

Glossary of Lighting Terms

Ampere A unit expressing the rate of flow of electric current.

ANSI (American National Standards Institute) The organization that develops voluntary guidelines and produces performance standards for the electrical and other industries.

Audible Noise (Sound) All fluorescent lamp ballasts produce some noise. Care should be taken when mounting the ballast to reduce vibration.

Average Rated Life An average rating, in hours, indicating when 50% of a large group of lamps have failed, when operated at nominal lamp voltage and current; manufacturers use 3 hours per start for fluorescent lamps and 10 hours per start for HID lamps when performing lamp life testing procedures; every lamp type has a unique mortality curve that depicts its average rated life. For Photo-Optic specialty lamps, average rated life refers to the operating period after which on statistical average, 50% of the lamps will perform within their specified values.

Ballast A device used with an electric discharge lamp to obtain the necessary circuit conditions (voltage, current and waveform) for starting and operating; all fluorescent and HID light sources require ballasts for proper operation. Dimming ballasts are special ballasts which, when used together with a dimmer, will vary the light output of a lamp. Typically, magnetic ballasts (also called electromagnetic ballasts) contain copper windings on an iron core while electronic ballasts are smaller and more efficient and contain electronic components.

Ballast Efficacy Factor (BEF)
Ballast factor (as a whole number)

divided by input power (watts). Used to measure the level of efficiency of similar ballast models.

Ballast Factor The measured ability of a particular ballast to produce light from the lamp(s) it powers; ballast factor is derived by dividing the lumen output of a particular lamp/ballast combination by the lumen output of the same lamp(s) on a reference ballast.

Ballast Losses Power consumed by a ballast that dissipates as heat instead of being converted into light. Electronic ballasts operate more efficiently than magnetic or hybrid ballasts. A typical ballast loss for a standard two lamp energy saving magnetic ballast is 12 watts, where an electronic equivalent would only be 7 watts.

Ballast Types There are three types of lighting ballasts; 1) Magnetic: an inefficient device that uses a core and coil assembly transformer to perform the minimum functions required to start and operate the lamp; 2) Hybrid or "low frequency electronic"; essentially a magnetic ballast with a few electronic components that switch off voltage to the lamp coil once the lamp has started. A minimal increase in efficiency is obtained via more expensive magnetic core material and the absence of power to the lamp coils during operation; 3) High frequency electronic; a ballast that operates lamps at frequencies above 10,000 Hz. Maximum efficiency is obtained through the use of electronic circuitry and optimum lamp operating characteristics.

Base or Socket The socket is the receptacle connected to the electrical supply; the base is the end of the lamp that fits into the socket. There are many types of bases used in lamps, screw bases being the most common for

incandescent and HID lamps, while bipin bases are common for linear fluorescent lamps.

Beam Angle The angle between the two directions for which the intensity (candlepower) is 50% of the maximum intensity as measured in a plane through the nominal beam centerline (center beam candlepower).

Beam Spread In any plane, the angle between the two directions in the plane in which the candlepower is equal to a stated percent of the maximum candlepower in the beam.

Bi-Pin Any base with two metal pins for electrical contact. This is the typical base for a fluorescent tube of 1 to 4 feet in length. It consists of 2 prong contacts which connect into the fixture. Medium bi-pins are used with type T-8 and T12 tubular fluorescent lamps, and miniature bi-pins are used for tubular T-5 fluorescent lamps.

Blackbody A hot body with an incandescent black surface at a certain temperature used as a standard for comparison. Note that a black surface is the best radiator possible. A tungsten filament will emit slightly less radiation than a blackbody at the same temperature.

Bollard A short, thick post with a light at the top, used for grounds and outdoor walkway lighting.

Bulb A loose way of referring to a lamp. "Bulb" refers to the outer glass bulb containing the light source which may contain a vacuum, elemental inert gas or metal and a means of light generation (filament or electrodes).

Candela (cd) The unit of measure indicating the luminous intensity (candlepower) of a light source in a specific direction; any given light source will have many different

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intensities, depending upon the direction considered.

Candlepower Distribution A curve that represents the variation in luminous intensity (expressed in candelas) in a plane through the light center of a lamp or luminaire; each lamp or lamp/luminaire combination has a unique set of candlepower distributions that indicate how light will be spread.

Cathode Metal filaments that emit electrons in a fluorescent lamp. Negatively charged free electrons emitted by the cathode are attracted to the positive electrode (anode), creating an electric current between the electrodes.

Center Beam Candlepower (CBCP) Refers to the luminous intensity at the center of the beam of a blown or pressed reflector lamp (such as a PAR lamp). Measured in candelas.

Ceramic Metal Halide (CMH) A type of metal halide lamp that uses a ceramic material for the arc tube instead of glass quartz, resulting in better color rendering (>80 CRI) and improved lumen maintenance.

Chromaticity The aspect of color that includes consideration of its dominant wavelength and purity.

Color Rendering Index (CRI) The Color Rendering Index (CRI) measures the effect a light source has on the perceived color of objects and surfaces. High CRI light makes virtually all colors look natural and vibrant. Low CRI causes some colors to appear washed out or even to take on a completely different hue.

Color Temperature (CT) Color temperature, which is measured in Kelvin, indicates whether a lamp has a warm, midrange or cool color appearance. "Warm" light sources have a low color temperature (2000-

3000K) and feature more light in the red/orange/yellow range. Light with a higher color temperature (>5000K) features more blue light and is referred to as "cool".

Compact Fluorescent Lamps Compact fluorescent lamps employ small diameter tubes that are bent so they begin and end in a single base. This allows them to be produced in a wide variety of configuration, greatly extending the applications for fluorescent lighting.

Correlated Color Temperature (CCT) A specification of the color appearance of a lamp, relating its color to that of a reference source, black body radiator, heated to a particular temperature, measured in degrees Kelvin (K); CCT generally measures the "warmth" or "coolness" of light source appearance.

Current A measure of the rate of flow of electricity, expressed in amperes.

Efficacy The efficiency of a light source is simply the fraction of electrical energy converted to light, i.e. watts of visible light produced for each watt of electrical power with no concern about the wavelength where the energy is being radiated. For example, a 100 watt incandescent lamp converts 7% of the electrical energy into light; discharge lamps convert 25-40% into light.

EMI (Electromagnetic Interference) High frequency electronic ballasts and other electronic devices can produce a small amount of radio waves which can interfere with radio and TV. Federal mandated requirements must be met for EMI levels before an electronic device is considered FCC compliant.

Filament A tungsten wire purposely positioned inside a lamp bulb, that when heated electrically generates radiation in the visible, infrared and ultra-violet ranges. Tungsten material is most often used, as it has great tensile strength, is very durable, and can be heated very near its melting point without evaporating rapidly. Lamp filaments are offered in a variety of designs optimized for specific applications.

Fixture (See Luminaire)

Flicker The periodic variation in light level caused by AC operation that can lead to strobe effects.

Floodlight A reflector lamp with a relatively wide beam angle, typically 20 degrees or more. Also a luminaire consisting of lamp and reflector at fixed distance providing a wide field of illumination.

Fluorescent Lamp A high efficiency lamp utilizing an electric discharge through inert gas and low pressure mercury vapor to produce ultraviolet (UV) energy. The UV excites phosphor materials applied as a thin layer on the inside of a glass tube which makes up the structure of the lamp. The phosphors transform the UV to visible light.

Footcandle (fc) A unit of illuminance or light falling onto a surface. It stands for the light level on a surface one foot from a standard candle. One footcandle is equal to one lumen per square foot.

Frequency Rate of alternation in an AC current. Expressed in cycles per second or Hertz (Hz).

Full Spectrum Lighting A marketing term, typically associated with light sources that are similar to some forms of natural daylight (5000K and above, 90+ CRI), but sometimes more broadly used for

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lamps that have a smooth and continuous color spectrum.

Halogen Lamp High pressure tungsten filament lamps containing halogen gases. The halogen gases allow the filaments to operate at higher efficacies than incandescent lamps. Halogen lamps also provide brighter, whiter light with better color characteristics, longer service life and improved energy efficiency.

Harmonic An electrical frequency that is an integer multiple of the fundamental frequency; for example, if 60 Hz is the fundamental frequency, then 120 Hz is the second harmonic and 180 Hz is the third harmonic. Some electronic devices, such as ballasts or power supplies, can cause harmonic distortion, directly affecting power quality.

Hertz (Hz) Unit used to measure frequency of alteration of current or voltage.

High Efficiency (Energy Saving) Electromagnetic Ballast Ballast with core and coils, designed to minimize ballast losses compared to the "standard" ballast.

High-Intensity Discharge (HID) Lamps Lamps in which an arc passing between two electrodes in a pressurized tube causes various metallic additives to vaporize and release large amounts of light. All HID lamps offer outstanding energy efficiency and service life. Metal halide lamps also offer good to excellent color rendering index (CRI).

High Power Factor A ballast whose power factor is corrected to 90% or greater by the use of a capacitor.

High Pressure Sodium (HPS) Lamp HPS lamps are high intensity discharge light sources that produce

light by an electrical discharge through sodium vapor operating at relatively high pressures and temperatures.

Igniter An electronic device providing a high voltage pulse to initiate an electrical discharge. Typically, the igniter is paired with or is a part of the ballast.

Illuminance Light arriving at a surface, expressed in lumens per unit area; 1 lumen per square foot equals 1 footcandle, while 1 lumen per square meter equals 1 lux.

Incandescent Lamp A light source using the principle of incandescence. When an electric current passes through a filament wire (usually tungsten), the heated wire glows. Filaments of standard incandescent lamps are enclosed in a vacuum or gas-filled bulb. They provide low initial cost, good color rendition and excellent optical control.

Induction Lighting Gases can be excited directly by radio-frequency or microwaves from a coil that creates induced electromagnetic fields. This is called induction lighting and it differs from a conventional discharge, which uses electrodes to carry current into the arc. Induction lamps have no electrodes inside the chamber and generally, therefore, have longer life than standard lamps.

Input Watts The total power input to the ballast which includes lamp watts and ballast losses. The total power input to the fixture is the input watts to the ballast or ballasts and is the value to be used when calculating cost of energy and air conditioning loads.

Instant Start (IS) Instant start ballasts apply high voltage across the lamp with no preheating of the cathode. This is the most energy

efficient starting method for fluorescent lamp ballasting. IS ballasts use 1.5 to 2 watts less per lamp than rapid start ballasts. Other IS ballast benefits typically include parallel lamp circuitry, longer remote wiring distance, easier installation due to less complicated wiring, and capability to start lamps at 0 degrees (versus 50 degrees F for rapid start).

Integral A popular term for a compact fluorescent lamp which includes a built-in ballast.

Inverse Square Law Formula stating that if you double the distance from the light source, the light level goes down by a factor of 4, if you triple the distance, it goes down by a factor of 9, and so on.

Kelvin A unit of temperature starting from absolute zero, parallel to the Celsius (or Centigrade) scale. 0C is 273 K.

Kilowatt (kW) The measure of electrical power equal to 1000 watts.

Kilowatt Hour (kWh) The standard measure of electrical energy and the typical billing unit used by electrical utilities for electricity use. A 100-watt lamp operated for 10 hours consumes 1000 watt-hours (100 x 10) or one kilowatt-hour. If the utility charges \$.10/kWh, then the electricity cost for the 10 hours of operation would be 10 cents (1 x \$.10).

Lamp Manufactured light source, synonymous with light bulb; the three broad categories of electric lamps are incandescent, fluorescent and high-intensity discharge.

Lamp Current Crest Factor (LCCF) Ratio of peak lamp current to RMS or average lamp operating current.

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Lamp Flicker Cyclic variation in output of a light source. High frequency electronic ballasts provide a minimal level of lamp flicker. Lamp flicker from magnetic ballasts may cause eye fatigue for some people.

Lamp Types Filament lamps: Incandescent, Halogen, Halogen-IR. Discharge lamps: Fluorescent, HID (High Intensity Discharge). HID Lamps: Mercury, HPS (High-Pressure Sodium), MH (Metal Halide), and CMH (Ceramic Metal Halide).

Lens A transparent or semi-transparent element which controls the distribution of light by redirecting individual rays. Luminaires often have lenses in addition to reflectors.

Light Center Length (LCL) The distance from a specified reference point on a lamp base to its light center.

Light Emitting Diode (LED) A solid that directly converts electrical impulses into light. Some LEDs today incorporate fluorescent materials to change the color characteristics of the emitted light.

Light Loss Factor (LLF) The product of all factors that contribute to lowering the illumination level including reflector degradation, dirt, lamp depreciation over time, voltage fluctuations, etc.

Light Pollution Light that is directed to areas where it is not needed, and thereby interferes with some visual act. Light pollution directed or reflected into the sky creates a "dome" of wasted light and makes it difficult to see stars above cities.

Lumens A measure of the luminous flux or quantity of light emitted by a source. For example, a dinner candle provides about 12 lumens. A

60-watt Soft White incandescent lamp provides about 840 lumens.

Lumens/Watts A ratio expressing the luminous efficacy of a light source. Typical lamp efficacies:

Thomas Edison's first lamp- 1.4 lpW
Incandescent lamps- 10-40 lpW
Halogen incandescent lamps- 20-45 lpW
Fluorescent lamps- 35-105 lpW
Mercury lamps- 50-60 lpW
Metal halide lamps- 60-120 lpW
High-pressure sodium lamps- 60-140 lpW

Luminaire A light fixture; the complete lighting unit, including lamp, reflector, ballast, socket, wiring, diffuser and housing.

Luminaire Efficiency The ratio of luminous flux (lumens) emitted by a luminaire to that emitted by the lamp or lamps used therein.

Luminance Light reflected in a particular direction; the photometric quantity most closely associated with brightness perception, measured in units of luminous intensity (candelas) per unit area (square feet or square meters).

Luminance Contrast The relationship between the luminances of an object and its immediate background.

Luminance Ratio The ratio between the luminances of any two areas in the visual field.

Lux (lx) A unit of illuminance or light falling onto a surface. One lux is equal to one lumen per square meter. Ten lux approximately equals one footcandle.

Maximum Overall Length (MOL) The end-to-end measurement of a lamp, expressed in inches or millimeters.

Mean Lumens The average light output of a lamp over its rated life. Based on the shape of the lumen depreciation curve, for fluorescent

and metal halide lamps, mean lumens are measured at 40% of rated lamp life. For mercury, high-pressure sodium and incandescent lamps, mean lumen ratings refer to lumens of 50% of rated lamp life.

Mercury Lamp A high-intensity discharge light source operating at a relatively high pressure (about 1 atmosphere) and temperature in which most of the light is produced by radiation from excited mercury vapor. Phosphor coatings on some lamp types add additional light and improve color rendering.

Metal Halide Lamp A high intensity discharge light source in which the light is produced by the radiation from mercury, plus halides of metals such as sodium, scandium, indium and dysprosium. Some lamp types may also utilize phosphor coatings.

Mesopic Typically referring to nighttime outdoor lighting conditions, the region between photopic and scotopic vision.

MR-16 and MR-11 A line of low voltage compact reflector lamps used for accent and spot lighting. The 16 and 11 refer to 16 eighths of an inch in diameter and 11 eighths.

National Electric Code (NEC) A nationally accepted electrical installation code to reduce the risk of fire, developed by the National Fire Protection Association.

Nominal Watts Wattage used to describe a lamp.

OFR Abbreviation for "ozone free" technology. Lamps with the designation OFR do not generate ozone during operation.

Operating Position Some lamps are specified designed to be operated in certain positions, i.e., horizontal or base up.



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PAR Lamps Pressed aluminized reflector lamp, with the outer bulb formed from two pressed glass parts that are fused or sealed together. PAR lamps may be incandescent, halogen, or HID types.

Parallel vs. Series Wiring configurations for ballasts. Ballasts with parallel lamp circuitry have the benefit of companion lamps remaining lit, even if one of the lamps operated by the ballast should fail. Systems with series lamp wiring (magnetic ballasts and many rapid start electronic types) result in all lamps operated on the ballast going out if one should fail.

Photo-Optic Specialty Lamps Photo-Optic specialty lamps employ a variety of technologies to meet the very precise levels of performance required by the entertainment industry, science, medical and other high-tech fields.

Photopic Vision for which the cones in the eye are responsible; typically at high brightness and in the foveal or central region.

Preheat A class of fluorescents requiring a starter, which allows the lamp and filaments to be properly heated before allowing the ballast to supply the correct current flow.

Programmed Rapid Start (PS) Lamp starting method which preheats the lamp filaments while not allowing the lamp to ignite and then applies the open circuit voltage (OCV) to start the lamp. The user may experience a half- to one-second delay after turning on the lamps while the pre-heating takes place. This type of starting circuit keeps lamp-end blackening to a minimum and improves lamp life performance, especially in applications where the lamps are frequently switched on and off.

Rapid Start (RS) Rapid start ballasts apply a low filament voltage to preheat the cathodes. Simultaneously, a starting voltage (lower than that used in instant start) is also applied to strike the arc. When the cathodes are hot enough, the lamp will strike. The filament voltage continues to be applied throughout the operation of the lamp. Rapid start ballasts appear to have a slight turn on delay compared to instant start. They will typically not be able to start lamps reliably under 50 degrees.

Reflector Lamp A light source with a built-in reflecting surface. Sometimes, the term is used to refer specifically to blown bulbs like the R and ER lamps; at other times, it includes all reflectorized lamps like PAR and MR.

Scotopic Vision where the rods of the retina are exclusively responsible for seeing, typically like the light levels in the countryside on a moonless, starlit night.

Spectral Power Distribution (SPD) A graph of the radiant power emitted by a light source as a function of wavelength. SPDs provide a visual profile or “finger print” of the color characteristics of the source throughout the visible part of the spectrum.

Spot A colloquial term referring to a reflector lamp with a tight beam of light, typically around 10 degrees or less. It comes from the fact that such a lamp produces a narrow spot of light as opposed to a wide flood of light.

T-12, T-8, T-5 A designation for the diameter of a tubular bulb in eighths of an inch; T-12 is 12 eighths of an inch, or 1 ½ inches; T-8 is 1 inch, and so on.

Total Harmonic Distribution (THD) A measure of the distortion of the input current on alternating current (AC) power systems caused by higher order harmonics of the fundamental frequency (60Hz in North America). THD is expressed in percent and may refer to individual electrical loads (such as ballast) or a total electrical circuit or system in building. ANSI C82.77 recommends THD not exceed 32% for individual commercial electronic ballasts, although some electrical utilities may require lower THDs on some systems. Excessive THDs on electrical systems can cause efficiency losses as well as overheating and deterioration of system components.

Troffer A long, recessed lighting unit, usually installed in an opening in the ceiling.

Tungsten Halogen Cycle A regenerative cycle of tungsten and halogen atoms, which, when incorporated into the design of the halogen light sources, prevents blackening of the lamp envelope during life.

Voltage (V) A measure of electrical potential, expressed in volts (V). Voltage is the “force” that pushes electrical current through a conductor.

Watt (W) A unit of electrical power equal to 1 joule per second. Lamps are rated in watts to indicate power consumption. Also see Nominal watts.

Wavelength Distance between two successive points of a periodic wave; the wavelengths of light are typically expressed in nanometers (nm), or billionths of a meter.