

## Luminaire/Lamp Technology Overview

When selecting lighting fixtures a major consideration is the light source technology. 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 accuracy which is measured in CRI, lamp (light bulb) life which is measured in hours, and lamp lumen depreciation which is the percent of output that a lamp loses over its life. Your decision will impact the quality of light generated, maintenance requirements 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 of a lighting system. Before you make a decision on the type of light technology you will deploy, it is important to know how many foot-candles of light are required in the area you are lighting. Then determine what light source uses the lowest watts while meeting your CRI, Kelvin and maintenance requirements.



### Incandescent

- Inexpensive**
- Good in Cold Climates**
- Low Efficiency**
- Short life of 750 to 1,000 hours**
- Being replaced by CFL's**

Incandescent lamps are the light source most commonly used in residential lighting. Light is produced by a wire or filament being heated to incandescence (emitting light) by a flow of current through it. Short life and low efficacy measured as lumens per watt (LPW) 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 be dimmed using relatively simple equipment and is available in different bulb sizes and shapes to facilitate decorative touch to an area.

To save energy, most fixtures that use incandescent bulbs are being retrofitted with screw in compact fluorescent bulbs. The luminaires on the right and below will accept CFLs or incandescent lamps. Soon there will also be cost effective LED retrofit bulbs too.



## Linear Fluorescent, Plug-In Fluorescent & Compact Fluorescent (CFL's)



- ❑ **Efficient using 65-75% less energy than Incandescent**
- ❑ **Relatively Inexpensive at \$2 to \$5 per lamp**
- ❑ **Long life of 10,000 to 20,000 hours**
- ❑ **Superior Color Resolution (CRI)**



Demand for energy savings has brought Fluorescent type bulbs to the forefront of the market. In hospitality and residential applications, plug in compact fluorescents are staples. Where older fixtures with medium sockets, screw in compact fluorescent lamps are replacing incandescent lamps. Additionally many new fixtures are coming with GU24 bases. GU24 bases use self ballasted CFLs like medium sockets, but are not backwards retrofittable insuring the socket only uses energy efficient lamps.

Customers with warehouses, light manufacturing facilities, and more are replacing old style Probe Start Metal Halides and Mercury Vapor fixtures with Linear Fluorescent High Bay fixtures. The Fluorescent High Bay fixtures use a fraction of the power of the old Probe Start Metal Halide. Additionally, when fitted with a programmed start ballast the fixtures can have an occupancy sensor and the on/off feature will not reduce the operating life of the lamps. In virtually all cases the switch will reduce energy use expenses by thousands of dollars a year and pay for the new fixtures a matter of months. Also, frequently there are demand supply management rebates from electric companies for switching energy efficient fluorescent fixtures. See the following link for incentives in your state. <http://www.dsireusa.org/>

Fluorescent lamps produce 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 are minor but include their large size relative to the amount of light produced. Controlling the light is more difficult too. The light floods or washes an 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 very northern parts of the US.



## Pulse Start Metal Halide (PS-MH)



- **High lumen output**
- **Operate Reliably in wide range of temperatures**
- **Good Color rendition (CRI)**
- **Long life of 20,000 hours**
- **Quicker start up than old style probe start**
- **Great in dirty environments**

Metal Halide lamps are similar in construction to older mercury vapor lamps albeit with the addition of various other metallic elements in the arc tube. Light control of a metal halide lamp is more precise since light emanates from the small arc tube. The major benefits of the latest pulse-start metal halide versions are they can achieve up to 110 lumens per watt, have good color rendition, and last longer. To read more about Pulse-start metal halide v. probe-start metal halide. As of January 1, 2009, new lighting fixtures containing 150W to 500W Metal Halide lamps cannot be manufactured or imported unless their ballast operates the lamp at a minimum efficiency level, in effect mandating Pulse-Start Metal Halide.



Metal halide is very effective for outdoor lighting. In most instances metal halide provides the most bang for the buck. It is the best source for high light output requirements where light quality is important such as sports and recreation facilities. In fact metal halide lights virtually all professional outdoor sporting venues. The white light is efficient, typically lasts 20,000 hours and has respectable color rendering.

Metal Halide has been used in commercial locations for years and now is even more efficient. While linear fluorescent high bays are making inroads in some commercial locations, metal halide is the superior choice where the lights remain on for long periods, when high light levels are required in areas that are dirty such as service garages where trucks are worked on and manufacturing facilities. Metal halide high bay luminaires don't require reflectors to be efficient while linear fluorescent high bays do. Reflectors lose their reflectivity in many manufacturing environments and all dirty environments.



Some metal halide lamps may suffer non-passive failure, which means in some instances they can explode raining down molten glass. All metal halide lamps should be used in enclosed luminaires or with open rated sockets. Open rated sockets are pink and will only accept protected metal halide lamps which do not suffer non-passive failure. Either enclosures or open rated sockets will provide a safe working environment. Please note that insurance companies and/or local regulations may require the use of enclosures or open rated sockets. (All Access Fixtures metal halide luminaires come standard with open rated sockets.)



## Induction



- ❑ **One of the more efficient lighting sources today**
- ❑ **Longest Life with a mean life of 100,000 hours**
- ❑ **Virtually no maintenance required**
- ❑ **Excellent Color Rendering (CRI)**
- ❑ **Great performance in any climate**

Induction Lighting is a proven technology that is related to the fluorescent lamp family. Induction lamps are electrode-less fluorescent lamp driven by high-frequency current, of between 250 kHz and 2.65 MHz via an external generator. They are available in limited wattages and are known for exceptionally long service life. Lamp efficacies typically range from 64 to 88 lumens per watt.



Induction lighting is virtually maintenance free with a 100,000 hour rated life. That's over 11 years of constant light 24 hours a day, 365 days a year. It is extremely useful in applications where lamp replacement is very expensive such as hard to reach places including wall packs on buildings, limited access areas like airports and tunnels, parking lot lighting where a lift is required for service

and many other locations. Induction lighting is also used where safety is paramount and the light have to stay on such as parking garages, walkways, around ATMs and in prisons.

Extreme temperatures have minimal effect on induction lighting making it a great choice for any climate. The light generated is a crisp white light with 80+ CRI, high reliability and instant on/off. Induction fixtures can typically provide as much, if not more light than a fixture at more than twice the energy consumption with better quality light. The advantages of the induction can turn into major dollar savings when considering energy savings, maintenance, labor, and replacement lamp cost of existing lighting fixtures. In many cases, the payback in maintenance savings will more than offset the initial cost of the system.

[More Information about Induction lighting](#)  
[U.S. Department of Energy's information on Induction lighting](#)



## Light Emitting Diodes (LED)



- ❑ Extremely efficient
- ❑ High life (50,000+ hours)
- ❑ Good Color Rendition (CRI)
- ❑ Dimmable

LEDs are the up and coming lighting technology. Each successive generation is more energy efficient than the last. Today LEDs last up to 10 times longer than compact fluorescents and far longer than typical incandescent bulbs. The latest LED (light emitting diode) light bulbs produce about the same amount of light per watt as compact fluorescent bulbs (CFLs). LEDs can be found in luminaires (light fixtures) and even retrofit lamps (bulbs).

A light-emitting diode (LED) is a semiconductor diode that radiates light (electroluminescence) when current passes through it in the forward direction. Electrons move through semiconductor medium and "fall into" other energy levels during their transit of the p-n junction. When these electrons make a transition to a lower energy level, they give off a photon of light. This photon may be in the infrared region or just about anywhere across the visible spectrum up to and into ultraviolet.



Because of the low power requirement for LEDs, using solar panels becomes more practical and less expensive than running an electric line or using a generator for lighting. There are other differences beyond life and energy savings. Unlike incandescent bulbs and CFLs, which splash light in all directions, LED bulbs are directional. LEDs drive their light in one direction, so that you have light exactly where you want it. This directional lighting equals savings in yet another fashion. LEDs don't waste light (energy) on areas you don't need illuminated, which is also why they are perfect task lights.

Since LEDs do not have a filament, they are not damaged under circumstances when a regular incandescent bulb would be broken. Because they are solid, LED bulbs hold up well to jarring and bumping. These bulbs do not cause heat build-up; LEDs produce 3.4 btu's/hour, compared to 85 for incandescent bulbs. Last, no mercury is used in the manufacturing of LEDs, and they are more efficient. LED light bulbs use only 2-10 watts of electricity (1/3rd to 1/30th of Incandescent or CFL).



## High Pressure Sodium (HPS)



- **Super high lumen output**
- **Very Long Life of 24,000 hours**
- **Low Color Rendition (CRI)**
- **Operates reliably in wide range of climates**
- **Low Kelvin puts out yellowish orange glow**



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. It is a very reliable efficient source of light.

The major objection to the use of HPS is its yellowish color and low color rendition. In fact, the yellowish color is both an objection and feature. HPS is ideal for outdoor applications such as street lights, wall packs and bollards, because it is long lasting and efficient. Also, the light does not effect the environment in the same way as whiter light does. The yellow light is much softer than the white and does not effect the migration of turtles or insects like the white light. Many cities, some states and even countries require HPS colored light to lessen the impact on the environment.

