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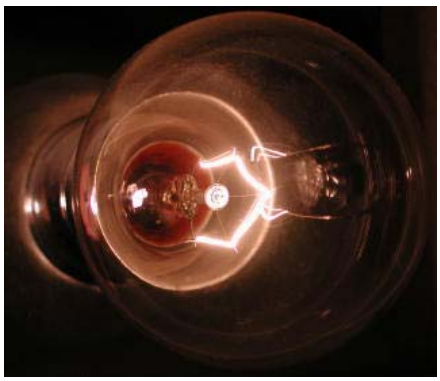
http://wolfstone.halloweenhost.com/Lighting/litcom_CommonLightSources.html

Common Light Sources

Here are some common ways to light things up.

All incandescent lamps operate on the same basic principle: an electric current is forced through a wire filament that resists the flow of electricity. As the current fights the resistance, heat is generated. When the filament gets very hot, it glows with "black body radiation" and becomes "incandescent".



This photo of an incandescent lamp with a clear envelope shows the filament glowing white hot.

This is one of the lamps in the vanity light in the bathroom of my sister's house. I took this picture Christmas day 2003. Thanks, Michele!

Modern incandescent lamps tend to have coiled filaments made from tungsten. The bulb envelope of most lamps is filled with an inert gas that keeps the hot filament from oxidizing, like argon, krypton, or nitrogen. In some special cases, the envelope is simply evacuated. This makes the lamp more efficient, but shortens the life of the lamp.

Even the simple "light bulb" lamp has many variations. Such lamps can be specified by their many characteristics:

- type and size of the base (electrical connector), which can be indicated several ways
- diameter of the glass envelope
- maximum overall length

For example, the common household "light bulb" in the United States uses an E26 screw base, and A19 envelope.

Halogen Lamp

The tungsten metal used for incandescent lamp filaments has a melting point of 6192°F (3695°K, 3422°C) and a boiling point of 10031°F (5828°K, 5555°C). You would think that it's pretty tough stuff. But as the lamp ages, tungsten evaporates from the filament and is deposited in the inner surface of the glass envelope. This is bad news for the lamp:

- the filament slowly wears away
- the envelope turns black, reducing light output
- the light that hits the darkened envelope is trapped as heat

The halogen lamp makes several changes to the basic incandescent lamp:

- the lamp is made smaller, so that the glass envelope is closer to the filament
- the glass envelope is made of tougher material, like synthetic quartz
- halogen (bromine or iodine) is added the the lamp

As a result of these changes, a halogen lamp becomes literally self-cleaning. Any tungsten that is deposited on the envelope is picked up by the halogen and redeposited on the filament. In order for this to work, halogen lamps must run hot: The envelope must be no cooler than 482°F, and sometimes has spots as high as 1250°F.

These lamps are known as "quartz halogen", "tungsten halogen", or "halogen cycle" lamps.

A halogen lamp is 10-20% more efficient, and lasts 2-3 times as long, as a ordinary incandescent lamp of similar size and power.

Gas-Discharge Lamps

The family of gas-discharge lamps encompasses a large number of different designs, but they all share a common trait: electricity "arcs" through a gas, which is ionized to create a luminous plasma.

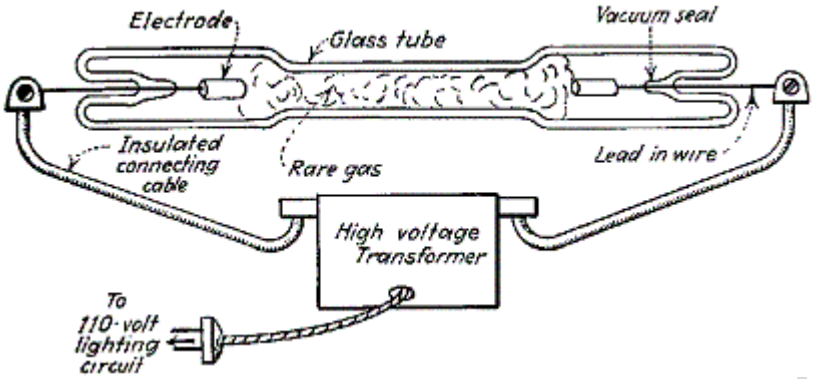
All forms of gas discharge lamp share an interesting characteristic: the electrical characterstics of the gas are nonlinear. In other words, the gas acts like an insulator, and a very high voltage is required to ionize it. But once the gas ionizes, it turns into an excellent conductor, and you can

turn down the voltage. If you don't use a special power supply that limits the current, the power that is required to start up the lamp is too high to run it with.

Neon Lamp

The "neon" lamp is the simplest form of gas discharge lamp, and is available in many different sizes and styles.

Neon signs are simply long tubes, with the air evacuated and replaced by neon gas. Simple cold-cathode electrodes on each end are excited by a high voltage. The gas is ionized to form a luminous plasma with a characteristic red-orange neon color. The long tubes can be bent to form words or shapes for decoration or advertising.



This drawing of a simple neon tube is from *Neon Signs*, by Miller and Fink, a 1935 text on neon lamp manufacture.

Some electronic gadgets use tiny neon lamps as indicators, overvoltage protection, or relaxation oscillators.

The color of neon lamps can be changed by:

- using a gas other than actual neon
- using colored or painted glass for the envelope
- addition of other materials, like mercury
- coating the inside of the glass envelope with phosphors, as in a fluorescent lamp

In modern practice, just about any color other than the orange-red of neon gas is actually produced by argon, mercury, and phoshors.

Neon lamps require a high voltage (15,000 Volts or more), with a ballast to limit the current when the arc is running. Traditionally, both jobs were performed by a special "neon sign transformer" or "luminous tube transformer", using a heavy iron core.

This is a traditional neon sign transformer. It puts out 12,000 Volts at 30 mA, and weight 19 pounds.

I also have a couple of smaller transformers that put out 3,000 Volts at 50-60 mA, and weigh 11.5 pounds apiece.

Nowadays, electronic power supplies are more efficient and lighter.

Fluorescent Lamp

The classic "fluorescent lamp" is a marriage of several technologies:

- The main body of the lamp constitutes a long electric arc, which ionizes the gas in the lamp to form a luminous plasma.
- Each end of the lamp tube contains an incandescent filament that heats up the lamp and emits electrons to kick-start the lamp.
- The tube contains a quantity of mercury. Ionized mercury vapor is an efficient way to make a lot of light, but much of it is ultraviolet.
- The inside surface of the tube is coated with a fluorescent phosphor that converts the ultraviolet to visible light.

Nowadays, lamps with classic filaments starters at both ends are termed "preheat". Newer technology provides "rapid start" fluorescents without filaments.

Fluorescent lamps generally run warm to the touch, not hot. Different colors of light are easily generated by using different phosphors in the inner lamp coating.

Fluorescent lamps require a "ballast". It performs two functions: it provides the starting kick to ionize the gas in the fluorescent tube, and it limits current after the arc has been established.

Lamp manufacturers all use different systems to come up with their part numbers, and I won't attempt to list them. In addition to the manufacturer's part numbers, most lamps also have a semi-standard number on them. The semi-standard number usually takes one of these formats:

{type}{shape}{wattage}{color}-T{diameter}

{type}{shape}{wattage}T{diameter}-{color}

{type}	F = "fluorescent" G = germicidal shortwave UV lamp
{shape}	C = circular or hoop nothing = straight tube
{wattage}	the *nominal* wattage; 4, 5, 8, 12, 15, 20, 30, 40, etc.
{diameter}	is a number giving the diameter of the glass tube in increments of 1/8-inch. 12 = is 1.5"
{color}	W = white CW = cool white WW = warm white BL = black light BLB = black light, with blue glass tube.

As was mentioned, the Tnn part of the number indicates the diameter of the glass tube in increments of 1/8-inch. Common values are:

T8	1"	2.54 cm
T12	1.5"	3.81 cm

The length of the tube is not encoded as part of the semi-standard number.

Compact Fluorescent Lamp

The "compact fluorescent lamp" is a refined version of the original fluorescent lamp.

- The lamp tube is smaller in diameter and not as long.
- The smaller lamp tube is made even more compact by coiling the tube, or bending it into parallel loops.
- In order to get good light output from the smaller tube:
    - High-efficiency phosphors are used.
    - More mercury is used, to generate more ultraviolet, to be turned into more usable light.
- The circuitry necessary to drive the lamp is miniaturized and built into the base of the lamp itself.

Compact fluorescent lamps are often used as drop-in replacements (well, screw-in replacements) for incandescent lamps. In this application, compact fluorescents save power and last longer than the lamps they replace.