

# Lighting Glossary of Terms

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## **Absorption**

The dissipation of light within a surface or medium.

## **AC (Alternating Current)**

Electrical current in which the direction is reversed at regular intervals or cycles; in the U.S. the standard is 120 reversals or 60 cycles per second.

## **Accent Lighting**

Directional lighting to emphasize a particular object or to draw attention to a part of the field of view.

## **Accommodation**

The involuntary muscular process by which the eye changes focus from one distance to another.

## **Adaptation**

The involuntary process by which the visual system changes its sensitivity, depending on the luminances prevailing in the visual field. The process involves both the iris and the light sensitive cells of the retina.

## **Ambient Lighting**

Background or fill light in a space.

## **Amperes (Amps)**

A measure of electrical current. Amps = Watts (Power)/Volts (Voltage)

## **American National Standards Institute (ANSI)**

A consensus based organization which coordinates voluntary standards for the physical, electrical and performance characteristics of lamps, ballasts, luminaires and other lighting and electrical equipment.

## **ANSI Codes**

These are 3-letter codes assigned by the American National Standards Institute. They provide a system of assuring mechanical and electrical interchangeability among products from various manufacturers.

## **Argon**

Inert gas used in incandescent and fluorescent lamp types. In incandescent light sources, argon retards evaporation of the filament.

## **ASHRAE**

American Society of Heating, Refrigerating, & Air-Conditioning Engineers

## **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. The life of an LED is defined as the operating time in hours for the lamp to reach L70 which designates 70% lumen maintenance (or 30% reduction in initial light output). Every lamp type has a unique mortality curve that depicts its average rated life.

## **Back Lighting**

The illumination provided for scenery in off-stage areas visible to the audience

## **Baffle**

An opaque or translucent element that serves to shield a light source from direct view at certain angles, or serves to absorb unwanted light.

## **Ballast**

The ballast is an auxiliary electrical device that performs two basic functions: 1) provides the starting voltage and 2) limits the current to sustain lamp operation. There are several types of ballasts including Instant Start, Programmed Start, Pulse Start and Rapid Start (see definitions).

## **Ballast Factor**

The percentage of a lamp's rated lumen output that can be expected when operated on a specific, commercially available ballast. For example, a ballast with a ballast factor of 0.93 will result in the

lamp's emitting 93% of its rated lumen output. A ballast with a lower BF results in less light output and also generally consumes less power.

### **"Batwing" Distribution**

Candlepower and distribution which serves to reduce glare and veiling reflections by having its maximum output in the 30° to 60° zone.

### **Beam Angle**

The beam angle defines the light pattern around the beam's central out to the angle where the luminous intensity (brightness) is half that of the maximum luminous intensity (CBCP - center beam candle power).

### **Bi-level switching**

Control of lighting system involving dual-circuiting a lighting system, which enables two different light and power levels in addition to OFF.

### **Burn Position**

The position in which a lamp is designed to operate in; this applies mainly to High Intensity Discharge lamps. Capacitor - Device in ballast that stores electrical energy. Often used for power factor correction and lamp regulation.

### **Candela (cd)**

The measure of luminous intensity of a source in a given direction, regardless of distance.

### **Candlepower**

Luminous intensity expressed in candelas.

### **Candlepower Distribution Curve**

A curve, generally polar, representing the variation of luminous intensity of a lamp or luminaire in a plane through the light center.

### **Cavity Ratio**

A number indicating cavity proportions calculated from length, width and height.

### **CE (Conformité Européene)**

CE Marking on a product is a manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety and environmental protection legislations, in practice.

### **Center Beam Candlepower (CBCP)**

The luminous intensity at the center of the beam of a reflector lamp. Measured in candelas. Chromaticity - Measure to identify the color of a light source, typically expressed as (x,y) coordinates on a chromaticity chart.

### **Class "P" Ballast**

Contains a thermal protective device which deactivates the ballast when the case reaches a certain critical temperature. The device resets automatically when the case temperature drops to a lower temperature.

### **Coefficient of Utilization (CU)**

The ratio of the luminous flux (lumens) from a luminaire calculated as received on the work-plane to the luminous flux emitted by the luminaires lamps alone.

### **Cold Cathode Lamp**

An electric-discharge lamp whose mode of operation is that of a flow discharge.

### **Colorimetry**

The measurement of color.

### **Color Corrected**

Refers to a lamp with a special phosphor or coating to give it a color rendering profile similar to natural daylight.

### **Color Rendering Index (CRI)**

A lamp's ability to render an object's true colors based on a scale of 100.

### **Commissioning**

A systematic process that ensures that all elements of the lighting control system perform interactively and continuously according to documented design intent and the needs of the building owner.

### **Continuous Dimming**

Control of the intensity of a light source without abrupt transitions between light levels.

### **Correlated Color Temperature (CCT)**

A numerical measurement of the color appearance of a light source measured in degrees Kelvin (K). It also refers to the way color groups are perceived (psychological impact of lighting). A low color

temperature implies warmer color (more yellow/red) light while high color temperature implies a cooler light (more blue).

### **Cone Reflector**

Parabolic reflector that directs light downward thereby eliminating brightness at high angles.

### **Contrast**

The difference in brightness (luminance) of an object and its background.

### **Control Zone**

A luminaire or group of luminaires controlled simultaneously by a single controller.

### **Cool Beam Lamps**

Incandescent PAR lamps that use a special coating (dichroic interference filter) on the reflectorized portion of the bulb to allow heat to pass out the back while reflecting only visible energy to the task, thereby providing a "cool beam" of light.

### **Cooling Loads**

The rate at which heat must be removed from a building or space to achieve thermal comfort for the occupants.

### **Cosine Sensitivity**

The property of cosine corrected light meters in which the sensitivity to light decreases with the cosine of the angle away from the direction perpendicular to the plane of the light meter.

### **Cove Lighting**

Lighting comprising sources shielded by a ledge or horizontal recess, and distributing light over the ceiling and upper wall.

### **Current**

A measure of the rate of flow of electricity, expressed in amperes (A)

### **Cutoff Luminaires**

Outdoor luminaires that restrict all light output to below 85° from vertical.

### **Daylight**

Light originating directly from the sun or direct sunlight that is scattered by the atmosphere.

### **Daylight Harvesting**

The appropriate turning off of electric lighting systems during times at which sufficient daylight is available for visual tasks that are performed in interior spaces.

### **Daylight Zone**

Area of consistent and substantial daylight availability within a building, expressed in square feet.

### **Daylighting**

Lighting strategies that use the sky as a light source, while shielding or reflecting direct sunlight to avoid glare, heat gain or thermal discomfort. Vertical windows and clerestory windows provide side-lighting, and monitors and skylights provide top-lighting.

### **Daylighting Control**

Control strategy in which lighting is either switched OFF or dimmed when photosensor-measured incoming or task light levels rise above a target threshold due to the presence of daylight.

### **DC (Direct Current)**

A type of electrical current and distribution by which electricity flows in one direction through the conductor. Battery operated systems are typical DC applications.

### **Demand Charge**

Utility rate structure which charges based upon peak electric demand use during the billing month. Fee rate is in \$/kW.

### **Demand Response**

Allows customers to bid into the power supply system by reducing building consumption during pre-defined peak load conditions.

### **Dichroic Reflector**

A reflector (or filter) that reflects the visible light region of the spectrum while allowing the other region(s) (heat) to pass through the back of the lamp. A reflector lamp with a dichroic reflector will have a "cool beam" since most of the heat has been removed.

### **Diffuse Daylight**

Daylight not originating directly from the sun or from specular reflections of the sun.

**Diffuse Reflectance**

The ratio of the luminous flux reflected from a surface to the luminous flux incident on the surface.

**Digital Addressable Lighting Interface (DALI)**

An open communications protocol used by multiple control and ballast manufacturers for digital control.

**Dim**

The act of reducing light intensity

**Dimming Ballast**

Special fluorescent lamp ballast, which when used with a dimmer control, permits varying light output.

**Direct Glare**

Glare resulting from high luminances or insufficiently shielded light sources in the field of view. It usually is associated with bright areas, such as luminaires, ceilings and windows which are outside the visual tasks or region being viewed.

**Direct Lighting**

Lighting involving luminaires that distribute 90 to 100% of emitted light in the general direction of the surface to be illuminated. The term usually refers to light emitted in a downward direction.

**Disability Glare**

Glare that causes a deterioration in visual capabilities. Disability glare is caused by light being scattered in the eye, the scattered light reducing the luminance contrast of the retinal image. Disability glare can be produced by small, high intensity light sources, such as the sun, and by large area light sources, such as the sky.

**Discharge Lamp**

A light source that produces light by passing a current between electrodes through a vapor or gas. Includes fluorescent and high intensity discharge lamps.

**Discomfort Glare**

Glare producing discomfort. It does not necessarily interfere with visual performance or visibility.

**Distributed Control**

Control strategy involving distribution of smaller control panels throughout a facility close to the loads they control.

**Department of Energy**

Governmental department whose mission is to advance energy technology and promote related innovation in the United States. <http://www.energy.gov>

**DMX512**

A digital communications protocol most commonly used to control theatrical, stage and entertainment lighting and effects.

**Downlight**

A recessed luminaire usually using a point source, with a round or square aperture that projects light downward.

**Driver**

A self-contained power supply that has outputs which match the electrical characteristics of the lamp. It is similar to a ballast and is used to power illumination sources.

**Dual-Switching**

A bi-level switching strategy involving dual-circuiting the inboard lamps separately from the outboard lamps in three-lamp luminaires, enabling three different light and power levels in addition to OFF. (Also known as Multi-level switching.)

**Eccentricity**

The angle between the line of sight and the line from the eye to the position of the target.

**Efficacy**

A measurement of how effective a light source is in converting electrical energy to lumens of visible light. Expressed in lumens-per-watt (LPW) this measure gives more weight to the yellow region of the spectrum and less weight to the blue and red region where the eye is not as sensitive.

**Efficiency**

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% to 40% into light. The efficiency of a luminaire or fixture is the percentage of the lamp lumens that actually comes out of the fixture.

## **Electrical Testing Laboratory (ETL)**

Independent testing laboratory that performs ballast tests and certifies accuracy of performance data.

## **Electromagnetic Spectrum**

A continuum of electric and magnetic radiation that is characterized by wavelength or frequency.

Visible light encompasses a small part of the electromagnetic spectrum in the region from about 380 nanometers (violet) to 770 nanometers (red) by wavelength.

## **Emergency Lighting**

Lighting system designed to provide minimum illumination required for safety, during power failures.

## **Enclosed Fixture Rated**

See Open Fixture Rated.

## **Energy Use Intensity (EUI)**

Measure of energy efficiency of buildings expressed in kBtu per square foot.

## **Environmental Protection Agency**

The mission of EPA is to protect human health and the environment. The EPA implements environmental laws written by Congress through the development of regulations and their enforcement. [www.epa.gov](http://www.epa.gov)

## **Energy Independence and Security Act (EISA) 2007**

The Energy Independence and Security Act of 2007 was signed into law on December 19, 2007. The act builds on the progress made by the Energy Policy Act of 2005 (EPAct) in setting out a comprehensive energy strategy for the 21st century. This act is a major step toward reducing our dependence on oil thereby increasing our energy security and making our country cleaner for future generations. An update was issued in 2009 for Incandescent Reflector Lamps and General Service Fluorescent Lamps.

## **Energy Star**

ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy promoting money savings and the protection of the environment through the use of energy efficient products and practices. [http:// www.energystar.gov](http://www.energystar.gov)

## **Energy Policy Act (EPAct)**

Energy legislation passed by Congress in 1992 and updated again in 2005, mandating labeling and minimum energy efficiency requirements for many commonly used incandescent and fluorescent lamps. Please note, the Energy Independence and Security Act of 2007 (EISA 2007) and Executive Order (E.O.) 13423 have been issued subsequent to the passage of EPAct 2005. See Energy Independence and Security Act (EISA) 2007.

## **Equivalent Sphere Illumination (ESI)**

The level of sphere illumination which would produce task visibility equivalent to that produced by a specific lighting environment.

## **"ER" (Elliptical Reflector)**

Lamp whose reflector focuses the light about 2" ahead of the bulb, reducing light loss when used in deep baffle downlights.

## **Exitance**

The total quantity of light emitted by, reflected from, and transmitted through a surface into a complete hemisphere. It is expressed in units of lumens per unit surface area.

## **Extended Life Lamps**

Incandescent lamps that have an average rated life of 2500 or more hours and reduced light output compared to standard general service lamps of the same wattage.

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## **Federal Communications Commission (FCC)**

The U. S. Federal agency that regulates emissions in the radio frequency portion of the electromagnetic spectrum. Part 18 of the FCC rules specifies electromagnetic interference (EMI) from lighting devices operating at frequencies greater than 9 kilohertz (kHz). Typical electronically ballasted compact fluorescent lamps operate in the 24 - 100 kHz frequency range.

## **Field Angle**

The angular dimension of the cone of light from reflectorized lamps (such as R and PAR types) encompassing the central part of the beam out to the angle where the intensity is 10% of maximum. See Beam Angle.

## **Fenestration**

Any opening or arrangement of openings (normally filled with glazing media) for the admission of daylight, including any devices in the immediate proximity of the opening that affect distribution (such as baffles, louvers, draperies, overhangs, light-shelves, jambs, sills, and other light-diffusing materials).

## **Filament**

Wire used in incandescent lamps, usually made of tungsten and often coiled, that emits light when heated by an electrical current.

## **Fill Light**

Illumination added to reduce shadows or contrast range.

## **Fixation Point**

The position in the visual field that lies on the line of sight. The retinal image of the fixation point falls on the fovea.

## **Floodlighting**

A system designed for lighting a scene or object to a luminance greater than its surroundings. It may be for utility, advertising or decorative purposes.

## **Fluorescent Lamp**

A low-pressure mercury electric-discharge lamp in which a phosphor coating transforms some of the ultraviolet energy generated by the discharge into light.

## **Footcandle (fc)**

The unit of measure for the density of light on a surface. One footcandle is equal to one lumen per square foot (lm/ft<sup>2</sup>). One footcandle = 10.674 lux.

## **Foot Lambert**

(fl) A unit of luminance of perfectly diffusing surface emitting or reflecting light at the rate of one lumen per square foot.

## **Footlights**

A set of strip lights at the front edge of the stage platform used to soften face shadows cast by overhead luminaires and to add general toning lighting from below.

## **General Lighting**

See Ambient Lighting.

## **General Service Lamps**

"A" or "PS" incandescent lamps.

## **Glare**

Glare is an interference with visual perception caused by an uncomfortably bright light source or reflection within one's field of view; a form of visual noise.

## **Glare Indices (Glare Index)**

A method of predicting the presence of discomfort glare due to daylighting. Factors affecting the glare index include the size and relative position of fenestration, sky luminance, and interior luminance. Most widely used in Europe, the glare index is similar to the index of sensation and the discomfort glare rating, which are used in North America for electric lighting applications.

## **Group Relamping**

Relamping of a group of luminaires at one time or reduce relamping labor costs.

## **Halogen**

A group of inert gases, particularly Bromine, which is used to reduce the amount of tungsten that plates the interior wall of the lamp. At high temperatures, the halogen reacts with the tungsten to form tungsten bromide freeing tungsten from the wall and re-depositing it onto the filament.

## **Halogen Cycle**

A regenerative cycle of tungsten and halogen atoms, which prevents blackening of the lamp envelope during the life of the lamp. See Halogen.

## **High Intensity Discharge (HID) Lamp**

A discharge lamp in which the light producing arc is stabilized by wall temperature, and the arc tube has a bulb wall loading in excess of three watts per square centimeter. HID lamps include groups of lamps known as mercury, metal halide, and high pressure sodium.

## High Lumen

Lamps that operate with higher lumens (brightness) than the standard model.

## High Output Fluorescent (HO)

Fluorescent lamps designed to be used with an 800 milliampere ballast. These lamps are able to operate at low temperatures (down to 0oF) and still produce high light levels.

## High Pressure Sodium (HPS) Lamp

High intensity discharge (HID) lamp in which light is produced by radiation from sodium vapor. Includes clear and diffuse-coated lamps.

## Horizontal Illuminance

Illuminance on a horizontal surface.

## IES

Illuminating Engineering Society

## Illuminance

The total density of visible light - from all directions - illuminating, falling on or incident to, a surface; one lumen per square foot equals one footcandle (lm/ft<sup>2</sup>), while one lumen per square meter equals one lux (lm/m<sup>2</sup>).

## Incandescence

The self-emission of radiant energy in the visible spectrum due to the thermal excitation of atoms or molecules.

## Incandescent Lamp

A lamp in which light is produced by a filament heated to incandescence by an electric current.

## Induction Lamps

A lamp that is powered by an electromagnetic field rather than through lamp electrodes or direct electrical connections.

## Initial Lumens

The measured luminous output of a new light source.

## Instant Start

A type of fluorescent lamp-ballast circuit designed to start fluorescent lamps as soon as the power is applied. Originally, instant-start circuits were developed to eliminate separate mechanical starter devices.

## Integrated Circuit (IC)

IC-based CFLs operate by controlling the voltage and current by adjusting the output frequency which provides stable operation of the CFL. Controlling the current produces less stress on the cathode and the electronic components, which results in long life, smoother dimming, and less noise.

## International Dark Sky Association (IDA)

IDA is the recognized authority on light pollution. Founded in 1988, IDA is the first organization to call attention to the hazards of light pollution. <http://www.darksky.org>

## Inverse Square Law

The law stating that the illuminance at a point on a surface varies directly with the intensity of a point source, and inversely as the square of the distance between the source and the point. If the surface at the point is normal to the direction of the incident light, the law is expressed by  $fc=cp/d^2$ .

## Ingress Protection (IP) Rating

International Protection (IP) rating system defined by International Standard IEC 60529, which classifies degrees of protection for electrical devices against intrusion by elements present in the space, such as water, dust and accidental contact by body parts such as hands and fingers. The minimum rating contains two numbers, the first describing the degree of protection against solid objects and the second against ingress of water. Additional letters may be used to identify other protections.

## IP65

The protection of enclosures against ingress of dirt or against the ingress of water is defined in IEC529 (BSEN60529:1991). The first digit in the rating is the protection against contact and foreign bodies. The second digit in the rating is the water protection factor. IP65 indicates a lamp is totally protected against dust and protected against low pressure jets if water from all directions - limited ingress permitted.

## Irradiance

The incident radiant flux per unit area of a surface. Irradiance is measured in watts / square meter.

## Isofootcandle (Isolux)

Contour lines linking points of the same footcandle or lux value.

## **Kelvin (K)**

The Kelvin unit is the basis of all temperature measurement. In lighting, Kelvin is the unit of measure for color temperature used to indicate the overall color of the light produced from a source. See correlated color temperature.

## **Kilowatt (kW)**

The measure of electrical power equal to 1000 watts.

## **Kilowatt Hour (kWh)**

The measure of electrical energy from which electricity billing is determined. For example, at the rate of \$0.11 per kWh, a 100 watt lamp operating for 1000 hours will cost \$11.00 ( $100 \times 1000/1000 = 100 \text{ kWh}$  x .11 = \$11.00)

## **Krypton**

A noble gas used in lamps, typically Krypton lamps offer brighter, whiter light than standard incandescent.

## **L70 (subscript number)**

A lumen maintenance term that describes the amount of time that elapses before a light source's output has dropped to 70%. Lumen maintenance is the inverse of lumen depreciation, in this case a lumen maintenance (L70 lifetime) is equivalent to 30% lumen depreciation.

## **Lamp**

The lighting industry term for a complete light source package, typically referred to by consumers as a "bulb".

## **Lamp Efficacy**

The ratio of lumens produced by a lamp to the watts consumed. Expressed as lumens per watt (LPW).

## **Lamp Lumen Depreciation (LLD)**

Multiplier factor in illumination calculations for reduction in the light output of a lamp over a period of time.

## **LEED**

Leadership in Energy and Environmental Design (LEED) is an internationally recognized green building certification system, developed and managed by the US Green Building Council (USGBC). LEED certification requires third-party verification that a building or community was designed and built using strategies aimed at improving performance across the following metrics: energy savings, water efficiency, CO2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

## **Lens**

Used in luminaires to redirect light into useful zones.

## **Life Cycle Assessment (LCA)**

A framework for identifying and evaluating the environmental burdens associated with the life of materials associated with a product, from raw extraction through end-of-use.

## **Life Cycle Cost Analysis (LCCA)**

Economic method for assessing the total cost of facility system ownership taking into account all costs of acquiring, owning and disposing of a building system.

## **Light**

Radiant energy that is capable of exciting the retina and producing a visual sensation. The visible portion of the electromagnetic spectrum extends from about 380 to 770 nm.

## **Light Center Length (LCL)**

The distance between the center of the filament, or arc tube, and a reference plane - usually the bottom of the lamp base.

## **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.

## **Light Trespass (Spill Light)**

Light that is not aimed properly or shielded effectively can spill out at into areas that don't want it: it can be directed towards drivers, pedestrians or neighbors. It is distracting and can be disabling.



## **Lighting Control**

General term referring to electrical devices and techniques necessary to provide the right amount of light where and when needed.

## **Lighting Control Narrative**

This document is used to briefly define the context for lighting control systems (general project goals and goals for lighting and controls), and then articulate the design intent for lighting control systems in the project, providing a written description of the lighting control system and a detailed sequence of operations, or description of system inputs/outputs.

## **Lighting Facts Label**

The Federal Trade Commission (FTC) mandated a new lighting facts label which will be included on all bulbs intended for general service purposes. Packaging for standard base LEDs, CFLs and your household incandescents will show this new two part label over the next few months leading up to the effective date for this new ruling of January 1st, 2012.

## **Lighting Power Density**

A measure of installed lighting power, expressed as Watts per square foot.

## **Line Voltage**

See voltage.

## **Load Scheduling**

An energy-saving lighting control strategy for switching or dimming during hours when a building space is unoccupied or occupied by individuals with less stringent lighting requirements. (Also known as scheduling.)

## **Load Shedding**

A lighting control strategy for selectively reducing the output of luminaires on a temporary basis as a means to reduce peak demand charges or earn a utility incentive.

## **Local Lighting**

Lighting designed to provide illuminance over a relatively small area or confined space without providing any significant general surrounding lighting.

## **Louver**

A series of baffles used to shield a source from view at certain angles or to absorb unwanted light. The baffles usually are arranged in a geometric pattern.

## **Long Life Lamps**

See Extended Life Lamps.

## **Low Pressure Sodium Lamp**

A discharge lamp in which light is produced by radiation of sodium vapor at low pressure producing a single wavelength of visible energy, i.e. yellow.

## **Low Voltage Lamps**

Incandescent lamps that operate at 6 to 12 volts.

## **Lumen (lm)**

A measure of luminous flux or quantity of light emitted by a source.

## **Lumen Depreciation**

The gradual decline in light output from a light source over time due to filament deterioration and bulb darkening.

## **Lumen Maintenance**

A measurement of how a lamp maintains its light output over time.

## **Lumens Per Watt (LPW)**

A measure of the efficacy (efficiency) of a light source. The number is achieved by dividing lumens produced by watts consumed.

## **Luminaire**

A complete lighting unit consisting of a lamp (or lamps), ballast (or ballasts) as required to distribute the light, position and protect the lamps and connect them to the power supply. A luminaire is often referred to as a fixture.

## **Luminaire Dirt Depreciation (LDD)**

The multiplier to be used in illuminance provided by clean, new luminaires to the reduced illuminance that they will provide due to direct collection on the luminaires at the time at which it is anticipated that cleaning procedures will be instituted.

## **Luminaire Efficiency**

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

## **Luminance**

A photometric measure of "brightness" of a surface as seen by the observer, measured in candelas per square meter. (cd/m<sup>2</sup>)

## **Luminance Contrast**

Luminance contrast quantifies the relative brightness of an object against its background. It can range from zero to one. The closer the luminance contrast is to one, the greater the relative brightness of the object against its background.

## **Luminance Distribution**

The distribution of luminance arriving at a point from all surrounding directions.

## **Luminous Efficacy**

The light output (lumens) of a light source divided by the total power input (watts) to that source. It is expressed in lumens per watt.

## **Luminous Flux**

Emitted light from a light source or a surface, measured in lumens.

## **Luminous Intensity**

Quantity of light emitted from a light source or a surface in a given direction, measured in candelas.

## **Lux (lx)**

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

## **Maintenance Factor (MF)**

A factor used in calculating illuminance after a given period of time and under given conditions. It takes into account temperature and voltage variations, dirt accumulation on luminaire and room surfaces, lamp depreciation, maintenance procedures and atmosphere conditions.

## **Maximum Overall Length (M.O.L.)**

The end-to-end measurement of a lamp, expressed in inches or millimeters.

## **Mean Lumens**

The measured luminous output of a light source at: 40% of lamp life for fluorescent and metal halide lamps and 50% of lamp life for mercury, high-pressure sodium and incandescent lamps.

## **Maximum of Diameter (M.O.D.)**

The measurement of a lamp's diameter, expressed in inches or millimeters.

## **Mercury**

Metallic chemical element, chemical symbol Hg, atomic number 80. Mercury is the only elemental metal that is liquid at ordinary temperatures, with a freezing point of -38 °F (-39 °C) and a boiling point of 674 °F (356.9 °C). It is used in Compact Fluorescent, Fluorescent and HID lamps.

## **Mercury Lamp**

A high intensity discharge (HID) lamp in which the major portion of the light is produced by radiation from mercury. Includes, clear, phosphor-coated and self-ballasted lamps.

## **Mercury Starvation**

The state in which a fluorescent lamp does not have enough mercury vapor present, often resulting in a pinkish lamp.

## **Mesh Wireless Control Network**

Network of wireless lighting control devices communicating as nodes in a network; a signal generated by one device is routed through other devices until reaching the recipient.

## **Metal Halide Lamp**

A high intensity discharge (HID) lamp in which the major portion of the light is produced by radiation of metal halides and their products of dissociation-possible in combination with metallic vapors such as mercury. Includes clear and phosphor coated lamps.

## **Model Lighting Ordinance (MLO)**

Outdoor lighting ordinance designed to address light pollution issues. The MLO was developed jointly by the Illuminating Engineering Society of North America (IESNA) and the International Dark Sky Association (IDA) for adoption by individual municipalities.

## **Modified Spectrum**

Light sources that utilize neodymium glass or coating (composed of rare earth elements) to simulate true daylight. This special glass or coating filters out the yellow light produced by standard incandescent lamps.

**Nadir**

Vertically downward directly below the luminaire or lamp; designated as 0°.

**Nanometer**

A unit of wavelength equal to one billionth of a meter.

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**Neodymium**

A rare earth element used to produce modified spectrum (full spectrum) incandescent lamps; also known as daylight or natural light. They use a colored glass shell to filter out the yellow light produced by standard incandescent lamps.

**Nominal Length**

A measurement for Fluorescent lamp length based on the length of the lamp plus an allowance for the luminaire's lamp holders.

**Occupancy Sensor**

A device that switches lights ON and OFF or dims and brightens them based on the presence or absence of people, by detecting a change in movement or sound.

**Open Fixture Rated**

Lamps that are approved for burning in open fixtures (as opposed to enclosed fixtures which have an acrylic lens or plate glass enclosure).

**Open Loop**

Photocontrol system that measures only daylight coming into the space, not actual light levels in the space.

**Overall Length (OAL)**

Maximum overall length of a light fixture.

**Overhead Glare**

Glare caused by a light source located directly above the viewer.

**Override**

A switch or other method that can be used by occupants to ensure continuation of lighting when required outside of normal operating hours (after a load scheduling event).

**PAR Lamp**

A PAR lamp, parabolic aluminized reflector, which may utilize either an incandescent filament, a halogen filament tube or a HID arc tube, is a precision pressed-glass reflector lamp. PAR lamps rely on both the internal reflector and prisms in the lens for control of the light beam. PAR lamps are also available using LED technology in which the lens is used to control the beam.

**Parabolic Louvers**

A grid of baffles which redirect light downward and provide very low luminaire brightness.

**Passive Infrared (PIR)**

Occupancy sensing method that detects occupancy by reacting to the movement of infrared heat energy emitted by people.

**Peak Demand**

Maximum electric demand load (kW) sustained for specified period (typically 15 minutes duration).

**Performance Testing**

Project phase in which a contractor, under the supervision of the commissioning authority, inspects and tests installed systems to ensure they are installed and operate according to the Basis of Design.

**Phosphor**

An inorganic chemical compound processed into a powder and deposited on the inner glass surface of fluorescent tubes, CFL's, LED's and some mercury and metal-halide lamp bulbs. Phosphors are designed to absorb short wavelength ultraviolet radiation and to transform and emit it as visible light.

**Photometry**

The measurement of light and related quantities.

**Phototransduction**

The process by which light is converted into electrical signals.

## **Photovoltaics**

Field of technology related to the application of solar cells for conversion of daylight into electricity.

## **Plasma Lighting**

An electrodeless lighting system consisting of a magnetron producing an electromagnetic field around a glass capsule inside an electrodeless lamp, converting its contents into light-emitting plasma with point-source distribution.

## **Point Method Lighting Calculation**

A lighting design procedure for predetermining the illuminance at various locations in lighting installations, by use of luminaire photometric data.

## **Polarization**

The process by which the transverse vibrations of light waves are oriented in a specific plane. Polarization may be obtained by using either transmitting or reflecting media.

## **Power Factor (PF)**

Measurement of the relationship between the AC source voltage and current. Power factors can range from 0 to 1.0, with 1.0 being ideal. Power factor is sometimes expressed as a percent. Incandescent lamps have power factors close to 1.0 because they are simple "resistive" loads. The power factor of a fluorescent and HID lamp system is determined by the ballast used. "High" power factor usually means a rating of 0.9 or greater.

## **Power Quality**

The degree to which current and voltage wave forms conform to a sinusoidal shape and are in synchronous phase with each other. Poor power quality results when the wave forms are distorted and/or out of phase and can interfere with data communications, cause inefficient operation or failure of other electrical equipment on the same supply line, and result in excessive current in electrical distribution lines.

## **Powerline Carrier (PLC)**

Method of lighting control involving using line-voltage power wires as communication pathways for control signals.

## **Pre-heat Lamp**

A fluorescent lamp in which the filament must be heated by use of a starter before the arc is created. These lamps are typically operated with electromagnetic ballasts.

## **Programmed Rapid Start**

A fluorescent lamp-ballast circuit that uses a custom integrated circuit (IC), which monitors lamp and ballast conditions to ensure optimal system lighting performance. PS ballasts heat the lamp cathodes to 700°C prior to lamp ignition. This puts the least amount of stress on the lamp electrodes, resulting in maximum lamp life regardless of the number of lamp starts. Programmed-start ballasts are typically wired in series.

## **Pulse Start**

A fluorescent lamp-ballast circuit that is designed with an ignitor to ignite the arc tube. Due to this, bulbs have no need for the starter electrode. Pulse start lamps are typically more efficient than standard counterparts.

## **"R" Lamps (Reflector)**

Reflectorized lamps available in spot (clear face) and flood (frosted face). Lamps made of blown or molded glass formed such that a parabolic or other shape is created which directs the light from the lamp out in a single direction. The reflecting surface is typically coated with aluminum or silver and the lens of the lamp may be clear, frosted or molded with prisms to further direct the light. Reflector lamps may utilize incandescent filaments, HID arc tubes or CFL assemblies.

## **Radiant Flux**

The rate of flow of electromagnetic radiation, measured in Watts.

## **Rapid Start**

A fluorescent lamp-ballast circuit which utilized continuous cathode heating, while the system is energized, to start and maintain lamp light output at efficient levels. Rapid start ballasts may be either electromagnetic, electronic or of hybrid designs. Full-range fluorescent lamp dimming is only possible with rapid start systems.

## **Rated Lamp Life**

The length of time of a statistically large sample between first use and the point when 50% of lamps died (no longer operating).

## **Raw Footcandles**

See Footcandles.

## **Reference Ballast**

A ballast that is built to a specific standard for the sole purpose of testing and characterizing lamps and other ballasts.

## **Reflection**

Light bouncing off a surface. In specular reflection the light strikes and leaves a surface at the same angle. Diffuse reflected light leaves a surface in all directions.

## **Reflectance**

Sometimes called reflectance factor. The ratio of reflected light to incident light (light falling on a surface). Reflectance is generally expressed in percent.

## **Reflected Glare**

Glare resulting from specular reflections of high luminances in polished or glossy surfaces in the field of view. It usually is associated with reflections from within a visual task or areas in close proximity to the region being viewed.

## **Reflector**

A device used to redirect the light flow from a source by bouncing it off the surface.

## **Reflector Lamp**

See "R" Lamps

## **Refraction**

The process by which the direction of a ray of light changes as it passes obliquely from one medium to another in which its speed is different.

## **Relative Photometry**

Photometry is the measurement of the properties of light, particularly intensity. Relative photometry, used for luminaires with conventional light sources, produces light intensity values that assume the lamping used in the luminaire delivers the initial rated lumens as rated by its manufacturer (on a reference ballast). As a result, multiple tests of the same luminaire with different lamps of the same type will generate the same results under normal conditions.

## **RoHS**

RoHS, a European directive, stands for the Restriction on hazardous Substances. RoHS is a regulation for the restriction of the use of certain hazardous substances in electrical and electronic equipment.

## **Room Cavity Ratio (RCR)**

A number indicating room cavity proportions calculated from length, width and height.

## **Rough Service Lamps**

Incandescent lamps designed with extra filament supports to withstand bumps, shocks and vibrations with some loss in lumen output.

## **Self-Ballasted Lamps**

A discharge lamp with an integral ballasting device allowing the lamp to be directly connected to a socket providing line voltage.

## **Shading Masks**

Parts of the sky dome that are blocked by exterior surfaces, such as the landscape, neighboring buildings and building-mounted shading systems.

## **Silver Bowl Lamps**

Incandescent "A" lamps with a silver finish inside the bowl or portion of the bulb. Used for indirect lighting.

## **Solid State Lighting (SSL)**

A form of lighting that uses semi-conductor materials to emit light, rather than using glowing filaments or gas-discharge sources. (LEDs)

## **Source Efficacy**

The ratio of light output of a light source to input power.

## **Spacing Criteria (SC or Ratio)**

Ratio of the distance between luminaire centers to the mounting height above the work-plane for uniform illumination. A multiplying factor calculated for a specific luminaire, which describes how far apart the luminaires can be spaced to deliver uniform lighting to the workplane. This multiplying factor, multiplied by the distance from the luminaire to the workplane, yields the maximum horizontal spacing for uniform lighting. The spacing criteria value may be different for lengthwise spacing than cross-wise spacing.

## **Spectral Energy Distribution (SED) Curves**

A plot of the level of energy at each wavelength of a light source.

## **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.

## **Sphere Illumination**

The illumination on a task from a source providing equal luminance in all directions about that task, such as an illuminated sphere with the task located at the center.

## **Spot Relamping**

A method of replacing lamps only after they have failed.

## **Starter**

An electronic module or device used to assist in starting a discharge lamp, typically by providing a high-voltage surge.

## **Starting Temperature (Minimum)**

The minimum ambient temperature at which the lamp will start reliably.

## **Step-Dimming Ballast**

A ballast that reduces light levels by one or more steps between full light output and OFF.

## **Surface Mounted Luminaire**

A luminaire that is mounted directly on a ceiling.

## **Suspended (Pendant) Luminaire**

A luminaire that is hung from a ceiling by supports.

## **System Efficacy**

Also referred to as relative system efficacy, system efficacy is a measurement of a system's ability to convert electricity into light. Measured in lumens per watt (LPW), system efficacy is the ratio of the light output (in lumens) to the active power (in watts).

## **T5**

A fluorescent lamp that is 5 eights (5/8") in diameter.

## **T8**

A fluorescent lamp that is 8 eights (1") in diameter.

## **T12**

A fluorescent lamp that is 12 eights (1.5") in diameter.

## **Tandem Wiring**

Wiring scheme in which two or more luminaires share a single ballast, reducing installation and energy costs.

## **Task Lighting**

Lighting designed for a specific visible operation (task) which requires higher light levels; requirements vary according to the proximity to that task and the level of detail involved.

## **Task Tuning**

A lighting control strategy in which the light output of a luminaire or group of luminaires can be adjusted by a user or users to achieve desired light levels for a local task.

## **Taskplane (Workplane)**

The surface or area on which visual attention is placed. In an office space, the workplane is at desk height, or 30" above the floor. In a corridor or parking lot, for example, the workplane is the floor or pavement.

## **Thermal Factor**

Thermal factor is a light loss factor that should be applied to a lighting design when application conditions imply ambient temperatures other than the optimal for the given lamp type operated within a given luminaire.

## **Three-Way Lamps**

Incandescent lamps that have two separately switched filaments permitting a choice of three levels of light such as 30/70/100, 50/100/150 or 100/200/300 watts. They can only be used in a base down position.

## **Total Harmonic Distortion (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 a 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.

### **Total Internal Reflection (TIR)**

The point where the angle of incidence of the light ray to a refractive surface is greater than the critical angle and therefore all incident light is internally reflected.

### **Toxicity Characteristic Leaching Procedure (TCLP)**

The Toxicity Characteristic Leaching Procedure (TCLP) test, specified in the Resource Conservation and Recovery Act (RCRA) of 1990, is used to characterize fluorescent lamp waste as hazardous or nonhazardous for the purpose of disposal. The TCLP test measures the ability of the mercury and/or lead in a lamp to leach from a landfill into groundwater.

### **Transformer**

An electrical device by which the alternating current of one voltage is changed (stepped up or down) to another voltage.

### **Transmission**

The passage of light through a material.

### **Transmission Losses**

Decreases in delivered electricity from "primary" electricity generated due to inherent inefficiencies in the delivery grid.

### **Tri-Phosphor**

Fluorescent lamps that utilize red, green, and blue phosphor compounds that glow to produce light similar in color rendering to regular illumination.

### **Troffer**

The housing of a fluorescent luminaire, usually a recessed metal housing that looks like an inverted trough.

### **Tungsten**

A hard, brittle, corrosion-resistant, gray to white metallic element extracted from wolframite, scheelite, and other minerals, having the highest melting point and lowest vapor pressure of any metal. Tungsten and its alloys are used in high-temperature structural materials; notably lamp filaments.

### **Tungsten-Halogen Lamp**

A gas filled tungsten incandescent lamp containing a certain proportion of halogens.

### **TUV Rheinland**

An international service group, TUV Rheinland documents the safety and quality of new and existing products, systems and services. <http://www.tuv.com>

### **Ultraviolet (UV) Radiation**

Radiant energy in the range of about 100-380 nanometers (nm). For practical applications, the UV band is broken down further as follows:

- Ozone-producing - 180-220 nm
- Bactericidal (germicidal) - 220-300
- Erythematous (skin reddening) - 280-320
- "Black" light - 320-400

The International Commission on Illumination (CIE) defines the UV band as UV-A (315-400 nm); UV-B (280-315 nm) and UV-C (100-280 nm).

### **Underwriter's Laboratory (UL)**

A private organization which tests and lists electrical (and other) equipment for electrical and fire safety according to recognized UL and other standards. A UL listing is not an indication of overall performance. Lamps are not UL listed except for compact fluorescent and LED lamp assemblies - those with screw bases and built-in ballasts.

### **Unified Glare Rating (UGR)**

Metric developed by the CIE intended to predict discomfort glare. Values range from 5 to 30 with the higher the number, the greater the discomfort.

### **Vacancy Sensor**

Term used to describe manual-ON occupancy sensors.

### **Veiling Reflections**

Regular reflections superimposed upon diffuse reflections from an object that partially or totally obscure the details to be seen by reducing the contrast. This is sometimes called reflected glare.

**Vertical Illuminance**

Illuminance on a vertical surface.

**Vibration Service Lamps**

See Rough Service Lamps.

**Visual Comfort Probability (VCP)**

The rating of a lighting system expressed as a percent of people who, when viewing from the specified location and in a specified direction, will be expected to find it acceptable in terms of discomfort glare.

**Visual Edge**

The line on a isolux chart which has a value equal to 10% of the maximum illumination.

**Visual Field**

The field of view that can be perceived when the head and eyes are kept fixed.

**Voltage**

A measurement of the electromotive force in an electrical circuit or device expressed in volts. Line voltage in the USA is 120V.

**Wall Wash Lighting**

A smooth even distribution of light over a wall.

**Watt**

A unit of electrical power. Lamps are rated in watts to indicate the rate at which they consume energy.

**Xenon**

A noble gas used in lamps, typically Xenon lamps offer brighter, whiter light than standard incandescent.

**Zonal Cavity Method Lighting Calculation**

A lighting design procedure used for predetermining the relation between the number and types of lamps or luminaires, the room characteristics, and the average illuminance on the work-plane. It takes into account both direct and reflected flux.

**Zonal Lumen Summary Table**

Element of luminaire photometric report typically presented in the manufacturer catalog sheet for the product. The table lists the luminaire's light output in lumens for specific zones and then summarizes for all light emitted down (0-90°), up (90-180°) and total (0-180°). These values are in turn used to calculate luminaire efficiency, the percentage of lamp light output that exits the luminaire relative to the total lamp lumens emitted by its light source.



# LED GLOSSARY

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## **Average Rated Life**

An average rating, in hours, indicating when a percentage of a large group of lamps have failed, when operated at nominal lamp voltage and current. The life of an LED is defined as the operating time in hours for the lamp to reach L70 which designates 70% lumen maintenance (or 30% reduction in initial light output). Every lamp type has a unique mortality curve that depicts its average rated life.

## **Binning**

The separation of LEDs according to color temperature subsequent to a production run for full manufactured, distribution in terms of color, lumen output and forward voltage. This allows luminaire manufacturers to select only those LEDs that meet their acceptable performance ranges and also maintain consistency in production.

## **Center Beam Candlepower (CBCP)**

The luminous intensity at the center of the beam of a reflector lamp. Measured in candelas.

## **Diode**

A two-terminal semiconductor device having a p-n (positive-negative) junction which allows energy travel in one direction.

## **Driver**

A self-contained power supply that has outputs which match the electrical characteristics of the lamp. It is similar to a ballast and is used to power illumination sources.

## **Federal Communications Commission (FCC)**

The U.S. Federal agency that regulates emissions in the radio frequency portion of the electromagnetic spectrum. Part 18 of the FCC rules specifies electromagnetic interference (EMI) from lighting devices operating at frequencies greater than 9 kilohertz (kHz). Typical electronically-ballasted compact fluorescent lamps operate in the 24 - 100 kHz frequency range.

## **Heat Sink**

A heat sink is an environment or object that absorbs and dissipates heat from another object. The design of an LED retrofit lamp's heat sink is an integral factor in the overall performance of the lamp.

## **High Power LED**

LED chips can be assembled in two primary methods for integration in an LED retrofit lamp: SMD (Surface Mount Device) and COB (Chip on Board).

- SMD – SMD LEDs are enclosed by a housing and the encased LED is soldered onto the printed circuit board (PCB). This method of assembly does not have optimal heat conduction.
- COB – COB LEDs are neither encased nor connected. The LED chips are placed directly onto the PCB through wire bonding and connected to the contact surface of the PCB. The benefits of COB technology include longer life, better performance as well as higher light output due to better heat conduction in this assembly structure.

## **LED Array**

A collection of multiple LEDs mounted onto a substrate, usually a printed circuit board. The light output from the LED array is the sum of the light outputs of the individual LEDs.

## **LED Junction Temperature (T<sub>j</sub>)**

Temperature of the LED chip within an LED package. T<sub>j</sub> is a critical parameter of LED performance. LED light output, lifetime, and color maintenance are all adversely affected by high LED junction temperatures.

## **LM79**

An IES approved method describing procedures and precautions in performing reproducible measurements of LEDs including total flux, electrical power, efficacy (lpw) and chromaticity. This is applicable to LED products incorporating control electronics and heat sinks (LED luminaires and integrated LED sources).

## **LM80**

An IES approved method for measuring lumen depreciation of solid-state (LED) light sources, array and modules. This does not apply to luminaires and does not define or provide methods for estimation of life.

### **Maximum Allowable Junction Temperature**

The manufacturer rated temperature limit of the LED device. Junction temperatures above this value may lead to sudden catastrophic failure or rapid light output degradation.

### **Power Factor (PF)**

Measurement of the relationship between the AC source voltage and current. Power factors can range from 0 to 1.0, with 1.0 being ideal. Power factor is sometimes expressed as a percent. "High" power factor usually means a rating of 0.9 or greater.

### **TM-21**

IESNA TM-21-11 provides the method for determining when the "useful lifetime" of an LED is reached, a point when the light emitted from an LED depreciates to a level where it is no longer considered adequate for a specific application through the use of extrapolated data from LM80 testing. Lumen maintenance of LED products and LED packages can vary by manufacturer. TM-21 ensures consistent lumen maintenance extrapolation methods for all LED manufacturers. TM-21 extrapolations are 'best-case' system lifetime estimates, and assume that no other failure mechanisms influence the life of the LED luminaire.

### **Total Harmonic Distortion (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 a building. ANSI C82.77 recommends THD not exceed 32% for individual commercial electronic ballasts.

### **Transformer**

An electrical device by which the alternating current of one voltage is changed (stepped up or down) to another voltage. Magnetic transformers use a core and coil assembly transformer to start and operate the lamp. Electronic transformers operate lamps at frequencies above 20,000Hz through the use of electronic circuitry.