

# Appendix

## Lamp Sizing Guide

### Lamp Size/Diameter

The diameter of a lamp, at its maximum dimension, is expressed in eighths of an inch. Examples: The diameter of an A19 lamp is 19-eighths of an inch, or 2-3/8", at its widest point. A T8 lamp has a diameter of 8-eighths, or one inch.

### Light Center Length (L.C.L.)

The distance between the center of the filament, or arc tube, and a reference plane — usually the bottom of the lamp base. See L.C.L. Reference Plane Location chart below.

### L.C.L. Reference Plane Location

Base Type	Location
All Screw Bases (except Mini-Can.)	Bottom of base contact
Mini-Can	Where diameter of ceramic base insulator is .531 inches
3-Contact Medium	Bottom of base contact
Mogul Medium Prefocus	Top of base fins
Mogul Prefocus	Top of base fins
Medium BiPost	Base end of bulb (Glass lamps) Bottom of ceramic base (Quartz lamps)
Mogul BiPost	Shoulder of posts (Glass lamps) Bottom of ceramic base (Quartz lamps)
2-Pin Prefocus	Bottom of ceramic base.
S.C. or D.C. Bayonet Candelabra	Top of base pins
Medium Bayonet	Top of base pins
S.C. or D.C. Prefocus	Plane of locating bosses on prefocus collar
Medium 2-Pin	Bottom of metal base shell

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

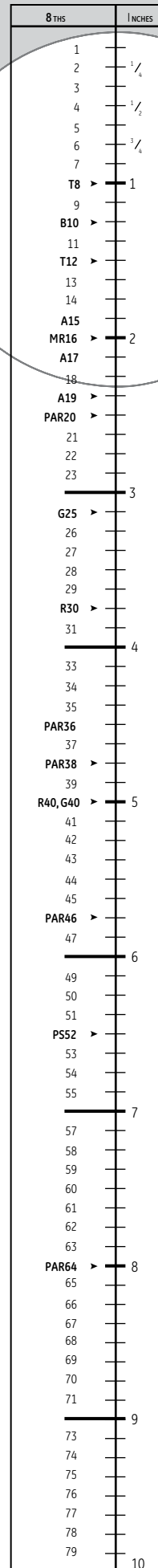
The end-to-end measurement of a lamp, expressed in inches or millimeters.

## Important Notice

This catalog is a compilation of accumulated data. Additional information is constantly being uncovered through research and testing, which may modify the data given herein. This is particularly true of newer lamps and ballasts. Accordingly, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE. For the latest lamp and ballast design data and information, contact your GE Representative.

The data and suggested applications contained in this catalog, as well as any additional information our representative may be able to furnish, are for general information only and are not intended and should not be taken as representations or warranties as to the suitability of a lamp or ballast for any particular application or use in any particular equipment, nor are our representatives authorized to make any such warranties. Applications and conditions of use are many and varied, and beyond our control. We cannot possibly have the same degree of knowledge that the purchaser has with respect to the design of his equipment and the conditions of its use. Therefore, it is up to the purchaser to make his own determination as to the suitability of a lamp or ballast for his intended application or use and to assume the responsibility for that determination.

General Electric desires to supply the best possible products at all times. For this reason, General Electric reserves the right to make changes in its products, and to introduce new products or discontinue existing ones without notice.



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Incandescent  
Halogen  
High Intensity Discharge  
Fluorescent  
Compact Fluorescent  
Ballast  
LED Lamps and Systems  
Stage and Studio  
Miniature and Sealed Beam  
Projection

**Electrode**

Any metal terminal emitting or collecting charged particles, typically inside the chamber of a gas discharge lamp. In a fluorescent lamp, the electrodes are typically metal filaments coated with special powders called emission mix. Negatively charged free electrons emitted by one electrode are attracted to the positive electrode (anode), creating an electric current and arc between electrodes.

**Electrodeless Lamps**

Light sources where the discharge occurs in a chamber with no electrodes (no metal). The energy for the discharge is supplied by radio frequency excitation, e.g. microwave (see INDUCTION LIGHTING and GENURA®).

**Electromagnetic Ballast** (see MAGNETIC BALLAST).

**Electromagnetic Spectrum**

A continuum of electric and magnetic radiation that can be 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.

**Electromagnetic Interference (EMI)**

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

**Electronic Ballast**

A short name for a fluorescent high-frequency electronic ballast. Electronic ballasts use solid-state electronic components and typically operate fluorescent lamps at frequencies greater than 25 kHz. The benefits are: increased lamp efficacy, reduced ballast losses and lighter, smaller ballasts compared to electromagnetic ballasts. Electronic ballasts may also be used with HID (high intensity discharge) lamps (see MAGNETIC BALLASTS).

**Electronic HID Ballast**

An electronic ballast capable of operating an HID lamp. GE’s UltraMax® (electronic HID ballast) operates PulseArc® (metal halide) and CMH® (ceramic metal halide) lamps between 250W and 400W and provides higher efficiency and significantly improved lumen maintenance over magnetic ballasts.

**Elliptical Reflector (ER) Lamp**

An incandescent lamp with a built-in elliptically shaped reflecting surface. This shape produces a focal point directly in front of the lamp which reduces light absorption in some types of luminaires. It is particularly effective at increasing the efficiency of baffled downlights.

**Energy Policy Act (EPACT)**

Comprehensive energy legislation passed by the U. S. Congress. The lighting portion includes lamp labeling and minimum energy efficacy (lumens/ watt) requirements for many commonly used incandescent and fluorescent lamp types. Federal Canadian legislation sets similar minimum energy efficacy requirements for incandescent reflector lamps and common linear fluorescent lamps.

**Dimmer, Dimming Control**

A device used to lower the light output of a source, usually by reducing the wattage it is being operated at. Dimming controls are increasing in popularity as energy conserving devices.

**Discharge Lamp**

A lamp where light is emitted from an electrical discharge between two electrodes as opposed to a filament lamp. Examples are: Fluorescent lamps and HID (High Intensity Discharge) lamps like Metal Halide, Mercury and High Pressure Sodium. All discharge lamps require some kind of current-limiting device, e.g. a ballast, to operate them.

**Ecolux®**

A term for GE lamps that have reduced mercury content and pass the TCLP test.

**Edison**

GE’s trademark for a wide range of halogen lamps for the consumer market.

**Efficacy**

A measurement of how effective the 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 regions where the eye is not as sensitive. 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.

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The efficiency of a luminaire or fixture is the percentage of the lamp lumens that actually comes out of the fixture (see LUMINAIRE EFFICIENCY).

**Efficiency of Ballast**

The ratio of output power divided by input power. A premium ballast would have an electrical efficiency greater than 90%. The efficiency of a luminaire or fixture is the percentage of the lamp lumens that actually comes out of the fixture.

**e-HID ballast** (see ELECTRONIC HID BALLAST).

**Electrical Discharge**

A condition under which a gas becomes electrically conducting and becomes capable of transmitting current, usually accompanied by the emission of visible and other radiation. An electric spark in air is an example of an electrical discharge, as is a welder’s arc and a lightning bolt.

**Electrical Testing Laboratory (ETL)**

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

**Color Rendering Index (CRI)**

An international system used to rate a lamp’s ability to render object colors. The higher the CRI (based upon a 0-100 scale) the richer colors generally appear. CRI ratings of various lamps may be compared, but a numerical comparison is only valid if the lamps are close in color temperature. CRI differences among lamps are not usually significant (visible to the eye) unless the difference is more than 3–5 points.

**Color Temperature (Correlated Color Temperature – CCT)**

A number indicating the degree of “yellowness” or “blueness” of a white light source. Measured in kelvins, CCT represents the temperature an incandescent object (like a filament) must reach to mimic the color of the lamp. Yellowish-white (“warm”) sources, like incandescent lamps, have lower color temperatures in the 2700K–3000K range; white and bluish-white (“cool”) sources, such as cool white (4100K) and natural daylight (6000K), have higher color temperatures. The higher the color temperature the whiter, or bluer, the light will be.

**Compact Fluorescent Lamp (CFL)**

The general term applied to fluorescent lamps that are single-ended and that have smaller diameter tubes that are bent to form a compact shape. Some CFLs have integral ballasts and medium or candelabra screw bases for easy replacement of incandescent lamps.

**ConstantColor®**

A GE registered name for lamp families that show very little color shift over life, such as GE’s Precise™ MR16 lamps and GE’s ceramic metal halide (CMH®) lamps.

**Cool White**

A term loosely used to denote a color temperature of around 4100K. The Cool White (CW) designation is used specifically for T12 and other fluorescent lamps using halophosphors and having a CRI of 62.

**Core**

Component of electromagnetic ballast that is surrounded by the coil. Core is comprised of steel laminations or solid ferrite material.

**Core & Coil Ballast**

A ballast that uses a “Core & Coil” assembly to operate fluorescent or HID lamps. Refers to copper or aluminum windings on a steel core.

**Cost of Light**

Usually refers to the cost of operating and maintaining a lighting system on an ongoing basis. The 88-8-4 rule states that (typically) 88% is the cost of electricity, 8% is labor and only 4% is the cost of lamps.

**covRguard®**

A lamp encased by a plastic sleeve or coating to help contain glass fragments if the lamp breaks.

**Crest Factor (Lamp Current Crest Factor)**

Ratio of peak to RMS for any AC waveform. Crest factor can refer to voltage crest factor or current crest factor.

**Current Type (AC/DC)**

Whether the operational voltage is based on Alternating Current or Direct Current.

**Daylight Harvesting**

Lighting design for building interiors that makes use of daylight as a way of reducing energy consumption.

**Candela (cd)**

The measure of luminous intensity of a source in a given direction. The term has been retained from the early days of lighting when a standard candle of a fixed size and composition was defined as producing one candela in every direction. A plot of intensity versus direction is called a candela distribution curve and is often provided for reflectorized lamps and for luminaires with a lamp operating in them.

**Candlepower**

An obsolete term for luminous intensity; current practice is to refer to this simply as candelas (see CANDELA).

**Candlepower Distribution Curve**

A graphical presentation of the distribution of light intensity of a light source, usually a reflector lamp or luminaire.

**Capacitor**

Device in ballast that stores electrical energy. Often used for power factor correction and lamp regulation.

**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 (see ELECTRODE).

**Cathode Resistance**

Resistance of the cathode in a Fluorescent lamp. It is measured “cold” before the lamp is turned on (Rc) or “hot” after the lamp is turned on (Rh). The ratio of the hot resistance to the cold resistance is also measured (Rh/Rc).

**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 (see CANDELA).

**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. GE ConstantColor® CMH® lamps feature a 3-piece arc tube design that delivers excellent color consistency and lamp reliability.

**ChromaFit™**

A GE brand name for metal halide lamps designed to operate on HPS ballasts, allowing a user to switch from the yellowish color of HPS to the white color of metal halide without retrofitting ballasts. These products are available in both quartz metal halide and ceramic metal halide (CMH®) versions.

**Class P Thermal Protector**

A switching device sensitive to current and heat that automatically disconnects ballast if the temperature exceeds UL temperature limitations.

**Coefficient of Utilization (CU)**

In general lighting calculations, the fraction of initial lamp lumens that reach the work plane. CU is a function of luminaire efficiency, room surface reflectances and room shape.

**Coil**

Windings of copper or aluminum wire surrounding the steel core in ballast. Also refers to the entire assembly comprising the inductor or transformer.

## Glossary of Terms

**Ambient Temperature**

Light output of fluorescent lamps depends on ambient temperature which refers to the temperature inside the fixture in the air surrounding the fluorescent lamp.

**Amperes**

(“Amps”) A measure of electrical current. In incandescent lamps, the current is related to voltage and power as follows: Watts (power) = Volts x Amps (current).

**ANSI (American National Standards Institute)**

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 Ballast Type**

A reference to the ANSI document describing the lamp which also lists the characteristics of the ballast required to operate the lamp. The following naming system is used: H – mercury lamps; M – metal halide lamps; S – high pressure sodium lamps; L – low pressure sodium lamps.

**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 similarly coded lamps from various manufacturers.

General Electric uses the assigned ANSI Codes as lamp ordering codes for most projection lamps.

**Auto Reset Shutdown Circuit**

Circuit senses lamp end life and will automatically shut off power to the lamp(s). When a new lamp is inserted in the socket, the ballast resets, and turns on the lamp automatically. Some shutdown circuits require the power to be cycled before a new lamp will re-light.

**Ballast**

An auxiliary piece of equipment required to start and to properly control the flow of current to gas discharge light sources such as fluorescent and high intensity discharge (HID) lamps. 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)**

Defined as ballast factor x 100 divided by input watts. The value is used to evaluate various lighting systems based on light output and power input. The BEF can only be used to compare systems operating the same type and quantity of lamps.

**Ballast Factor (BF)**

This is the percentage of a lamp’s rated lumen output that can be expected when operated on a specific, commercially available ballast. Note that the “rated output” is sometimes measured on a reference ballast unlike ones that actually operate the lamp in the field. 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.

**Ballast Hum**

Sound generated by the vibration of laminations in the iron core of the transformer or inductor present in the ballast.

**Ballast Losses**

Power or energy dissipated in the ballast as heat and not converted to lamp energy.

**Base Temperature (Maximum)**

The maximum operating temperature permitted for the base in Celsius. Fixture manufacturers need to ensure that these conditions are satisfied in their fixture.

**Beam 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 50% of maximum. The beam angle (sometimes called “beam spread”) is often part of the ordering code for reflectorized lamps. Example: The 50PAR30/HIR/ NFL25 is a 50 watt PAR30 narrow flood lamp with a beam angle of 25 degrees, i.e. 12.5 degrees on either side of the center (see FIELD ANGLE).

**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 that connect into the fixture. Medium bi-pins are used with type T-8 and T-12 tubular fluorescent lamps, and miniature bi-pins are used for tubular T-5 fluorescent lamps.

**Biax®**

GE trademark for its biaxial family of high-efficiency and long-life compact fluorescent lamps. DBX (Double Biax), TBX (Triple Biax) and QBX (Quad Biax) refer to the number of U-shaped legs present in the lamp.

**Bottom Exit (BE)**

(CFL plug-in ballasts) A configuration with leads or a wire-trap on the bottom or base of the ballast. This type of configuration is usually used when the ballast is mounted onto a junction box plate.

**Bottom Exit Studs (BES)**

(LFL plug-in ballasts) A configuration with screw studs mounted on the base plate or bottom of the ballast. The screws are 3/8” inches long with a #8-32 thread size (#8-32 nut). They are mounted on a two-inch center. The studs are usually used to mount the ballast directly onto a junction box plate.

**Bulb Size**

Bulb shape followed by its size (the maximum diameter of the bulb expressed in eighths of an inch). For Compact Fluorescent products, “S”, “D”, “T”, and “Q” are used to represent Single, Double, Triple and Quad Biax® sizes. The code also includes a reference such as T4 to represent the size of the tube. Rectangular headlamps are designated as “Rect” and the number of millimeters horizontally.

**Canadian Energy Standards**

Indicates ballast complies with Canadian Energy Standards and meets the requirements of CAN/ CSA C654-M91.

**Canadian Standards Association (CSA)**

Association that generates product performance and safety standards for many Canadian industries.

# Glossary of Terms

## ENERGY STAR®

U.S. Department of Energy (DOE) designation for products meeting certain energy efficiency and performance standards. Among manufacturers of compact fluorescent lamps, GE has the largest number of ENERGY STAR® products as listed on the Federal Government’s website.

## EOL (End-of-Life Protection)

A circuit that senses that a lamp has reached end of life (compact fluorescent lamps and small-diameter linear fluorescent lamps) and turns off power to the lamp. Continuing to power the lamp beyond end of life can result in overheating of the lamp ends.

## 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 at frequencies greater than 450 kilohertz (kHz). A consumer-rated Class B ballast is designed for use in the home near TV and radio receivers. It produces less electrical noise that could interfere with consumer products. A Class A-rated ballast is designed for use in commercial and industrial applications that are not in the vicinity of TV and radio receivers.

## 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).

## Flicker

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

## Fluorescent HO

Fluorescent HO and VHO lamps require special ballasts that generate higher currents than standard ballasts and operate the lamps at higher wattage than standard lamps. These lamps are generally less efficient than the standard product. Metal Halide HO and XHO lamps operate on the same ballasts as standard lamps and at the same wattage but are more efficient and produce higher light output than standard lamps.

## Fluorescent Lamp

A high efficiency lamp utilizing an electric discharge through low pressure mercury vapor to produce ultra-violet (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 (see LUX).

## Four-Pin Compact Fluorescent Lamps

A “plug-in” compact fluorescent lamp with 4 pins in the base to make electrical contact with the ballast. Four-pin lamps can be dimmed on appropriate dimming ballasts while two-pin lamps cannot.

## 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 lamps that have a smooth and continuous color spectrum.

## Genura®

GE’s electrodeless compact fluorescent lamp, Genura®, uses induction to power the discharge. The chamber generates UV (just like a discharge in a regular fluorescent lamp) that is converted by phosphors to visible light. Because Genura® uses no electrodes, the life of this unique reflector lamp is longer than typical compact fluorescent products (see INDUCTION LIGHTING).

## Glare

Visual discomfort caused by excessive brightness is called discomfort glare. If task performance is affected it is called disability glare. Glare can be direct glare or indirect (reflected) glare.

## Group Relamping

The practice of replacing all the lamps at an installation at one time with new lamps when the lamps have operated for (typically) 65% to 70% of rated life. The two benefits of group relamping are: (1) reduced maintenance costs because of the expense and inconvenience of replacing failing lamps one at a time, and (2) improved appearance and performance since older lamps are often degrading in brightness and color as they age.

## Halogen Lamp

A halogen lamp is an incandescent lamp with a filament that is surrounded by halogen gases, such as iodine or bromine. Halogen gases allow the filaments to be operated at higher temperatures and higher efficacies. The halogen participates in a tungsten transport cycle, returning tungsten to the filament and prolonging lamp life. All halogen lamps have a tungsten filament and, often, a quartz envelope.

## HIR™

GE designation for high-efficiency tungsten halogen lamps. HIR lamps utilize shaped filament tubes coated with numerous layers of materials that transmit light but reflect the heat (infrared) back onto the filament. This reduces the power needed to keep the filament hot.

## Harmonic

An integral multiple of the fundamental frequency (60 Hz) that becomes a component of the current.

**Harmonic Distortion** (see TOTAL HARMONIC DISTORTION or THD).

## Hertz (Hz)

Unit used to measure frequency of alteration of current or voltage, in cycles per second.

## High-Efficiency (Energy Saving) Electromagnetic Ballast

Ballast with core & coils, designed to minimize ballast losses compared to the “standard” ballast.

## Highbay Lighting

Lighting designed for (typically) industrial locations with a ceiling height of 25 feet and above.

## High Intensity Discharge (HID) Lamp

A general term for mercury, metal halide (GE ConstantColor® CMH®, Multi-Vapor®, MXR or Arcstream®) and high-pressure sodium (GE Lucalox®) lamps. HID lamps contain compact arc tubes which enclose various gases and metal salts operating at relatively high pressures and temperatures.

## High Output/Very High Output (HO, VHO) Lamps

Designation for lamps generating more light than standard lamps.

## High Power Factor

A ballast whose power factor is corrected to 90% or greater.

## 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. GE markets these lamps under the trade name of Lucalox®.

## Hot Restart Time

If there is a momentary power interruption and the HID lamp goes out, there will be a delay of 10 to 15 minutes before the lamp has cooled down sufficiently to start again. This is called the Hot Restart time. PulseArc® lamps have a significantly shorter Hot Restart time (typically 3–5 minutes) than standard metal halide lamps. Lucalox® Standby lamps will start up immediately while standard Lucalox® lamps require a few minutes.

## Ignitor

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

## Illuminance

The “density” of light (lumens/area) incident on a surface; i.e. the light level on a surface. Illuminance is measured in footcandles or lux.

## Incandescent Lamp

A light source that generates light utilizing a thin filament wire (usually of tungsten) heated to white heat by an electric current passing through it.

## Indirect Lighting

The method of lighting a space by directing the light from luminaires upwards towards the ceiling. The light scattered off the ceiling produces a soft, diffuse illumination for the entire area.

## 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. Genura® is an example of an induction lamp.

## Infrared Radiation

Electromagnetic energy radiated in the wavelength range of about 770 to 1,000,000 nanometers. Energy in this range cannot be seen by the human eye, but can be sensed as heat by the skin.

## Input Voltage

Power supply voltage required for proper operation of fluorescent or HID ballast.

## Input Watts

The total power input to the ballast that 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. More than 90% of the input watts is wattage or power delivered to the lamp load with typical ballast.

## Instant Start

A type of ballast designed to start fluorescent lamps as soon as the power is applied. Most T8 fluorescent lamps are being operated on electronic instant-start ballasts. Slimline fluorescent lamps operate only on instant-start circuits.

## Instant-Start Lamp

A fluorescent lamp, usually with a single pin at each end, approved to operate on instant-start ballasts. The lamp is ignited by a high voltage without any filament heating.

## Integral

A popular term for a compact fluorescent lamp that includes a built-in ballast (see CFL).

**Kelvins** (see COLOR TEMPERATURE).

## Kilowatt (kW)

A 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).

## Laminations

Layers of steel, making up the “core” that is surrounded by the coils in a core & coil ballast.

## Lamp

The term used to refer to the complete light source package, including the inner parts as well as the outer bulb or tube. “Lamp,” of course, is also commonly used to refer to a type of small light fixture such as a table lamp.

## Lamp Current Crest Factor

Ratio of peak lamp current to RMS or average lamp operating current.

## Lamp Types

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

## Lamp Watts

Power dissipated in the lamp—some of which is converted to light, some to heat and some to ultraviolet.

**Life** (see RATED LAMP LIFE).

## Light

Radiant energy that can be sensed or seen by the human eye. Visible light is measured in lumens.

## Light Center Length (L.C.L.)

The distance between the center of the filament, or arc tube, and a reference plane—usually the bottom of the lamp base. See L.C.L. Reference Plane Location chart on page A-1.

## 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, temperature effects, burn-out factor, etc.

## Lucalox®

The GE brand name for high-pressure sodium lamps.

## Lumen

A measure of 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 840 lumens.

## Lumen Depreciation, Lumen Maintenance

A measure of how well a lamp maintains its light output over time. It may be expressed numerically or as a graph of light output vs. time. The “mean lumens” of a lamp is the lumens at 40% of rated life (50% for HPS lamp).

## Lumens Per Watt (LPW)

A ratio expressing the luminous efficacy of a light source.

Typical lamp efficacies:	
Edison’s first lamp.....	1.4 LPW
Incandescent lamps.....	10-20
Halogen lamps.....	15-30
Fluorescent lamps.....	35-105
Mercury lamps.....	50-60
Metal halide lamps.....	60-120
High-pressure sodium lamps.....	60-140

**Note:** The values above for discharge lamps do not include the effect of the ballasts, which must be used with those lamps. Taking ballast losses into account reduces “system” or lamp ballast efficacies typically by 10-20% depending upon the type of ballast used.

## Luminaire

A complete lighting unit consisting of a lamp (or lamps), ballast (or ballasts) as required together with the parts designed 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 Efficiency

The ratio of total lumens emitted by a luminaire to those emitted by the lamp or lamps used in that luminaire.

## Luminance

A photometric measure of “brightness” of a surface as seen by the observer, measured in candelas per square meter.

## 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 (see LUMENS PER WATT).

## Lux (lx)

A unit of illuminance or light falling onto a surface. Lux stands for the light level on a surface one meter from a standard candle. One lux is equal to one lumen per square meter. Ten lux approximately equals one footcandle (see FOOTCANDLE).

## Magnetic Ballast

A ballast used with discharge lamps that consists primarily of transformer-like copper or aluminum windings on a steel or iron core. Also called “Core & Coil” (see ELECTRONIC BALLASTS).

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

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 at 50% of rated lamp life (see LUMEN MAINTENANCE).

## Medium Base

Usually refers to the screw base typically used in household incandescent lamps. There is also the medium bi-pin base commonly used in T12 and T8 fluorescent lamps.

## 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 Cases

Case design used in both magnetic and electronic ballasts. These ballasts are grounded once they are mounted to the fixture. They meet all safety codes, some of which do not allow plastic in open plenum areas.

## 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. GE trade names include: Multi-Vapor®, ConstantColor® CMH®, PulseArc®, Staybright®, Watt-Miser®, ChromaFit™ and Arcstream®.

## Mogul Base

A screw base used on larger lamps, e.g. many HID lamps.

## Mortality Curve

Lamps have a rated or expected life but individual failures occur earlier and some lamps will last longer. The mortality curve depicts the expected percent surviving in a group of lamps at various points between zero hours and rated life or beyond. The curve starts with 100% at zero hours and goes to 50% surviving at the rated life (e.g. 3000 hours or 20,000 hours, etc.) However, the shape of the curve between these two end points can vary depending on the lamp type.

## Mounting Height

Distance from the bottom of the fixture to either the floor or work plane, depending on usage.

## Multi-Vapor®

A GE brand name for metal halide lamps.

## Nanometer

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

## National Energy Standards for Fluorescent Ballasts

A federal law enacted in 1988 that sets energy standards for ballasts consistent throughout the United States.

## National Electric Code (NEC)

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

# Glossary of Terms

## National Stock Number

The standardized part number used by the U.S. Government for procurement.

## NOM

Laboratory that sets safety standards for building materials, electrical appliances and other products for Mexico.

## Non-PCB Capacitor

Capacitor used in ballasts to help provide power factor correction. Contains no polychlorinated biphenyls and meets EPA requirements.

## Normal Power Factor

Ballasts with power factor less than .90 and do not incorporate any means of Power Factor Correction.

## Open Circuit Voltage (OCV)

Open Circuit Voltage measured across the socket the lamp screws into, with the ballast powered on. It is dangerous to stick a voltmeter into such a socket without precise knowledge of the ballast because exceedingly high voltages could be present.

## Operating Voltage

For electrical discharge lamps, this is the voltage measured across the discharge when the lamp is operating. It is governed by the contents of the chamber and is somewhat independent of the ballast and other external factors.

## PAR Lamp

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

## Parallel Lamp Operation/Parallel Wiring

Refers to ballasts that employ multiple output current paths from a single ballast to allow lamps to operate independent of one another, allowing other lamps operated by the ballast to remain lit should companion lamp(s) fail (see SERIES LAMP OPERATION).

## PCB (Polychlorinated Biphenyls)

Chemical pollutant formerly used in ballast capacitors that were part of ballasts. It is now illegal to use PCBs and most such ballasts have been replaced over time.

## Phosphor

An inorganic chemical compound processed into a powder and deposited on the inner glass surface of fluorescent tubes 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.

**Photopic** (see SCOTOPIC/PHOTOPIC).

## Potting

Material used to completely surround and cover components of some magnetic and electronic ballasts. Potting compound fulfills functions of protecting components, dampening sound, and dissipating heat.

## Power Factor (PF)

A measure of the phase difference between voltage and current drawn by an electrical device, such as a ballast or motor. 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 companies may penalize users for using low-power-factor devices.

## Power Factor Corrected

Ballasts that incorporate a means of Power Factor Correction yielding power factor of 90% or greater.

## Precise™

The GE trade name for the compact MR-16 and MR-11 low-voltage halogen dichroic cool beam reheatrized spot and flood lamps.

## Preheat Circuit

A type of fluorescent lamp-ballast circuit used with the first commercial fluorescent lamp products. A push button or automatic switch is used to preheat the lamp cathodes. Starting the lamp can then be accomplished using simple “choke” or reactor ballasts. A preheat fluorescent lamp is one 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.

## Product Code

It is important to use this five-digit code when ordering to ensure that you receive the exact product you require.

## Programmed Rapid Start

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 preheating 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.

## PulseArc®

GE description for a type of metal halide lamp that provides improved lumen maintenance for longer useful life and extended relamp cycles. These products are designed to operate on ballasts that have ignitors to help with lamp starting.

## Pulse Start

The generic name for a PulseArc® lamp or for an HID ballast with a high-voltage ignitor to start the lamp.

## Quartz

A name for fused silica or melted sand from which many high-temperature containers are fashioned in the lighting industry. Quartz looks like glass but can withstand the high temperatures needed to contain high-intensity arc discharges.

**Quartz-Halogen Lamp** (see HALOGEN LAMP).

## Quartzline®

A GE registered trademark term for some types of halogen lamps.

## Radiation

A general term for the release of energy in a “wave” or “ray” form. All light is radiant energy or radiation, as is heat, UV, microwaves, radio waves, etc.

## Rapid Start

Lamp starting method in which lamp filaments are heated while open circuit voltage (OCV) is applied to facilitate lamp ignition. A Rapid Start fluorescent lamp has two pins at each end connected to the filament. Some rapid start lamps may be instant-started without filament heat, for example, the F32T8 lamp.

## Rapid Start Circuit

A fluorescent lamp-ballast circuit that utilizes 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

For most lamp types, rated lamp life is the length of time of a statistically large sample between first use and the point when 50% of the lamps have died. It is possible to define “useful life” of a lamp based on practical considerations involving lumen depreciation, color shift and also on the need to reduce lamp replacement costs (see GROUP RELAMPING).

## Reflector Lamp (R)

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.

## Reveal®

GE’s product family of incandescent lamps with the element neodymium added to the glass bulb. Neodymium filters out much of the yellow light produced by ordinary lamps. Less yellow means whites look whiter and colors appear more vibrant in spaces lighted with Reveal® lamps.

## Room Cavity Ratio (RCR)

A shape factor (for a room, etc.) used in lighting calculations. RCR = 5H (L+W) / L x W, or, alternately, RCR = (2.5) Total Wall Area / Floor Area. Where H = height, L = length and W = width of the room. A cubical room will have an RCR of 10; the flatter the room the lower the RCR.

## Scotopic/Photopic (S/P) Ratio

This measurement accounts for the fact that of the two light sensors in the retina, rods are more sensitive to blue light (scotopic vision) and cones to yellow light (photopic vision). The Scotopic/ Photopic (S/P) Ratio is an attempt to capture the relative strengths of these two responses. S/P is calculated as the ratio of scotopic lumens to photopic lumens for the light source on an ANSI reference ballast. Cooler sources (higher-color-temperature lamps) tend to have higher values of the S/P Ratio compared to warm sources.

## Self-Ballasted Lamps

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

## Series Lamp Operation

Refers to ballasts that employ a single current path passing through all lamps operated by the ballast. If one lamp should fail, companion lamps operated by the same ballasts will also extinguish or dim.

## Spacing to Mounting Height Ratio

Ratio of fixture spacing (distance apart) to mounting height above the work plane; sometimes called spacing criterion. It is OK to have fixture spaced closer than the spacing criterion suggested by the manufacturer but not farther, or you will get dark spots in-between fixtures.

## Specification Series (SP) Colors

Energy-efficient, all-purpose tri-phosphor fluorescent lamp colors that provide good color rendering. The CRI for SP colors is 70 or above and varies by specific lamp type. See Lamp Color Chart on page A-10.

## Specification Series Deluxe (SPX) Colors

Energy-efficient tri-phosphor fluorescent lamp colors that provide better color rendering than Specification Series (SP) colors. The CRI for SPX colors is 80 or higher and varies by specific lamp type. All GE CFL products use SPX phosphors. See Lamp Color Chart on page A-10.

## Specification Series Deluxe eXtreme (SPXX) Colors

A color designation for GE ceramic metal halide lamps with superior color rendering ~ 90.

## Specular Reflection

Reflection from a smooth, shiny surface, as opposed to diffuse reflection.

## 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 “fingerprint” of the color characteristics of the source throughout the visible part of the spectrum. Also called “spectral curve” or “spectrum.”

## Spiral® Lamp

GE trademark for its helical family of high-efficiency, long-life compact fluorescent lamps.

## Starcoat®

GE’s special barrier coating applied on the inside of all GE T8 fluorescent lamps, as well as some other lamp types, to enhance lamp life and deliver superior lumen maintenance.

## Starter

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

## Starting Temperature (Minimum)

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

## T12, T8, T5

A designation for the diameter of a tubular bulb in eighths of an inch; T12 is 12 eighths of an inch, or 1-1/2 inches; T8 is 1 inch, and so on.

## Task Lighting

Supplemental lighting provided to assist in performing a localized task, e.g. a table lamp for reading or an inspection lamp for fabric inspection.

## Terminal-to-Terminal Starting Lamp Voltage (VRMS) (Minimum or Maximum)

The minimum or maximum voltage allowed into lamp from ballast under varying conditions as specified.

## TCLP Test

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 waste. The TCLP test

measures the ability of the mercury and/or lead in a lamp to leach from a landfill into ground water.

**THD** (see TOTAL HARMONIC DISTORTION).

## 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 a 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.

## Transients

High voltage surges through an electrical system caused by lightning strikes to nearby transformers, overhead lines or the ground. May also be caused by switching of motors or compressors, as well as by short circuits or utility system switching. Can lead to premature ballast failure (see TVSS).

## Troffer

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

**Tungsten Halogen Lamp** (see HALOGEN LAMP).

## TVSS

Transient Voltage Surge Suppressors, which will protect ballasts and other electronic equipment from transient high-voltage spikes that may be present in the power line.

## Two-Pin Compact Fluorescent Lamps

Type of lamps that have the glow bottle starter built into the base of the lamp. Traditionally 2-pin lamps are designed to work with electromagnetic ballasts (see FOUR-PIN COMPACT FLUORESCENT LAMPS).

## Ultra

A common way of referring to high-efficiency GE T8 family of lamps and Ballast that performs better than standard T8 lamps. Also refers to the system.

## UltraMax® Ballast

A family of high-efficiency GE instant-start electronic linear fluorescent ballasts designed to optimize GE’s T8 Ultra lamps for enhanced system energy savings. UltraMax® ballasts have a low lamp current crest factor and virtually “read” and adapt to incoming voltage from 108V to 305V. Other features include UL Type CC Anti-Arc Rating and anti-striation control to eliminate lamp striations and spiraling. GE also has an UltraMax® HID ballast which can operate PulseArc® and CMH® lamps anywhere from 250 watts to 400 watts and provides greatly improved lumen maintenance.

## UltraStart® Ballast

A family of high-efficiency GE Program Start electronic linear fluorescent ballasts designed to optimize GE’s T8 Ultra lamps in frequently switched applications. Instant-start ballast provides 10,000 starts. UltraStart® provides 100,000 to 200,000 starts. Use program start ballast to ensure long lamp life when turning lamps on and off more that twice a day.

## Ultraviolet (UV) Radiation

For practical purposes, any radiant energy within the range of 100–380 nanometers. It is beyond the blue or violet region of the spectrum, and is invisible to the eye just like the silent “ultrasound” dog whistle is inaudible to the ear.

UV is divided into 3 regions:

UVA.....100 to 280 nm  
UVB.....280 to 315 nm  
UVC.....315 to 400 nm

Some wavelengths (180–220) produce ozone, some (220–300) are bactericidal, some (280–320) erythema (redden human skin); others (320–400) cause secondary luminance (black light).

## Ultra Watt-Miser®

GE’s family of energy-saving T8 fluorescent lamps.

## Underwriters Laboratories (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 lamp assemblies – those with screw bases and built-in ballasts.

## Uniform Product Code (UPC)

The 12-digit code on the saleable unit that is used for scanning at the register.

## Veiling Reflection

Effective reduction in contrast between task and its background caused by the reflection of light rays; sometimes called “reflected glare.” You might have dealt with veiling reflections when you have to tilt a shiny magazine to avoid glare so as to read it, or struggled with reading a computer monitor because of the reflection of a window or a light fixture.

## Visual Comfort Probability (VCP)

For a given lighting scheme, VCP is a ratio expressed as a percent of people who, when viewing from a specific location and in a specified direction, find the system acceptable in terms of glare (see GLARE).

## Volt

A measure of “electrical pressure” between two points. The higher the voltage, the more current will be pushed through a resistor connected across the points. The volt specification of an incandescent lamp is the electrical “pressure” required to drive it at its designed point. The “voltage” of a ballast (e.g. 277 V) refers to the line voltage it must be connected to.

## Voltage

A measurement of the electromotive force in an electrical circuit or device expressed in volts. Voltage can be thought of as being analogous to the pressure in a waterline.

## Voltage Surge

Transient spikes in line voltage that can be harmful to electronic equipment like computers and electronic ballasts. Surge suppressors are often used to protect against such transients.

## Wall Temperature (Maximum Bulb)

The maximum operating bulb wall temperature in Celsius.

## Warm-Up Time

HID lamps typically take a few minutes to warm up to full brightness after starting.

Incandescent

Halogen

High Intensity Discharge

Fluorescent

Compact Fluorescent

Ballast

LED Lamps and Systems

Stage and Studio

Miniature and Sealed Beam

Projection

# Glossary of Terms

**Warm-Up Time to 90%**  
The time it takes for a High Intensity Discharge lamp to reach 90% of light output after being turned on.

**Warm White**  
Refers to a color temperature around 3000K, providing a yellowish-white light.

**Watt**  
A unit of electrical power. Lamps are rated in watts to indicate the rate at which they consume energy (see KILOWATT HOUR).

**Wattage Indicator Reduced**  
Indicates that this is a reduced wattage option for lamps normally used in this application. Be sure to check wattage, lumens and life to determine which lamp is best suited to your needs.

**Watt-Miser®**  
A Watt-Miser® lamp is a term used by GE to indicate a reduced-wattage lamp with performance characteristics (life, light output, etc.) such that it can usually directly replace a higher-wattage product. Watt-Miser® lamps are available in a wide range of incandescent, fluorescent and HID lamp types.

**Wavelength**  
The distance between two neighboring crests of a traveling wave. The wavelength of light is between 400 and 700 nanometers.

# the three of Lighting costs

## Electricity is the biggest chunk of your lighting costs

Averaging across different lamp types and systems, we estimate that only \$1 of every \$25 goes toward lamps, \$2 toward labor, and **\$22 toward electricity!**

The simplest way to save energy is to retrofit with energy-efficient products and systems from GE Lighting: your #1 energy-saving choice!

And remember...every watt reduced in your lighting system results in a one-third watt reduction in your A/C load (while A/C is running). The reduced power consumption from an energy-efficient lighting upgrade results in an immediate reduction in the electric bill. However, there is another benefit that typically shows up six months to a year after the lighting upgrade. The reduced lighting loads (along with the accompanying reduction in air-conditioning load) often leads to a net reduction of peak electric demand for the site. This results in the electric bill going down even further since utilities have a demand charge based on the peak load at the site over a 15-minute to 30-minute period during the previous six months. Consult your utility company to discover the expected benefit from this effect.

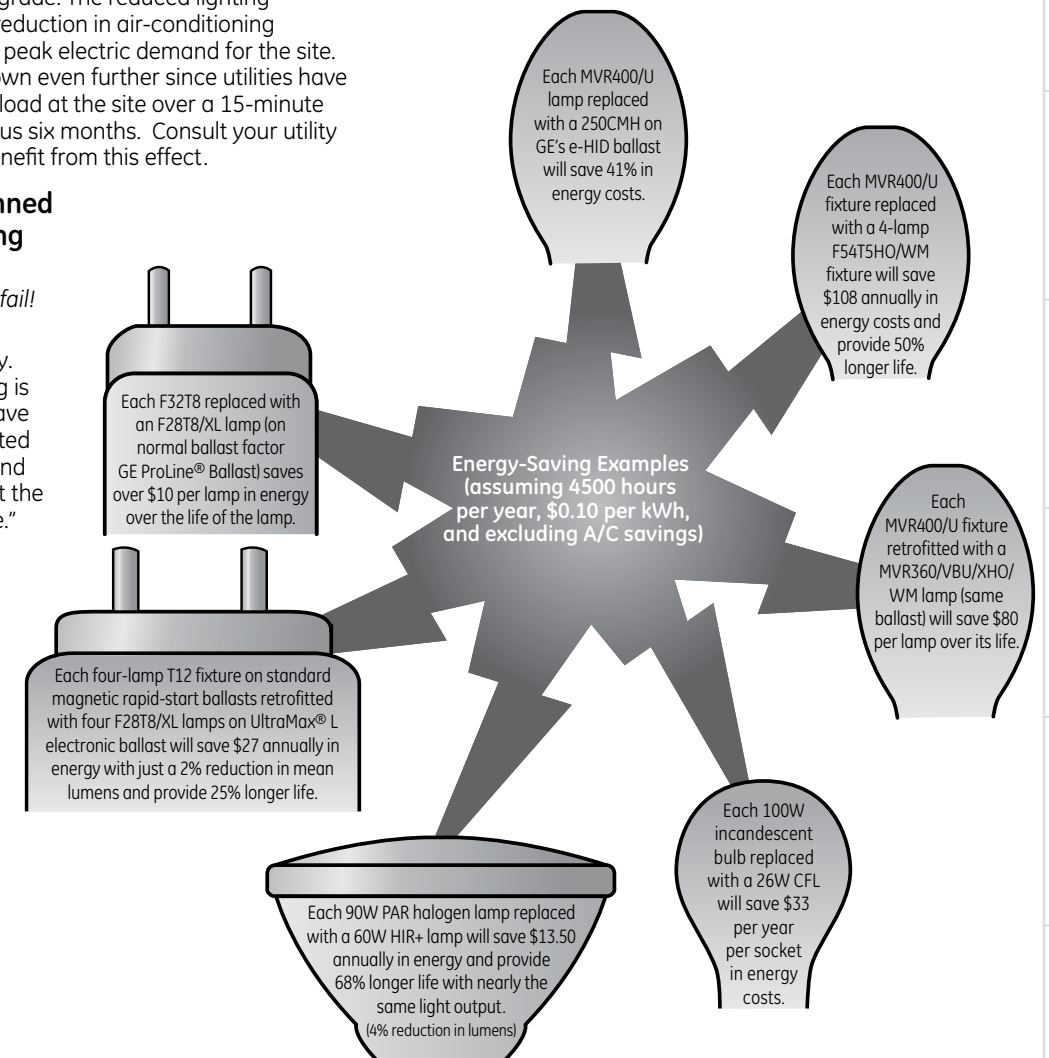
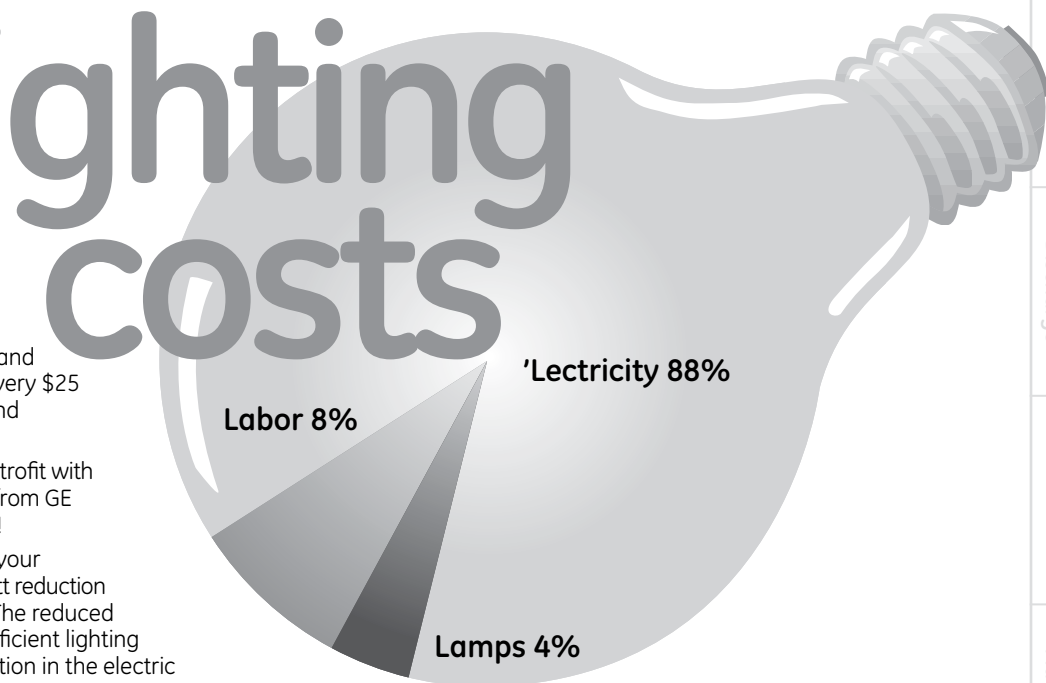
## Reduce Labor Costs With Planned Maintenance/Group Relamping

*Schedule your lighting maintenance instead of simply waiting for lamps to fail!*

In any large installation, failure rates increase with age in a predictable way. The **optimal** point for group relamping is typically when 8% to 12% of lamps have failed, usually around two-thirds of rated life. At this point, both lumen output and lamp color may have deteriorated, yet the cost of electricity remains at "full price."

The per-lamp labor cost of installing new lamps is usually significantly less when an entire site is relamped, compared to the per-lamp labor cost of replacing lamps one at a time.

The result? The facility gets a face-lift and the maintenance costs over the next two or three years are generally significantly reduced. **Contact your GE Account Manager or GE Distributor to understand the full benefits of planned maintenance and to get set up on a money-saving group relamping schedule.**



Incandescent  
Halogen  
High Intensity Discharge  
Fluorescent  
Compact Fluorescent  
Ballast  
LED Lamps and Systems  
Stage and Studio  
Miniature and Sealed Beam  
Projection

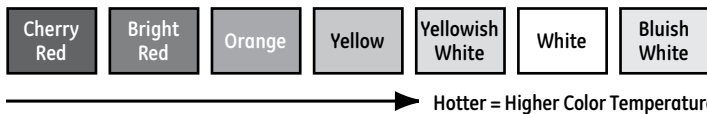
# selecting the **best** color lamp

## Descriptions: "Warm" Or "Cool"

When talking about white light sources (or about white paint) we use the descriptions "warm" and "cool." White light with a yellowish tinge, reminiscent of candlelight and fireplaces, is called "warm white." Incandescent lamps produce a warm white color. Bluish white, reminiscent of moonlight on cold snow, is considered "cool white." Fluorescent lamps can produce warm white or cool white, or anywhere in between, depending on the mix of phosphors used.

### Correlated Color Temperature (CCT)

Correlated Color Temperature is a way of describing the degree of "yellowness" or "blueness" of a white light source. We relate the light source to the color of a hypothetical piece of hot metal. A piece of steel or tungsten as it is heated, will progressively change color in the sequence shown below:



When we say a lamp has a color temperature of 2700K—typical of incandescent lighting—it simply means that a piece of metal heated to a temperature of 2700 kelvins (which is about 3000°C or 5400°F) would mimic the color of the lamp. Such a source would be yellowish-white. In contrast, the color of a lamp at 6000K—typical of daylight entering through a window on a sunny day—can be mimicked by doubling the temperature of the hot metal piece to 6000 kelvins. This is significantly bluer or "cooler" than the light of incandescent lamps. Note that higher CCT refers to sources described as "cooler."

Generally, 4000K and above is considered "cool white," 3200K and below is "warm white," and 3500K is "neutral white."

## Better Color Rendering For Better Appearance

There is no such thing as the "true" color of any material; the perceived color is a function of the light under which the material is viewed and the reflectance characteristics of the material itself. However, we can make a general statement: the higher the Color Rendering Index (CRI) of a light source (also denoted by  $R_a$ ) the better—and more natural—colors typically appear under the light source.

In measuring CRI, scientists compare how eight specific colors appear under the source to how these same colors appear under a reference source. However, there are two reference sources: incandescent lighting is the reference for warm color lamps and daylight is the reference for cool color lamps. In this system, both incandescent lamps and daylight are considered to have "perfect" CRIs of nearly 100 even though, as we know, materials appear quite different when viewed under these light sources. These two sources are very different in color temperature (see below) although both have CRIs close to 100. CRI is, therefore, meaningful in comparing lamps that are close in color temperature.

CRI is not a perfect measure, but it is still useful as an indicator of the quality of light from a source.

Typical Color Indicators for Various Lamps	Correlated Color Temperature	Color Rendering Index
<b>Incandescent Lamps</b>		
Typical	2500-2800K	97-100
<b>Halogen Lamps</b>		
Typical	2800-3000K	97-100
<b>Fluorescent Lamps (Ordered By CCT)</b>		
C75 "Chroma Series"	7500K	90 +
SPX65 (865)	6500K	80 +
SP65 (765)	6500K	70 +
C50 "Chroma Series"	5000K	90 +
SPX50 (850)	5000K	80 +
SP50 (750)	5000K	70 +
SPX41 ( 841)	4100K	80 +
SP41 (741)	4100K	70 +
Cool White	4100K	62
SPX35 (835)	3500K	80 +
SP35 (735)	3500K	70 +
SPX30 (830)	3000K	80 +
SP30 (730)	3000K	70 +
Warm White	3000K	50
covRfresh	2750K	87
SPX27 (827)	2700K	80 +
Note: Some 4' T8 "SP" lamps, including reduced wattage types, may have a CRI >80.		
<b>High Pressure Sodium Lamps</b>		
Lucalox®	1900-2100K	22
Deluxe Lucalox®	2200K	65
<b>Metal Halide Lamps</b>		
Standard and PulseArc® MVR Multi-Vapor®	3000-4300K	65-75
MXR Multi-Vapor®	3200-3500K	65-70
Arcstream®	3000-6000K	75-90
Multi-Vapor® ChromaFit™	4000-4500K	65-70
<b>Ceramic Metal Halide Lamps</b>		
CMH®	3000-4200K	80-93
CMH® ChromaFit™	3000K	85