



## Lighting & Daylighting Terminology

Prepared by LightLouver LLC (February 2011)

Many terms are used by the lighting ( daylighting + electric lighting ) design community and by LightLouver LLC regarding the LightLouver™ Daylighting System. LightLouver LLC staff have assembled the following glossary of lighting / daylighting terms to support our independent sales teams and to assist our customers.

### Glossary of Lighting / Daylighting Terms

**AMPERE:** The standard unit of measurement for electric current that is equal to one coulomb per second. It defines the quantity of electrons moving past a given point in a circuit during a specific period. Amp is an abbreviation.

**ANSI:** Abbreviation for American National Standards Institute.

**ARC TUBE:** A tube enclosed by the outer glass envelope of a HID lamp and made of clear quartz or ceramic that contains the arc stream.

**ASHRAE:** American Society of Heating, Refrigerating and Air-Conditioning Engineers

**BAFFLE:** A single opaque or translucent element used to control light distribution at certain angles.

**BALLAST:** A device used to operate fluorescent and HID lamps. The ballast provides the necessary starting voltage, while limiting and regulating the lamp current during operation.

**BALLAST CYCLING:** Undesirable condition under which the ballast turns lamps on and off (cycles) due to the overheating of the thermal switch inside the ballast. This may be due to incorrect lamps, improper voltage being supplied, high ambient temperature around the fixture, or the early stage of ballast failure.

**BALLAST EFFICIENCY FACTOR:** The ballast efficiency factor (BEF) is the ballast factor (see below) divided by the input power of the ballast. The higher the BEF ( within the same lamp-ballast type ( the more efficient the ballast.

**BALLAST FACTOR:** The ballast factor (BF) for a specific lamp-ballast combination represents the percentage of the rated lamp lumens that will be produced by the combination.

**CANDELA:** Unit of luminous intensity, describing the intensity of a light source in a specific direction.

**CANDELA DISTRIBUTION:** A curve, often on polar coordinates, illustrating the variation of luminous intensity of a lamp or luminaire in a plane through the light center.

**CANDLEPOWER:** A measure of luminous intensity of a light source in a specific direction, measured in candelas (see above).

**CBM:** Abbreviation for Certified Ballast Manufacturers Association.

**CEC:** Abbreviation for California Energy Commission.

**COEFFICIENT OF UTILIZATION:** The ratio of lumens from a luminaire received on the work plane to the lumens produced by the lamps alone. (Also called "CU")

**COLOR RENDERING INDEX (CRI):** A scale of the effect of a light source on the color appearance of an object compared to its color appearance under a reference light source. Expressed on a scale of 1 to 100, where 100 indicates no color shift. A low CRI rating suggests that the colors of objects will appear unnatural under that particular light source.

**COLOR TEMPERATURE:** The color temperature is a specification of the color appearance of a light source, relating the color to a reference source heated to a particular temperature, measured by the thermal unit Kelvin. The measurement can also be described as the "warmth" or "coolness" of a light source. Generally, sources below 3200K are considered "warm;" while those above 4000K are considered "cool" sources.

**COMPACT FLUORESCENT:** A small fluorescent lamp that is often used as an alternative to incandescent lighting. The lamp life is about 10 times longer than incandescent lamps and is 3-4 times more efficacious. Also called PL, Twin-Tube, CFL, or BIAX lamps.

**CONSTANT WATTAGE (CW) BALLAST:** A premium type of HID ballast in which the primary and secondary coils are isolated. It is considered a high performance, high loss ballast featuring excellent output regulation.

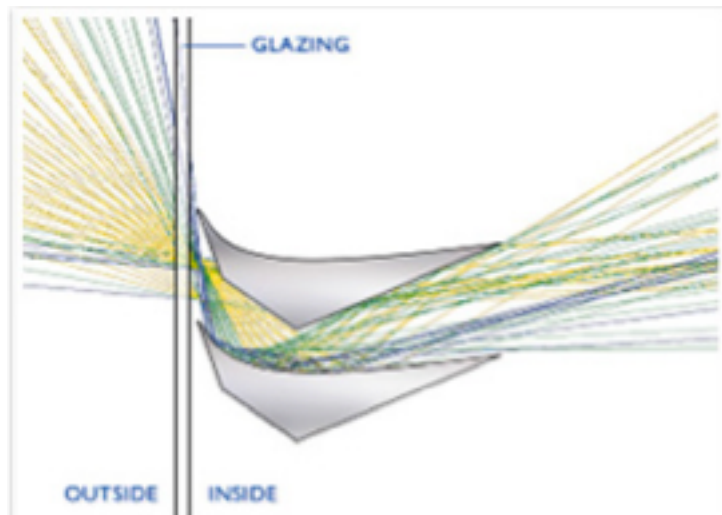
**CONSTANTWATTAGE AUTOTRANSFORMER (CWA) BALLAST:** A popular type of HID ballast in which the primary and secondary coils are electrically connected. Considered an appropriate balance between cost and performance.

**CONTRAST:** The relationship between the luminance of an object and its background.

**CRI: (SEE COLOR RENDERING INDEX)**

**CUT-OFF ANGLE:** The angle from a fixture's vertical axis at which a reflector, louver, or other shielding device cuts off direct visibility of a lamp. It is the complementary angle of the shielding angle.

As used regarding the LightLouver Daylighting System, it is the solar altitude angle above which all rays of sunlight will be directed in an upward direction. LightLouver reflective slats have a 5 degree cut-off angle, as shown below in a cross section of several LightLouver reflective slats.



**DAYLIGHT COMPENSATION:** A dimming system controlled by a photocell that reduces the output of the lamps when daylight is present. As daylight levels increase, lamp intensity decreases. An energy-saving technique used in areas with significant daylight contribution.

**DAYLIGHT PERFORMANCE METRICS:** A metric which defines the contribution / performance of a daylighting system in meeting the illumination requirements of an architectural space. Four daylight performance metrics are presented below.

**DAYLIGHT AUTONOMY:** Represented as a percentage of annual daytime hours that various grid points in a space are above a specified illumination threshold. It originally was proposed by the Association Suisse des Electriciens in 1989 and was improved by Christoph Reinhart from 2001 to 2004. It is a major innovation because it considers location-specific weather information on an annual basis. It also can directly relate to electric lighting energy savings if the threshold set is based on electric lighting criteria.

**DAYLIGHT FACTOR (DF):** A ratio that represents the amount of illumination indoors relative to outdoors at the same time. It typically is calculated by dividing a value of horizontal work plane illumination by the horizontal illumination available as measured horizontally on the roof of the building being tested. DF was developed at the beginning of the 20th century independently by A.P. Trotter and Percy J. Waldram, and was formalized by Waldram and his son in 1923 in a paper entitled, "The Natural and Artificial Lighting of Buildings," which appeared in the *Journal of the Royal Institute of British Architects*, Vol. XXXII, No. 13, pp. 405–426 and 441–446.

**USEFUL DAYLIGHT ILLUMINANCE:** A modification of Daylight Autonomy conceived by architectural researcher John Mardaljevic in 2005. This metric bins hourly time values based on three illumination ranges, 0–100 lux, 100–2000 lux, and over 2000 lux.

**DAYLIGHT SATURATION PERCENTAGE:** A modification of Useful Daylight Illuminance that modifies the lower limit to 40 footcandles and increases the upper limit to 400 footcandles. It goes further to penalize grid point annual hour values above 400 footcandles by forcing them to be subtracted from the grid point annual hour values above 40 footcandles and below 400 footcandles. The Lighting and Daylighting Committee for the Collaborative for High Performance Schools program (CHPS) developed it in 2006.

**DIFFUSE:** Term describing dispersed light distribution. Refers to the scattering or softening of light.

**DIFFUSER:** A translucent piece of glass or plastic sheet that shields the light source in a fixture. The light transmitted throughout the diffuser will be redirected and scattered.

**DIRECT GLARE:** Glare produced by a direct view of light sources. Often the result of insufficiently shielded light sources. (See GLARE)

**DOWNLIGHT:** A type of ceiling luminaire, usually fully recessed, where most of the light is directed downward. May feature an open reflector and/or shielding device.

**EFFICACY:** A metric used to compare light output to energy consumption. Efficacy is measured in lumens per watt. Efficacy is similar to efficiency, but is expressed in dissimilar units. For example, if a 100-watt source produces 9000 lumens, then the efficacy is 90 lumens per watt.

**ELECTROLUMINESCENT:** A light source technology used in exit signs that provides uniform brightness, long lamp life (approximately eight years), while consuming very little energy (less than one watt per lamp).

**ELECTRONIC BALLAST:** A ballast that uses semi-conductor components to increase the frequency of fluorescent lamp operation ( typically in the 20-40 kHz range. Smaller inductive components provide the lamp current control. Fluorescent system efficiency is increased due to high frequency lamp operation.

**ELECTRONIC DIMMING BALLAST:** A variable output electronic fluorescent ballast.

**EMI:** Abbreviation for electromagnetic interference. High frequency interference (electrical noise) caused by electronic components or fluorescent lamps that interferes with the operation of electrical equipment. EMI is measured in microvolts, and can be controlled by filters. Because EMI can interfere with communication devices, the Federal Communication Commission (FCC) has established limits for EMI.

**ENERGY-SAVING BALLAST:** A type of magnetic ballast designed so that the components operate more efficiently, cooler and longer than a "standard magnetic" ballast. By US law, standard magnetic ballasts can no longer be manufactured.

**ENERGY-SAVING LAMP:** A lower wattage lamp, generally producing fewer lumens.

**FC:** (SEE FOOTCANDLE)

**FLUORESCENT LAMP:** A light source consisting of a tube filled with argon, along with krypton or other inert gas. When electrical current is applied, the resulting arc emits ultraviolet radiation that excites the phosphors inside the lamp wall, causing them to radiate visible light.

**FOOTCANDLE (FC):** The English unit of measurement of the illuminance (or light level) on a surface. One footcandle is equal to one lumen per square foot.

**FOOTLAMBERT:** English unit of luminance. One footlambert is equal to 1/p candelas per square foot.

**GLARE:** The effect of brightness or differences in brightness within the visual field sufficiently high to cause annoyance, discomfort or loss of visual performance.

**HALOGEN:** (SEE TUNGSTEN HALOGEN LAMP)

**HARMONIC DISTORTION:** A harmonic is a sinusoidal component of a periodic wave having a frequency that is a multiple of the fundamental frequency. Harmonic distortion from lighting equipment can interfere with other appliances and the operation of electric power networks. The total harmonic distortion (THD) is usually expressed as a percentage of the fundamental line current. THD for 4-foot fluorescent ballasts usually range from 20% to 40%. For compact fluorescent ballasts, THD levels greater than 50% are not uncommon.

**HID:** Abbreviation for high intensity discharge. Generic term describing mercury vapor, metal halide, high pressure sodium, and (informally) low pressure sodium light sources and luminaires.

**HIGH BAY:** Pertains to the type of lighting in an industrial application where the ceiling is 20 feet or higher. Also describes the application itself.

**HIGH OUTPUT (HO):** A lamp or ballast designed to operate at higher currents (800 mA) and produce more light.

**HIGH POWER FACTOR:** A ballast with a 0.9 or higher rated power factor, which is achieved by using a capacitor.

**HIGH PRESSURE SODIUM LAMP:** A high intensity discharge (HID) lamp whose light is produced by radiation from sodium vapor (and mercury).

**HOT RESTART or HOT RESTRIKE:** The phenomenon of re-striking the arc in an HID light source after a momentary power loss. Hot restart occurs when the arc tube has cooled a sufficient amount.

**IESNA:** Abbreviation for Illuminating Engineering Society of North America.

**ILLUMINANCE:** A photometric term that quantifies light incident on a surface or plane. Illuminance is commonly called light level. It is expressed as lumens per square foot (footcandles), or lumens per square meter (lux).

**INDIRECT GLARE:** Glare produced from a reflective surface.

**INSTANT START:** A fluorescent circuit that ignites the lamp instantly with a very high starting voltage from the ballast. Instant start lamps have single-pin bases.

**LAMP CURRENT CREST FACTOR (LCCF):** The peak lamp current divided by the RMS (average) lamp current. Lamp manufacturers require  $<1.7$  for best lamp life. An LCCF of 1.414 is a perfect sine wave.

**LAMP LUMEN DEPRECIATION FACTOR (LLD):** A factor that represents the reduction of lumen output over time. The factor is commonly used as a multiplier to the initial lumen rating in illuminance calculations, which compensates for the lumen depreciation. The LLD factor is a dimensionless value between 0 and 1.

**LAY-IN-TROFFER:** A fluorescent fixture; usually a 2' x 4' fixture that sets or "lays" into a specific ceiling grid.

**LED:** Abbreviation for light emitting diode. An illumination technology used for exit signs. Consumes low wattage and has a rated life of greater than 80 years.

**LENS:** Transparent or translucent medium that alters the directional characteristics of light passing through it. Usually made of glass or acrylic.

**LIGHT LOSS FACTOR (LLF):** Factors that allow for a lighting system's operation at less than initial conditions. These factors are used to calculate maintained light levels. LLFs are divided into two categories, recoverable and non-recoverable. Examples are lamp lumen depreciation and luminaire surface depreciation.

**LIFE-CYCLE COST:** The total costs associated with purchasing, operating, and maintaining a system over the life of that system.

**LOUVER:** Grid type of optical assembly used to control light distribution from a fixture. Can range from small-cell plastic to the large-cell anodized aluminum louvers used in parabolic fluorescent fixtures.

**LOW POWER FACTOR:** Essentially, an uncorrected ballast power factor of less than 0.9 (SEE NPF)

**LOW-PRESSURE SODIUM:** A low-pressure discharge lamp in which light is produced by radiation from sodium vapor. Considered a monochromatic light source (most colors are rendered as gray).

**LOW-VOLTAGE LAMP:** A lamp ( typically compact halogen ) that provides both intensity and good color rendition. Lamp operates at 12V and requires the use of a transformer. Popular lamps are MR11, MR16, and PAR36.

**LOW-VOLTAGE SWITCH:** A relay (magnetically-operated switch) that allows local and remote control of lights, including centralized time clock or computer control.

**LUMEN:** A unit of light flow, or luminous flux. The lumen rating of a lamp is a measure of the total light output of the lamp.

**LUMINAIRE:** A complete lighting unit consisting of a lamp or lamps, along with the parts designed to distribute the light, hold the lamps, and connect the lamps to a power source. Also called a fixture.

**LUMINAIRE EFFICIENCY:** The ratio of total lumen output of a luminaire and the lumen output of the lamps, expressed as a percentage. For example, if two luminaires use the same lamps, more light will be emitted from the fixture with the higher efficiency.

**LUMINANCE:** A photometric term that quantifies brightness of a light source or of an illuminated surface that reflects light. It is expressed as footlamberts (English units) or candelas per square meter (Metric units).

**LUX (LX):** The metric unit of measure for illuminance of a surface. One lux is equal to one lumen per square meter. One lux equals 0.093 footcandles.

**MAINTAINED ILLUMINANCE:** Refers to light levels of a space at other than initial or rated conditions. This term considers light loss factors such as lamp lumen depreciation, luminaire dirt depreciation, and room surface dirt depreciation.

**MERCURY VAPOR LAMP:** A type of high intensity discharge (HID) lamp in which most of the light is produced by radiation from mercury vapor. Emits a blue-green cast of light. Available in clear and phosphor-coated lamps.

**METAL HALIDE:** A type of high intensity discharge (HID) lamp in which most of the light is produced by radiation of metal halide and mercury vapors in the arc tube. Available in clear and phosphor-coated lamps.

**MR-16:** A low-voltage quartz reflector lamp, only 2" in diameter. Typically the lamp and reflector are one unit, which directs a sharp, precise beam of light.

**NADIR:** A reference direction directly below a luminaire, or "straight down" (0 degree angle).

**NEMA:** Abbreviation for National Electrical Manufacturers Association.

**NIST:** Abbreviation for National Institute of Standards and Technology.

**NPF (NORMAL POWER FACTOR):** A ballast/lamp combination in which no components (e.g., capacitors) have been added to correct the power factor, making it normal (essentially low, typically 0.5 or 50%).

**OCCUPANCY SENSOR:** Control device that turns lights off after the space becomes unoccupied. May be ultrasonic, infrared or other type.

**OPTICS:** A term referring to the components of a light fixture (such as reflectors, refractors, lenses, louvers) or to the light emitting or light-controlling performance of a fixture.

**PAR LAMP:** A parabolic aluminized reflector lamp. An incandescent, metal halide, or compact fluorescent lamp used to redirect light from the source using a parabolic reflector. Lamps are available with flood or spot distributions.

**PAR 36:** A PAR lamp that is 36 one-eighths of an inch in diameter with a parabolic shaped reflector (SEE PAR LAMP).

**PARABOLIC LUMINAIRE:** A popular type of fluorescent fixture that has a louver composed of aluminum baffles curved in a parabolic shape. The resultant light distribution produced by this shape provides reduced glare, better light control, and is considered to have greater aesthetic appeal.

**PARACUBE:** A metallic coated plastic louver made up of small squares. Often used to replace the lens in an installed troffer to enhance its appearance. The paracube is visually comfortable, but the luminaire efficiency is lowered. Also used in rooms with computer screens because of their glare-reducing qualities.

**PHOTOCELL:** A light sensing device used to control luminaires and dimmers in response to detected light levels.

**PHOTOMETRIC REPORT:** A photometric report is a set of printed data describing the light distribution, efficiency, and zonal lumen output of a luminaire. This report is generated from laboratory testing.

**POWER FACTOR:** The ratio of AC volts x amps through a device to AC wattage of the device. A device such as a ballast that measures 120 volts, 1 amp, and 60 watts has a power factor of 50% (volts x amps = 120 VA, therefore 60 watts/120 VA = 0.5). Some utilities charge customers for low power factor systems.

**PREHEAT:** A type of ballast/lamp circuit that uses a separate starter to heat up a fluorescent lamp before high voltage is applied to start the lamp.

**QUAD-TUBE LAMP:** A compact fluorescent lamp with a double twin tube configuration.

**RADIO FREQUENCY INTERFERENCE (RFI):** Interference to the radio frequency band caused by other high frequency equipment or devices in the immediate area. Fluorescent lighting systems generate RFI.

**RAPID START (RS):** The most popular fluorescent lamp/ballast combination used today. This ballast quickly and efficiently preheats lamp cathodes to start the lamp. Uses a "bi-pin" base.

**ROOM CAVITY RATIO (RCR):** A ratio of room dimensions used to quantify how light will interact with room surfaces. A factor used in illuminance calculations.

**REFLECTANCE:** The ratio of light reflected from a surface to the light incident on the surface. Reflectances are often used for lighting calculations. The reflectance of a dark carpet is around 20%, and a clean white wall is roughly 50% to 60%.

**REFLECTOR:** The part of a light fixture that shrouds the lamps and redirects some light emitted from the lamp.

**REFRACTOR:** A device used to redirect the light output from a source, primarily by bending the waves of light.

**RECESSED:** The term used to describe the doorframe of a troffer where the lens or louver lies above the surface of the ceiling.

**REGULATION:** The ability of a ballast to hold constant (or nearly constant) the output watts (light output) during fluctuations in the voltage feeding of the ballast. Normally specified as +/- percent change in output compared to +/- percent change in input.

**RELAY:** A device that switches an electrical load on or off based on small changes in current or voltage. Examples: low voltage relay and solid state relay.

**RETROFIT:** Refers to upgrading a fixture, room, or building by installing new parts or equipment.

**SELF-LUMINOUS EXIT SIGN:** An illumination technology using phosphor-coated glass tubes filled with radioactive tritium gas. The exit sign uses no electricity and thus does not need to be hardwired.

**SEMI-SPECULAR:** Term describing the light reflection characteristics of a material. Some light is reflected directionally, with some amount of scatter.

**SHIELDING ANGLE:** The angle measured from the ceiling plane to the line of sight where the bare lamp in a luminaire becomes visible. Higher shielding angles reduce direct glare. It is the complementary angle of the cutoff angle. (See CUTOFF ANGLE).

**SPACING CRITERION:** A maximum distance that interior fixtures may be spaced that ensures uniform illumination on the work plane. The luminaire height above the work plane multiplied by the spacing criterion equals the center-to-center luminaire spacing.

**SPECULAR:** Mirrored or polished surface. The angle of reflection is equal to the angle of incidence. This word describes the finish of the material used in some louvers and reflectors.

**STARTER:** A device used with a ballast to start preheat fluorescent lamps.

**STROBOSCOPIC EFFECT:** Condition where rotating machinery or other rapidly moving objects appear to be standing still due to the alternating current supplied to light sources. Sometimes called "strobe effect."

**T12 LAMP:** Industry standard for a fluorescent lamp that is 12 one-eighths (1 inches) in diameter. Other sizes are T10 (1 inches) and T8 (1 inch) lamps.

**TANDEM WIRING:** A wiring option in which a ballast is shared by two or more luminaires. This reduces labor, materials, and energy costs. Also called "master-slave" wiring.

**THERMAL FACTOR:** A factor used in lighting calculations that compensates for the change in light output of a fluorescent lamp due to a change in bulb wall temperature. It is applied when the lamp-ballast combination under consideration is different from that used in the photometric tests.

**TRIGGER START:** Type of ballast commonly used with 15-watt and 20-watt straight fluorescent lamps.

**TROFFER:** The term used to refer to a recessed fluorescent light fixture (combination of trough and coffer).

**TUNGSTEN HALOGEN LAMP:** A gas-filled tungsten filament incandescent lamp with a lamp envelope made of quartz to withstand the high temperature. This lamp contains some halogens (namely iodine, chlorine, bromine, and fluorine), which slow the evaporation of the tungsten. Also, commonly called a quartz lamp.

**TWIN-TUBE: (SEE COMPACT FLUORESCENT LAMP)**

**ULTRA VIOLET (UV):** Invisible radiation that is shorter in wavelength and higher in frequency than visible violet light (literally beyond the violet light).

**UNDERWRITERS' LABORATORIES (UL):** An independent organization whose responsibilities include rigorous testing of electrical products. When products pass these tests, they can be labeled (and advertised) as "UL listed." UL tests for product safety only.

**VANDAL-RESISTANT:** Fixtures with rugged housings, break-resistant type shielding, and tamper-proof screws.

**VCP:** Abbreviation for visual comfort probability. A rating system for evaluating direct discomfort glare. This method is a subjective evaluation of visual comfort expressed as the percent of occupants of a space who will be bothered by direct glare. VCP allows for several factors: luminaire luminances at different angles of view, luminaire size, room size, luminaire mounting height, illuminance, and room surface reflectivity. VCP tables are often provided as part of photometric reports.

**VERY HIGH OUTPUT (VHO):** A fluorescent lamp that operates at a "very high" current (1500 mA), producing more light output than a "high output" lamp (800 mA) or standard output lamp (430 mA).

**VOLT:** The standard unit of measurement for electrical potential. It defines the "force" or "pressure" of electricity.

**VOLTAGE:** The difference in electrical potential between two points of an electrical circuit.

**WALLWASHER:** Describes luminaires that illuminate vertical surfaces.

**WATT (W):** The unit for measuring electrical power. It defines the rate of energy consumption by an electrical device when it is in operation. The energy cost of operating an electrical device is calculated as its wattage times the hours of use. In single phase circuits, it is related to volts and amps by the formula: Volts x Amps x PF = Watts. (Note: For AC circuits, PF must be included.)

**WORK PLANE:** The level at which work is done and at which illuminance is specified and measured. For office applications, this is typically a horizontal plane 30 inches above the floor (desk height).

**ZENITH:** The direction directly above the luminaire (180 angle).