

OUTDOOR LIGHTING

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The quality of light affects the ease and comfort of both work and leisure. Outdoor lighting is used for convenience, landscape enhancement, security and improved animal production.

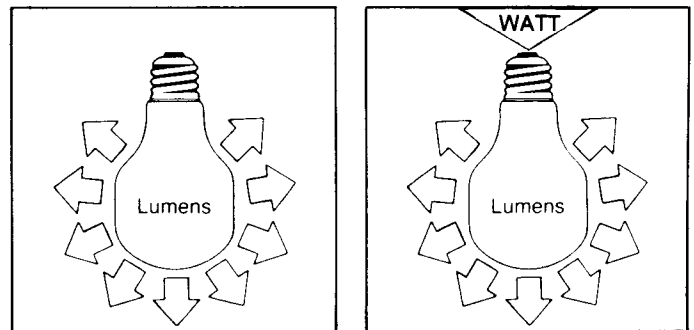
SELECTING A LIGHTING SYSTEM

Several factors need to be considered when selecting a lighting system, including the amount of light desired, the purpose of the light and the efficiency of the light.

Though many people associate wattage with the brightness of a lamp, wattage does not measure light output. Wattage measures the rate at which the lamp consumes energy. The efficiency of a light source is indicated by 'lumens per watt' (lm/W). It measures the amount of light produced for each unit of power consumed (Figure 1).

The efficiency of different light sources varies from less than 10 lm/W (incandescent lamp) to over 200 lm/W (low pressure sodium). When evaluating a lamp, consider efficiency as well as the amount of light delivered on the target area. Some flood lights provide concentrations of light onto a small area with some light surrounding the area. Other flood lights have horizontal and vertical beam patterns of 150° or more. Fixture and mounting height should be selected based on the size of the area to be lighted. A 40 foot tall yard light will provide a larger circle of light in the yard than a 25 foot tall yard light with the same fixture. Less eye strain and increased productivity are a few benefits of concentrating the light where it is needed.

Energy consumption is the largest single item in the total cost of lighting. The cost of the energy consumed by a 100 watt incandescent lamp during its life is 10 times the original cost of the lamp. These costs vary with kilowatt hour costs and lamp prices. A 100 watt incandescent lamp



The quantity of light emitted by a lamp = LUMENS (lm)

Lumens per watt (lm/W) = LAMP EFFICIENCY

Figure 1.

with an average life of 1000 hours will use about 87 kW hours of electricity over a period of three months. This value is determined from a lamp usage of 12 hours per day and six days a week.

Efficient use of lighting energy also depends upon the quantity and characteristics of the lamp in use. It pays to use efficient lamps, but also to use those lamps efficiently by directing light where it is needed or altering the color output.

Colors of objects are largely determined by the light under which they are viewed. The way in which the light 'reproduces' these colors is referred to as color rendering.

Some lamps produce light which is remarkably similar to sunlight while other lamps provide light which makes it difficult to distinguish one color from another. Color rendering should be considered when selecting a light source.

Illumination is the measure of light intensity in a given area. It is expressed in footcandles (fc). One footcandle is one lumen falling on one square foot of surface (Figure 2). Recommended outdoor lighting levels for certain tasks and lamp wattage requirements to maintain a certain number of fc are shown in Figure 3. The number of fc needed in a specific area depends upon how the area is used.

TYPES OF OUTDOOR LAMPS

For most applications, lamps are divided into categories: 1) incandescent, 2) fluorescent and 3) high intensity discharge (HID) which includes mercury vapor, metal halide, high pressure sodium and low pressure sodium. Their basic characteristics are shown in Figure 4.

Incandescent Lamps

The incandescent lamp is the one most commonly used. It is also the lamp with the poorest efficiency. The incandescent lamp is popular because it is simple to use and because of the low initial price of both the lamp and the fixture.

An incandescent lamp produces light when current passes through the filament. To improve lamp life, air is removed from the lamp and replaced with an inert gas, usually argon.

The efficiency of incandescent lamps increases as lamp wattage increases. This makes it possible to save on both energy and fixture costs whenever you can use one higher wattage lamp instead of two lower wattage lamps.

Fluorescent Lamps

The fluorescent lamp is the second most common light source. It is easily identified by its tubular design - circular, straight or bent in a 'U' shape.

To operate, an electric arc is drawn along the length of the tube. The ultraviolet light produced by the arc activates a phosphor coating on the inside wall of the tube, causing light to be produced. The phosphor also controls the 'color'

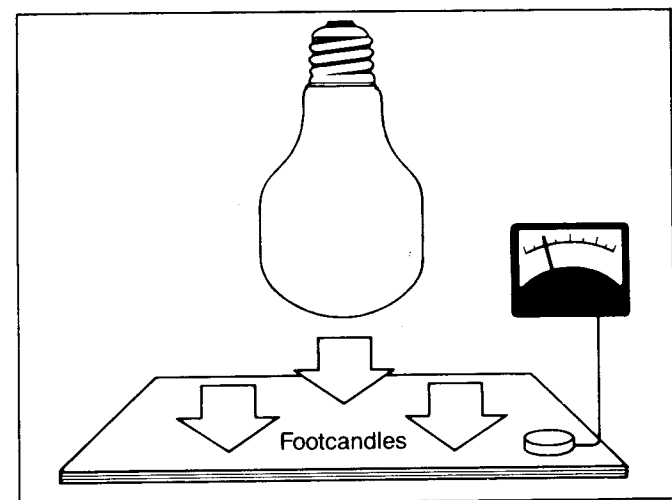


Figure 2.

of the light. The fluorescent lamp requires a ballast to initially strike the electric arc in the tube and to maintain the proper voltage and current to maintain that arc. Proper ballast selection is important for optimum light output, lamp life and overall efficiency.

Lamp sizes range from 4 to 215 watts. The efficiency of a lamp increases with lamp length (from 4 to 8 feet). For most applications, the cool white and warm white lamps provide acceptable color and energy efficiency ratings.

Fluorescent lamp life is rated according to the number of operating hours per start, for example, 20,000 hours at three hours operation per start. The greater the number of hours operated per start, the longer the lamp life.

OUTDOOR LIGHTING LEVELS

	Footcandles Maintained on the Task
CONSTRUCTION	
■ general	10fc
■ excavation	2fc
INDUSTRIAL YARD/MATERIAL HANDLING	
	.5fc
MALLS	
	5fc/10fc
PARKING AREAS	
■ open-high activity/medium activity	2fc/1fc
■ covered-parking, pedestrian areas	5fc
■ entrances-day/night	50fc/5fc
STORAGE YARDS	
■ active/inactive	20fc/1fc
USED CAR LOTS	
■ front line-first 20 feet of lot	100fc/500fc
■ remaining area	20fc/75fc

OUTDOOR AREA LIGHTING

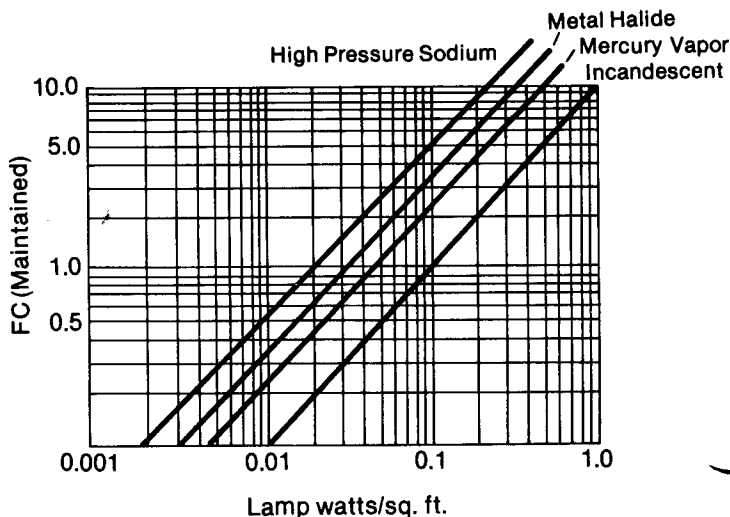



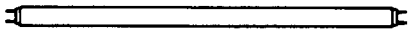
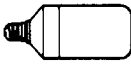
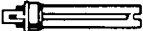









Figure 3.

Figure 4. Principal ranges of lamps for general lighting purposes.

Category	Type	Maximum lamp efficiency lm/W	Average life hrs	Characteristic features	Typical application areas
Incandescent Lamps 	Normal incandescent lamps and reflector lamps	22	1,000	Easy to install, easy to use; many different versions; instant start; low cost price; reflector lamps allow concentrated light beams	General lighting in the home; decorative lighting; localized lighting; accent and decorative lighting (reflector lamps)
 	Halogen	27	2,000	Compact; high light output; white light; easy to install; long life compared with normal incandescent lamps	Accent lighting; floodlighting
Fluorescent Lamps 	Tubular	104	20,000	Wide choice of light colors; high lighting levels possible; economical in use	All kinds of commercial and public buildings; streetlighting; home lighting
		50	7,500	Energy-effective; direct replacement for incandescent lamps	Most applications where incandescent lamps were used before
		80	10,000	Compact; long life; energy-effective	To create a pleasant atmosphere in social areas; local lighting; signs; security and orientation lighting
Gas-Discharge Lamps 	Self-ballasted	28	12,000/16,000	Long life; good color rendering; easy to install; better efficiency than incandescent lamps	Direct replacement for incandescent lamps; small industrial and public light projects
 	High pressure mercury	63	24,000 +	High efficacy; long life; reasonable color quality	Residential area lighting; sports grounds; factory lighting
	Metal halide	94	15,000	Very high efficiency combined with excellent color rendering; long life	Floodlighting, especially for color TV; industrial lighting; road lighting;
 	High pressure sodium	125	24,000 +	Very high efficiency; extremely long life; good color rendering	Public lighting; floodlighting; industrial lighting; direct replacement for mercury lamps
	Low pressure sodium	200	18,000	Extremely high efficacy; very long life; high visual acuity; poor color rendering; monochromatic light	Many different application areas: wherever energy/cost-effectiveness is important and color is not critical

High Intensity Discharge (HID) Lamps

High intensity discharge (HID) is the term commonly used to designate four distinct types of lamps that actually have very little in common. The four lamp types are 1) mercury vapor, 2) metal halide, 3) high pressure sodium and 4) low pressure sodium. Each requires a few minutes (1 to 7) to reach full light output. If power to the lamp is lost or turned off, the arc tube must cool to a given temperature before the arc can be restruck and light produced. Up to 15 minutes may be required for metal halide lamps while mercury vapor lamps take 7 to 10 minutes to reach full light output.

Mercury Vapor Lamps

The mercury vapor lamp produces light when the electrical current passes through a small amount of mercury vapor. The lamp consists of two envelopes: an inner quartz envelope in which the arc is struck, and an outer protective envelope. The mercury vapor lamp requires a ballast designed for its specific use. Mercury vapor lamps work well in outdoor lighting applications because of their low cost and lamp life of 16,000 to 24,000 hours.

The color rendering qualities of the mercury vapor lamp are not as good as those of incandescent and fluorescent lamps. A significant portion of the energy radiated is in the ultraviolet region. Through use of phosphor coating on the inside of the outer envelope, some of this energy is converted to visible light. As a result, the color rendition and lamp efficiency of phosphor-coated mercury vapor lamps is better than that of their clear (no phosphor coating) counterparts. Mercury vapor lamp sizes range from 40 to 1,000 watts.

Metal Halide Lamps

The metal halide lamp is very similar in construction to the mercury vapor lamp. The major difference is that the metal halide lamp contains various metal halide additives in addition to mercury vapor. These metal halides produce the color instead of depending on a phosphor coating to produce acceptable color. Metal halide lamps are used where color rendition characteristics are important, such as used car lots, vegetable stands or for enhancing floral and landscaping arrangements.

The efficiency of metal halide lamps is from 1.5 to two times that of mercury vapor lamps. Some of the newer metal halide lamps provide color similar to that of incandescent lamps.

Metal halide lamp sizes range from 175 to 1,500 watts in both clear and coated designs. Ballasts designed specifically for metal halide lamps must be used.

High Pressure Sodium Lamps

The high pressure sodium (HPS) lamp produces light when electricity passes through a sodium vapor. This lamp has two envelopes, the inner one being made of a polycrystalline alumina in which the light-producing arc is struck. The outer envelope is protective and may either be clear or coated.

Because the sodium in the lamp is pressurized, the light produced is a 'golden white' light which enables the lamp to have fair color rendering characteristics. These color rendering characteristics are not as good as those found in metal halide lamps. Although the HPS lamp first found its principal use in street and outdoor lighting, it now is a readily accepted light source in industrial plants as well as many commercial and institutional applications.

HPS lamp sizes range from 35 to 1,000 watts. Ballasts designed specifically for HPS lamps must be used.

Low Pressure Sodium Lamps

The low pressure sodium (LPS) lamp is the most efficient of all, providing up to 200 lm/W. It is used where color is not important because it has a monochromatic light output. This means that reds, blues and other colors illuminated by an LPS lamp all appear as tones of gray or yellow.

LPS lamps range in size from 18 to 180 watts. Ballasts designed specifically for LPS lamps must be used. The primary use of the lamps is currently for street and highway lighting as well as outdoor area and security lighting. LPS lights are being replaced by HPS lights because of their high cost and poor color.

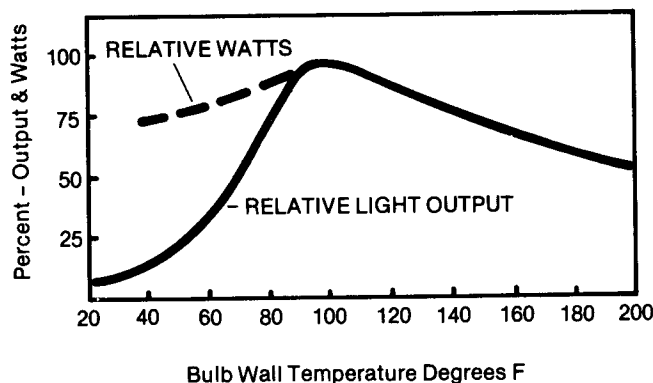
EFFECTS OF COLD WEATHER ON LAMPS

Cold weather affects the light output of fluorescent lamps. The problems encountered in using fluorescent lamps outdoors are starting and operation. Fluorescent lamps become harder to start when cold. Outdoor or low-temperature ballasts are designed to compensate for this and to start lamps reliably at specified temperatures, usually 0°F or -20°F. Some lamps have glass jackets that are designed to protect the lamps from drafts so that the lamps operate warmer than if they were unjacketed. Successful operation depends on how hot the lamp becomes.

Maximum light output for most fluorescent lamps occurs when the coolest spot on the lamp is about 100°F. Light output and wattage of fluorescent lamps vary as bulb wall temperature varies from this optimum temperature (Figure 5).

SUMMARY

Outdoor lighting can enhance and make any farm, home, industrial plant or office more productive and secure. Once the proper type of lamp is selected, any activity or task will usually be easier to perform and more enjoyable.



Light output and wattage of fluorescent lamps vary as bulb wall temperature varies from the optimum of 100°F.

Figure 5.