Lamp Types

When selecting lighting fixtures a major consideration is the choice of light source. While a number of light sources are available, each has its own unique combination of operating characteristics. Characteristics that need to be considered are efficacy which can be measured in lumens per watt; color; lamp life; and lamp lumen depreciation which the percent of output that a lamp loses over its life. The choice will impact the quality of light generated, maintenance of the system and the cost of operating the lighting fixtures. It should be noted that statistically the cost of energy to operate the lighting fixtures is 90% or more of the total cost of a lighting system over the life the lighting system.

Incandescent: Incandescent lamps (light bulbs) are the light source most commonly used in residential lighting. Light is produced in this source by a wire or filament being heated to incandescence (emitting light) by a flow of current through it. Short life and low efficacy (lumens per watt) of this source limits its use mostly to residential and decorative commercial lighting. Efficacy varies with wattage and filament type, but generally ranges from 15 to 25 lumens per watt for general service lamps. The incandescent source produces light in a well accepted warm tone. It is more convenient because it can be run directly on line current and doesn't require a ballast. Incandescent can also be dimmed using relatively simple equipment. It is available in different bulb sizes, shapes and distributions to add a decorative touch to an area.

To save energy, some fixtures that use incandescent bulbs are being retrofitted with screw in compact fluorescent bulbs. Soon there will be cost effective LED retrofit bulbs for decorative fixtures.

Fluorescent: The fluorescent lamp produces light by activating selected phosphors on the inner surface of the bulb with ultraviolet energy, which is generated by a mercury arc. Because of the characteristics of a gaseous arc a ballast is needed to start and operate fluorescent lamps. The advantages of the fluorescent light source include improved efficacy and longer life than incandescent lamps. Efficacy for fluorescent lamps ranges from 50 to 100 lumens per watt. Their low surface brightness and heat generation make them ideal for offices and schools where thermal and visual comfort is considered important. The disadvantages of fluorescent lamps include their large size relative to the amount of light produced. Controlling the light is more difficult too. The light floods or washes and area which results in a diffuse, shadow-less environment. The use of fluorescent lamps outdoors areas is somewhat less economical because light output of a fluorescent source is reduced at lower ambient temperatures. This is more relevant in northern parts of the US.

Induction: Induction lamps are electrode-less fluorescent lamps driven by high-frequency current, typically between 250kHz and 2.65mHz, usually via an external generator. They are available in limited wattages and are known for exceptionally long service life: up to 100,000 hours. Lamp efficacies typically range from 64 to 88 lumens per watt. Color rendition with induction lamps is very good. Although not easily optically controllable in a lighting fixture because of the large lamp size, induction lighting is often employed in applications where lighting fixtures may be very difficult to access or where maintenance costs are a strong factor in the lighting design and installation. Initial system purchasing costs are high compared to the best HID or fluorescent systems, but will deliver a sufficient ROI in the correct application.

Click here for our own takeaway printout about Induction lighting.

Click here to learn about the U.S. Government's Department of Energy's information on Induction lighting.

High Intensity Discharge (HID) and LPS: High intensity discharge sources include mercury vapor, metal halide, and high pressure sodium (HPS) lamps. Light is produced in HID and low pressure sodium (LPS) sources through a gaseous arc discharge using a variety of elements. Each HID lamp consists of an arc tube which contains certain elements or mixtures of elements which, when an arc is created between the electrodes at each end, gasify and generate visible radiation. The major advantages of HID sources are their high efficacy in lumens per watt, long lamp life and point-source characteristic for good light control. Disadvantages include the need for a ballast to regulate lamp current and voltage as well as a starting aid for HPS and some MH and the delay in re-striking after a momentary power interruption.

Learn more about Metal Halide Pulse-Start vs. Metal Halide Probe-Start Lamps - Click here.

Mercury Vapor (MV): The mercury vapor source was the first HID lamp developed, filling the need for a more efficient, yet compact, high output lamp. When first developed, the major disadvantage of MV fixtures was poor color rendition. Over time the color was improved by coating the lamps walls with a phosphor. The life of mercury vapor lamps is good, averaging 24,000 hours for most larger wattage lamps. Because the output diminishes so greatly over time (lumen depreciation), the economical operational life is often much shorter. Efficacy ranges from 30 to 60 lumens per watt, with the higher wattages being more efficacious than the lower wattages. As with other HID lamps, the starting of a mercury vapor lamp is not immediate. Starting time is short, though, taking 4-7 minutes to achieve maximum output depending upon the ambient temperature.

EPAct 2005, legislated the elimination of manufacturing, marketing, and importation of Mercury Vapor (MV) ballasts in the United States. While this legislation was passed in 2005, the effective date was January 1, 2008.

EPAct 2005 represents a continuing trend of state and federal agencies voting in law that will sustain our environment for future generations and reduce the America's dependence on foreign fossil fuels.

High Pressure Sodium (HPS): In the 1970s, as increasing energy costs placed more emphasis on the efficiency of lighting, high pressure sodium lamps (developed in the 1960s) gained widespread usage. With efficacies ranging from 80 to 140 lumens per watt, these lamps provide about 7 times as much light per watt as incandescent and about twice as much as some mercury or fluorescent. The efficacy of this source is not its only advantage. An HPS lamp also offers the longest life (24,000+ hrs.) and the best lumen maintenance characteristics of all HID sources. The major objection to the use of HPS is its yellowish color and low color rendition. It is ideal mainly for some warehouse and outdoor applications.

Metal Halide (MH): Metal halide lamps are similar in construction to mercury lamps with the addition of various other metallic elements in the arc tube. The major benefits of this change are an increase in efficacy to 60 to 100 lumens per watt and an improvement in color rendition to the degree that this source is suitable for commercial areas. Light control of a metal halide lamp is also more precise than that of a deluxe mercury lamp since light emanates from the small arc tube, not the total outer bulb of the coated lamp. Pulse-start metal halide lamps have several advantages over standard (probe-start) metal halide: higher efficacy (110 lumens per watt), longer life, and better lumen maintenance. A disadvantage of the metal halide lamp is its shorter life (7,500 to 20,000 hrs) as compared to mercury and high pressure sodium lamps. Starting time of the metal halide lamp is approximately the same as for mercury lamps. Restriking after a voltage dip has extinguished the lamp, however, can take substantially longer, ranging from 4 to 12 minutes depending on the time required for the lamp to cool.

EISA 2007 regulates the efficiency of ballasts in new lighting fixtures containing 150W to 500W metal halide lamps. Starting January 1, 2009, new metal halide lighting fixtures cannot be manufactured or imported unless their ballast operates the lamp at a minimum efficiency level. For all intensive purposes, probe-start HID fixtures with 400 watt lamps or less that use magnetic ballasts will be virtually eliminated. Compliant fixtures will contain a capital E printed in a circle on their packaging and ballast labels similar to legislated fluorescent ballasts.

Exceptions include fixtures with regulated lag ballasts, fixtures with electronic ballasts for operation at 480V, and 150W wet-location fixtures containing a ballast rated to operate at ambient temperatures above 50°C.

This Federal law covers manufacture and not sale, so distributors will be able to sell their inventories of non-compliant fixtures until they are depleted unless prohibited by state law. The law covers fixtures and not replacement ballasts.

Learn more about Metal Halide Pulse-Start vs. Metal Halide Probe-Start Lamps and the cost of operation - Click here.

Low Pressure Sodium (LPS): Low pressure sodium offers the highest initial efficacy of all lamps on the market today, ranging from 100 to 180 lumens per watt but because all the light output is in the yellow portion of the visible spectrum, it produces extremely poor and unattractive color rendition. Because of the size of the lamp, control of this source is more difficult than with HID sources. The average life of low pressure sodium lamps is 18,000 hours. Lumen maintenance through life of the lamp is good.