

Neon Lamp



Neon lamps are recommended for 110 volt AC, 220 volt AC, and DC applications in excess of 90 volts. The lamps are available in miniature and sub-miniature sizes.

A neon lamp is constructed by mounting two electrodes within a small glass envelope. Two wire leads made of tin plated Dumet metal are brought out of the lamp to make electrical connections to the electrodes. Standard brightness lamps are filled with a neon/argon gas mixture, and high brightness lamps are filled with pure neon gas. When a starting voltage (usually 55-110 volts AC, or 90-140 volts DC) is applied, the gas ionizes and starts to glow permitting a very small current to travel from one electrode to the other. Once ionized, a lower voltage will maintain the operation of the lamp. The maintaining voltage is usually 10-20 volts below the starting voltage, depending on the lamp and the operating current. For lamps operating on AC voltages of 60 Hz or higher frequency, the light output will appear to the eye as continuous.

When the gas ionizes it becomes a conductor, and an external series resistor is required to limit the current. To calculate the value of the series resistor, subtract the maintaining voltage from the supply voltage to obtain the voltage across the resistor, then use Ohm's Law and desired current level to determine resistance value.

Resistance Value Formula

$$R(\text{resistor value in Ohms}) = \frac{[V_p(\text{power supply voltage}) - V_n(\text{neon lamp voltage})^*]}{I(\text{current in Amperes})}$$

* Typical neon operating voltage is approximately 90 volts

Typical resistance values range from 10 KiloOhms to 220 KiloOhms. The power dissipation of the required resistor is small, usually less than 1/4 watt, but should be checked for high voltage applications. Typical current for neon lamps is between 0.5 and 3.0 mA. Power dissipation in the resistor can be calculated by the following formula:

$$P(\text{power in watts}) = I(\text{current in Amperes}) \times I(\text{current in Amperes}) \times R(\text{resistor in Ohms})$$

Neon lamps are very rugged and not affected by vibration, mechanical shock, or frequent ON/OFF operation. Neon lamps may be operated over a wide temperature range from -40 to +150 degrees C, and are not damaged by voltage transients of high voltage static discharges.

Neon lamps have a special operating characteristic that also allow them to be used as moderately stable high voltage reference voltage sources. When driven with DC voltage at their design current the voltage across the lamp is stable at a value near 90 volts.

Neon lamps gradually decline in light output as electrodes evaporate and condense on the inside of the glass envelope. This situation is gradual with failure defined as a 50% decrease from the original brightness. As neon lamps age, the firing voltages slowly increase until reaching the value of the supply voltage. At this point the lamp flickers and becomes erratic, indicating the end of useful lifetime.

Life expectancy of a neon lamp increases considerably as operating current is decreased. For high brightness lamps, there is a 4 to 5 power inverse relationship between current and life, whereas for standard brightness types, the lamp life varies inversely as the 3.5 power of the current. With light

output exponentially proportional to current, large increases in rated life can be obtained with small reductions in current and only a small reduction in brightness. For neon lamp applications requiring life ratings of more than 50,000 hours the use of a higher value resistor will reduce lamp current and achieve longer life.

For DC operation, the life of a high brightness lamp is about 50% of a neon lamp operating at the same RMS AC voltage. The life of a standard brightness lamp at DC is about 60% of the life value at AC.

Typical light output color for clear glass neon lamps is in the orange-red range of 600 to 700 nanometers. Other emitted colors as green, yellow and blue are available through secondary emission by coating the inside surface of the envelope with phosphor.