations. The following are the standard lamp base configurations that are readily available. Please contact our design engineers if you require a custom lamp base and socket for you application.

1/2-20 UNF 2A/2B THREAD
TAB LEADS

B1



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10-32 UNF 2A/2B THREAD
FOR SOCKET

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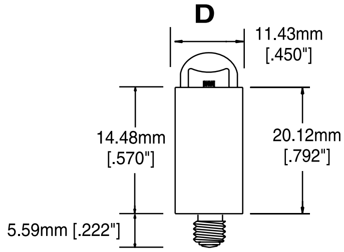

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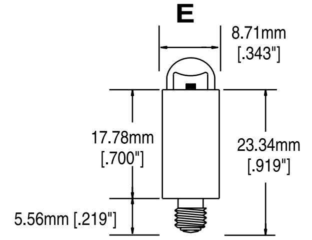

SMOOTH
INSULATED WIRE LEAD

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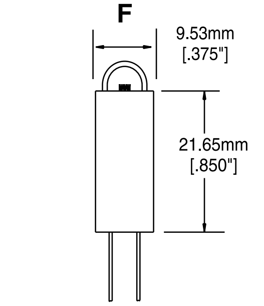

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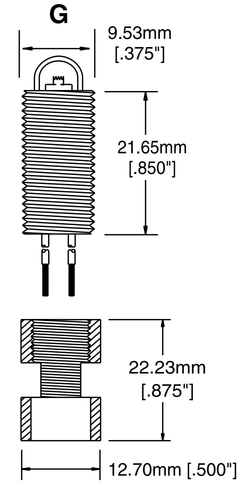

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SMOOTH
BUTTON CONTACT

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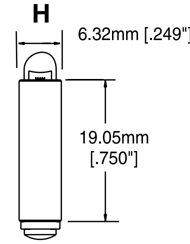

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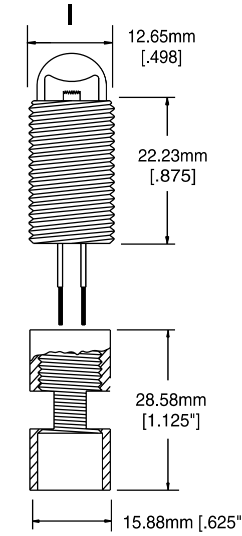

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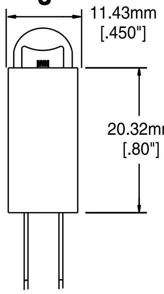
SMOOTH
INSULATED WIRE LEAD

J



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FOR SOCKET

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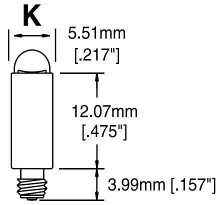
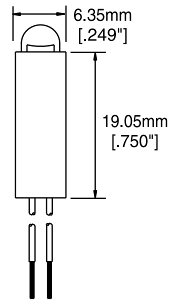


SMOOTH
INSULATED WIRE LEAD

M



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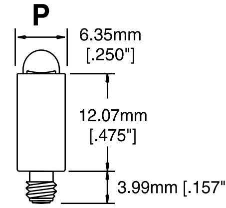

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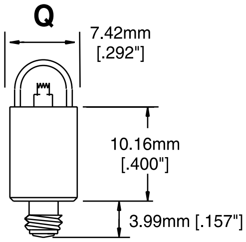
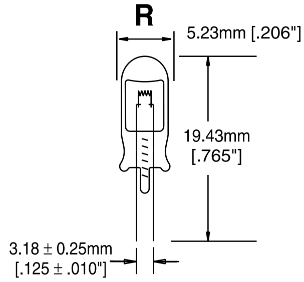
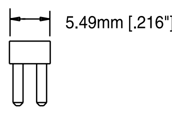


TWO PIN

R





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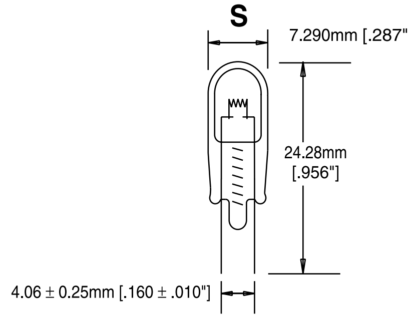
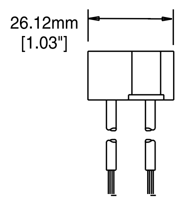
WITH LEADS:
NO. 920571-3

TWO PIN

S





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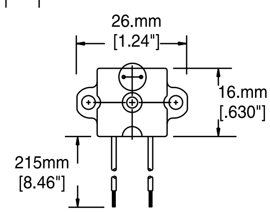

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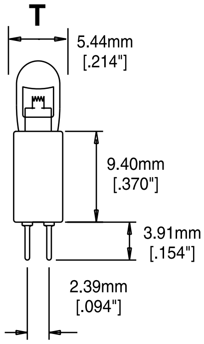
NO. 920504-2
NO. 920504-3

BI-PIN

T



SUB-MINIATURE FLANGED

U