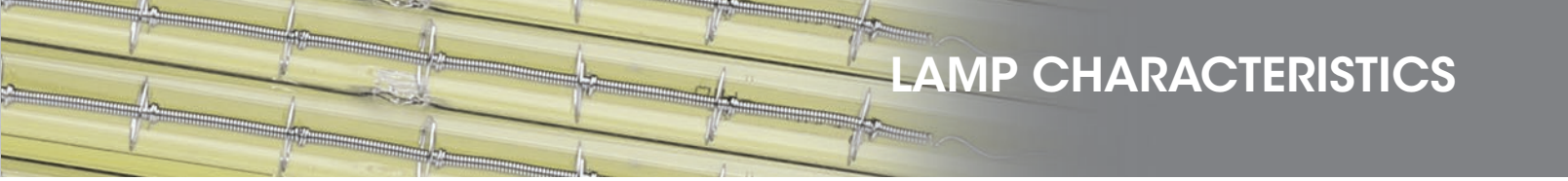


LAMP CHARACTERISTICS

USHIO (QIH) IR LAMP ADVANTAGES

- High Efficiency: Up to 95% of Energy Converted to IR Radiation
- Long Life: Typically Greater Than 5,000 Hours
- Fast Response: Typically < 1 Sec. to Reach 90% Output
- Output Maintenance: Typically <10% Drop in Output Over Life
- Variable Power Control
- Reliability: High Quality Parts and Stringent Processes Used to Produce a Superior Product
- Custom Lamp Designs Available
- Small Production Runs Possible
- Short Lead Times for Samples
- Exceptional Technical Support

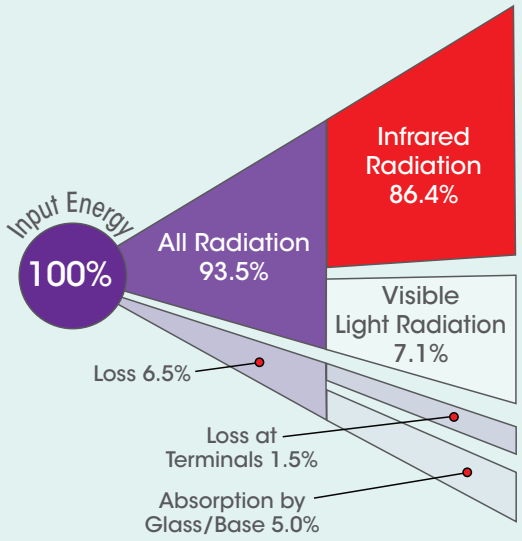
QUARTZ INFRARED HEATER - DESCRIPTION

- **Economy**
  Compact and lightweight, halogen lamps have made it possible to design very compact lighting or heating fixtures and equipment, allowing for a reduction in the cost of production facilities. Additionally, the long life of halogen lamps permits a further reduction in maintenance and related expenses.
- **Heat Impact Resistance**
  With their quartz glass envelope, halogen lamps are much more resistant to heat impact than ordinary incandescent lamps. It is very unlikely that a halogen lamp will break should it come into contact with cold water.
- **High Efficiency**
  The lamp envelope is of quartz glass. The compact bulb supplies a high luminous output per watt. The "Halogen Cycle" minimizes evaporation of the tungsten filament.
- **Long Life**
  The "Halogen Cycle" guarantees extremely long lamp life. Service life is about twice that of an ordinary incandescent lamp.
- **Stable Color Temperature**
  Thanks to the "Halogen Cycle" – a chemical reaction whereby evaporated tungsten particles are returned to the filament – blackening of the bulb wall and thinning of the tungsten filament are kept to a minimum. Light intensity and color temperature remain stable throughout the life of the lamp.
- **Warm Up and Cool Down**
  When a Quartz Infrared Heater lamp is turned on, it will be able to achieve its maximum radiation (heat energy) in the shortest time when compared with other heaters. The length of time it takes to achieve the maximum radiation output is 40-50 seconds; it also has a rapid cool down when the lamp is switched off.

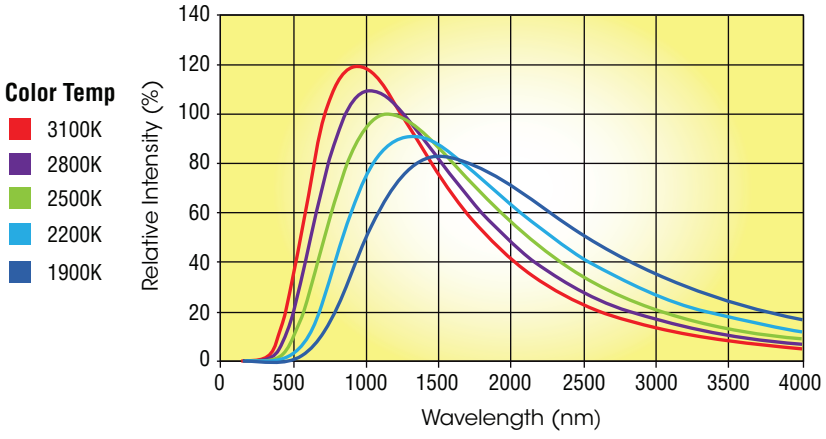
COLOR TEMPERATURE & SPECTRAL DISTRIBUTION

Typical Ratio of Radiated Energy and Heat Loss

A lamp converts 75%~95% of electric energy into heat and light emitted from the lamp. Visible light accounts for up to 12% of the converted energy. The remainder is emitted in the form of infrared radiation.



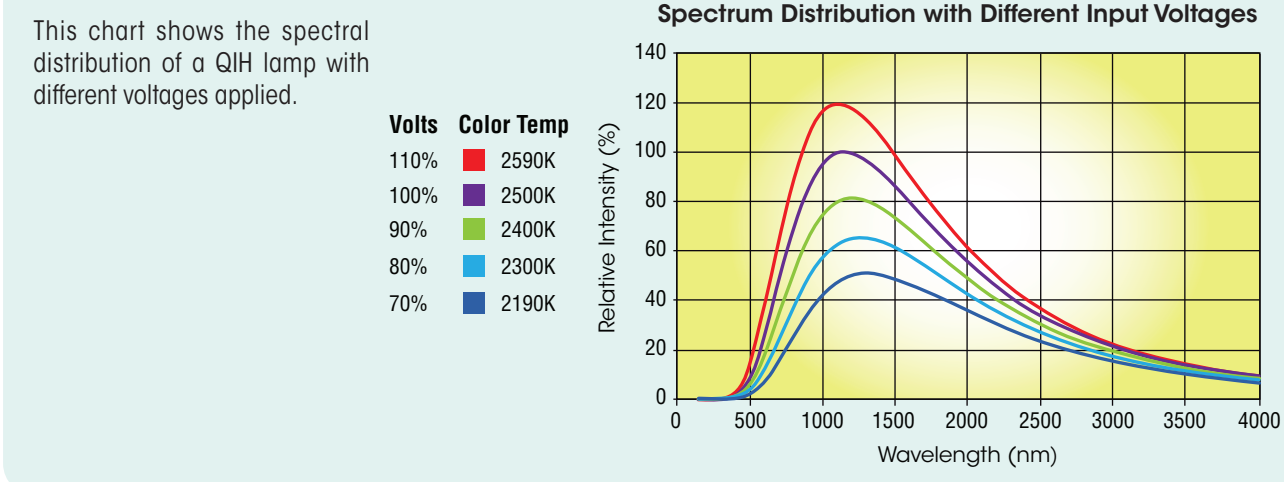
Spectrum Distribution with Fixed Input of Electrical Energy



The relative intensity increases as the temperature increases with the resulting peak being shifted towards the shorter wavelength range.

This chart shows the spectral distribution of a QIH lamp with different voltages applied.

Spectrum Distribution with Different Input Voltages



VOLTAGE VARIATIONS AND VARIATIONS OF OTHER FACTORS

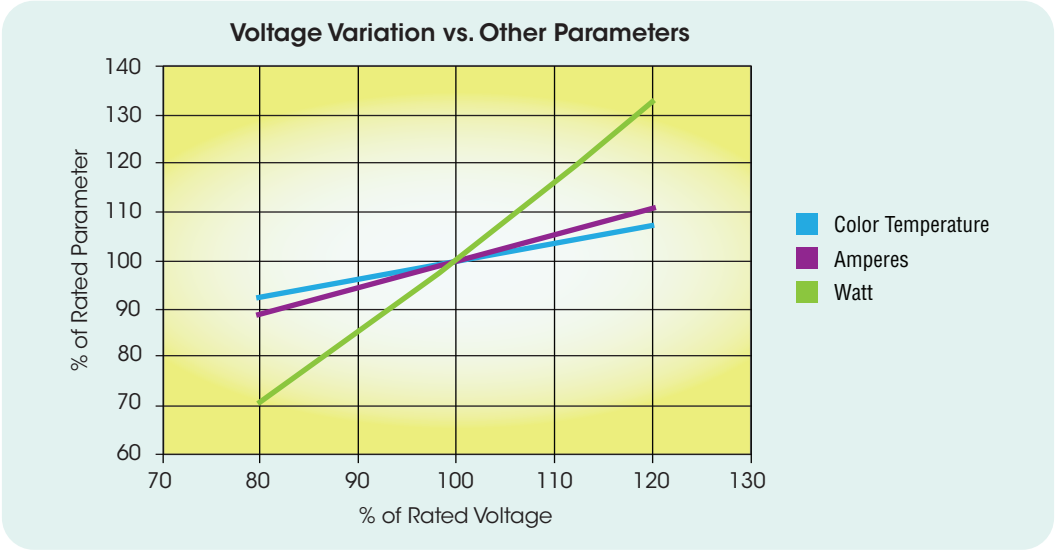
There are several factors (F), as shown in the below table, which are inherent to the characteristics of QIH lamps. The change ratio (F/F_0; F is the actual value and F_0 is the rated value), for these factors is approximate and expressed as:

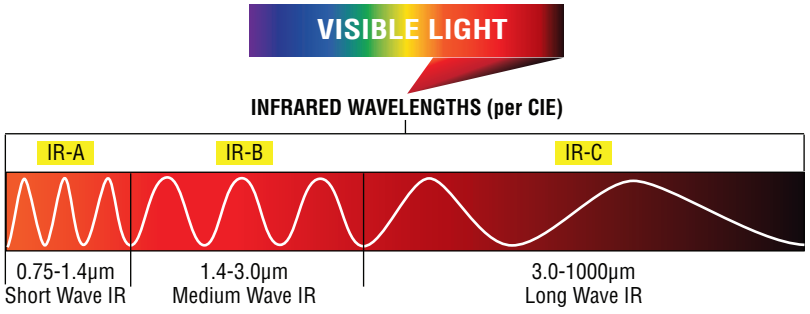
$F = F_0 * (V/V_0)^K$ where V is the actual voltage value and V_0 is the rated voltage value. The chart also shows the values of K for each of the factors (values for K may vary slightly according to the configuration of each lamp). The voltage variation chart displays the graphs for each factor.

	F	Current (A)	Wattage (W)	Color Temp. (K)
K	Halogen Lamps	0.54	1.54	0.37

VOLTAGE VARIATION AND LIFE VARIATION

The life of a lamp is greatly affected by the voltage applied to the lamp. If the voltage were increased by 10% over the rated voltage, the life expectancy would be cut by 1/3 of the rated life. Inversely and theoretically, if the voltage applied were limited to 90%, the life would be expected to increase by 3.5 times the rated life. In practice however, there are other factors involved which prevent such a large increase. Nonetheless, it should be noted that life can be influenced significantly by relatively small changes in voltage.





LAMP LIFE

USHIO's QIH series of IR lamps are manufactured to high quality standards and are designed to provide reliable performance over life. Reliable performance however, is contingent on several parameters which are dependent on operating conditions. Key information is provided below on a few of these parameters.

- **SEAL TEMPERATURE**
  The temperature of the seal at the point where the metal foil meets the outer pin of the lamp must be kept under 350ºC. If this junction exceeds 350ºC, there are several detrimental effects that will be encountered.

  - Accelerated oxidation will occur resulting in increased expansion and seal fracture.
  - Higher thermal expansion will induce stress between the metal and the quartz, resulting in possible fracture.
  - The integrity of the hermetic seal could be compromised.

  It is recommended that thermocouple testing be performed to ensure proper operating temperatures. Ushio can provide lamps equipped with thermocouples upon request.

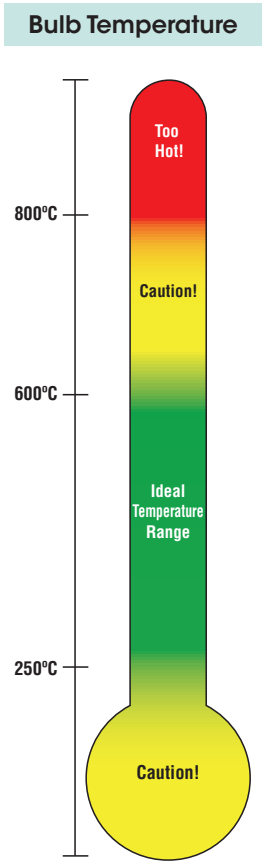
- **BULB TEMPERATURE AND HALOGEN CYCLE**
  The bulb temperature should be maintained between 250ºC and 800ºC. This is to ensure the Halogen Cycle is operating effectively and to maintain the integrity of the quartz bulb and seals.

  The Halogen cycle refers to the Halogen gas that is often filled into the lamp which reacts and combines with the evaporated tungsten from the filament thus preventing tungsten from being deposited on the bulb wall causing wall blackening.

  At temperatures below 250ºC, the halogen gas will not be very effective and any evaporating tungsten from the filament will be deposited on the bulb wall. The amount of deposit may be small, considering the evaporation of tungsten is lower at low temperatures versus when hot, but over time these tungsten deposits can accumulate and result in bulb wall darkening. (If encountered, this effect can often be overcome by once again operating the lamp within the prescribed temperature range, which should clean up most of this blackening).

  At temperatures greater than 600ºC, the halogen gas again becomes less effective at preventing wall blackening. Beginning at this temperature, the process of dissociation of the halogen/tungsten compound starts to play a role, with some of the free tungsten becoming deposited on the bulb wall.

  At temperatures greater than 800ºC, not only does blackening increase, but also stresses in the quartz due to increased temperature gradients will begin to affect the lamp, both at localized areas of the bulb as well as at the transition from the bulb to the seals. In addition, any slight impurities within the lamp will no longer have negligible effects due to increased mobility and reaction rates.



- **VOLTAGE VARIATION**
  It has already been explained that slight changes in nominal operating voltage can have significant impacts on the life of the lamp.

INRUSH CURRENT

The resistivity of tungsten changes significantly with temperature. When an IR lamp is started from a cold state, the lamp will draw a current (amperes) that is about 7-10 times the normal operating current. The magnitude and duration of this current is highly dependant on the particular lamp being used. This Inrush current should be taken into account when designing systems using many lamps as it may impact the service requirements at the electrical mains supporting the system. There are methods to alleviate this such as soft starting, or idling the lamps at low power in between uses. For more information contact Ushio America, Inc. - Application Engineering.