NONRESIDENTIAL LIGHTING
AND ELECTRICAL POWER DISTRIBUTION

A guide to meeting or exceeding California’s 2022 Building Energy Efficiency Standards
CHAPTER 1

INTRODUCTION

THE BENEFITS OF EFFICIENCY

Energy-efficient nonresidential buildings lead to both environmental benefits and cost savings. The lighting requirements of California’s Building Energy Efficiency Standards (Energy Code) aim to reduce energy use and demand while maintaining high-quality lighting.

Today’s commercial buildings consume 19% of U.S. energy, according to the Department of Energy’s Office of Energy Efficiency & Renewable Energy.

Improving the energy efficiency of lighting systems has a large potential for energy savings for new construction and existing buildings undergoing retrofits. A significant fraction of that potential savings must come from inclusion of lighting controls, such as occupancy, daylighting, institutional tuning, automated demand response and personal controls.¹

While energy efficiency is a priority in today’s lighting design practice, so are occupant comfort, health and wellness. A successful lighting design balances these objectives.

OCCUPANT COMFORT

Factors to consider in lighting design include human needs, like visibility, safety and comfort; and environmental and economic issues, such as energy consumption, equipment costs and sustainability. Additionally, how well the lighting complements the building design must be considered. A successful lighting design utilizes the right equipment to maximize visual comfort while reducing costs and the building’s carbon footprint.

Market analysis indicates that companies with sustainability initiatives tend to profit more and perform better than competitors without these programs.¹ Sustainability programs increasingly are recognized as a source of innovation and a way to improve the appeal of a company or brand.² One path towards increased sustainability includes the lighting environment. The design and installation of a highly efficient and long-lasting lighting system provides a high-profile, visual indicator of a company’s commitment to energy efficiency.

Such a commitment can reap positive benefits with employees and clientele, as well. For example, consumers have become increasingly concerned about their impact on the environment and aware of how their shopping habits affect the planet. Retailers have responded by increasing the sustainability of their products and business practices. Improving efficiency and reducing waste not only lowers overhead costs for building owners but also provides an opportunity for business growth.³

LAYERS OF LIGHT

Adding task and accent lighting to ambient lighting, also referred to as general lighting, allows the total lighting load to be reduced without compromising safety or visual comfort. Lighting designs that include task and accent lighting are thought to be more attractive by some, as they provide variety and visual interest.

GENERAL AND PERSONAL LIGHTING CONTROLS

General lighting controls address an entire space or area. These controls are typically programmed to provide general purpose areas with energy-efficient control strategies. For example, corridors equipped with occupancy sensors that enable bi-level lighting are one form of general lighting control.

Personal lighting controls address a sub-area and are typically associated with an individual’s workstation or task area. For example, lighting installed at a desk to provide illumination only on the desk plane is controlled separately from the overhead lighting in place for the entire office. The personal and general lighting described above are examples of layers of light in a lighting design.

¹ 2013 Retail Sustainability Report: Fueling Continuous Development, 2013, Retail Industry Leaders Association (RILA).
³ 2013 Retail Sustainability Report: Fueling Continuous Development, 2013, Retail Industry Leaders Association (RILA).
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HEALTH AND WELLNESS

There is evidence indicating that the intensity and spectrum of light sources found in homes and workplaces have a significant impact on health and well-being. The spectral impact relates predominantly to hormonal imbalances on a diurnal basis that affect our natural cycles, or “circadian rhythms”. Circadian-friendly design creates environments that resemble the intensity and spectral variations of light over the course of a day. During the daytime, access to daylight throughout the home or workplace supports circadian wellness. Avoiding blue spectrum with high melanopic sensitivity at night is recommended to maintain appropriate melatonin production throughout the evening.

ABOUT THIS GUIDE

This is one of three lighting-focused guides designed to help builders, designers, contractors and others involved in the compliance process become more familiar with California’s Energy Code. It is designed to serve as a resource for industry professionals involved in the design, construction or retrofit of buildings in California, although most of the content is likely of use to projects outside of California as well. The guides include compliance requirements and recommendations for implementing the Energy Code in new construction, addition or alteration projects.

All three guides can be found on the California Lighting Technology Center’s website (cltc.ucdavis.edu).

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COMPLIANCE PROCESS OVERVIEW
Chapter 1 includes an overview of the compliance process that outlines the responsibilities, requirements and documentation involved in each phase of a project, from design to final inspection.

CONCEPTS AND PRINCIPLES
Chapter 2 discusses lighting concepts and principles, including color quality metrics, correlated color temperature, light output and lamp life. These concepts are vital for making informed decisions about lamps, luminaires and controls.

TECHNOLOGY, SYSTEMS AND COMPLIANCE STRATEGIES
Chapter 3 examines how to create an effective lighting system by pairing the correct light source technology with the appropriate fixture and lighting controls. This guide focuses on light sources, control devices and control strategies. This section of the guide also describes luminaire classification under the Energy Code, control strategies and control systems relevant to nonresidential spaces.

COMPLIANCE REQUIREMENTS
Chapter 4 explains mandatory requirements in the Energy Code related to electric lighting, daylighting and lighting controls. This chapter also examines the prescriptive requirements of the Energy Code, including the approved methods to calculate allowed lighting power for indoor and outdoor applications.

REQUIREMENTS AND RECOMMENDATIONS: PRESCRIPTIVE APPROACH IN PRACTICE
Chapter 5 includes requirements and recommendations for meeting the Energy Code in specific nonresidential space types. This portion of the guide focuses on how to apply the prescriptive approach to retail, office and educational spaces. Example exercises are included, detailing the steps for the prescriptive approach, as well as how to complete relevant forms.

THE COMPLIANCE PROCESS

The Energy Code requires the following process for all new construction, additions and alterations of existing buildings where a permit is issued. Repairs, as defined in the Energy Code, do not require Energy Code compliance.

STEP 1: COMPLY WITH ALL MANDATORY REQUIREMENTS

All nonresidential buildings must be designed and built to comply with the mandatory requirements of the Energy Code using devices that adhere to the Appliance Efficiency Regulations. Mandatory requirements are the basic set of requirements that apply to all buildings. For example, lighting controls requirements are mandatory requirements.

STEP 2: COMPLY WITH APPLICABLE PRESCRIPTIVE OR PERFORMANCE REQUIREMENTS

In addition to meeting the mandatory requirements for your project, commercial buildings must adhere to the applicable prescriptive or performance requirements.

- **Prescriptive approach:** The prescriptive approach allows builders to comply by meeting a set list of requirements, with minimal flexibility between building areas. This approach does not require software — rather, it is completed in a checklist format using the Certificates of Compliance.

- **Performance approach:** The performance approach allows builders freedom of design so long as the building achieves the same overall efficiency as an equivalent building using the prescriptive option. This approach requires using software approved by the Energy Commission and is best suited for use by experienced professionals familiar with the Energy Code. This method allows for energy trade-offs between building systems. For example, under the performance approach, use of highly efficient lighting can allow for a larger portion of the energy budget to be allocated to heating and cooling loads.

STEP 3: VERIFY COMPLIANCE

After a compliance method is chosen, the proposed energy use of the building or spaces within the building must be calculated. This value should not exceed the allowed energy budgets specified in the Energy Code. If the design does not comply, it will have to be revised.

STEP 4: PREPARE AND SUBMIT PLANS

Once the Energy Code requirements have been met, the design team prepares the building plans and Certificates of Compliance. Plans and compliance forms are submitted to the appropriate enforcement agency, together with a building permit application.
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STEP 5: PASS PLAN REVIEW AND RECEIVE PERMIT
A building department plans examiner must check that the building design satisfies the Energy Code requirements and that the submitted documentation contains all information to be verified during field inspection. A building permit is issued after plans are approved by the building department.

STEP 6: COMPLETE CONSTRUCTION
The installation team must follow the approved plans and specifications during construction. Certificates of Installation must be completed and signed by approved individuals to certify that the lighting installed for the project corresponds with the lighting proposed on the Certificates of Compliance.

STEP 7: COMMISSION BUILDING SYSTEMS
After construction is complete, the contractor or the design team must properly commission, or bring into working condition, the building and its systems. They also must advise the building owners and operators of their responsibilities regarding compliance with the Energy Code. They must provide information and training to the building owner on how to maintain and operate the building systems.

STEP 8: PASS ACCEPTANCE TESTING
The Energy Code requires that Certified Lighting Controls Acceptance Test Technicians (CLCATT) review and test newly installed building systems to ensure the controls and connected loads operate as required by the Energy Code.

STEP 9: PASS FINAL INSPECTION
The building department field inspector(s) verifies that the building construction follows the plans and specifications that were approved when the building permit was issued. Once final inspection is complete, the Certificate of Occupancy is issued.

STEP 10: PROVIDE DOCUMENTATION TO BUILDING OWNERS
Upon tenant occupancy, the builder must provide copies of the energy compliance documents from the installation team, including Certificates of Acceptance, along with instructions for operation and maintenance.
COMPLIANCE DOCUMENTS

The compliance process includes completing a set of forms, which must be submitted for review by the authority having jurisdiction. Not all forms are required for all projects.

Instructions for completing these forms are provided in Section 5.11 of the Energy Commission’s Nonresidential Compliance Manual.

1R: Residential Certificate of Compliance
2R: Residential Certificate of Installation
3R: Residential Certificate of Verification
CC: Certificate of Compliance
Cl: Certificate of Installation
CA: Certificate of Acceptance
CV: Certificate of Verification
E: Verified by
A: Completed by Acceptance
Test Technician

NR CA – LTI – 02 – A

NR: Nonresidential
LM: Low-rise Multifamily
CF: Residential
LT: Lighting
CXR: Commissioning Review
ELC: Electrical
ENV: Envelope
MCH: Mechanical
PLB: Plumbing
PRC: Process

Number in Sequence

CERTIFICATES OF COMPLIANCE

Certificates of Compliance and building plans are submitted with a building permit application to the enforcement agency. (See Step 4 in the compliance overview.) Some Certificates of Compliance are mandatory for every project, while others are required only if the system design includes specific components or strategies.

NRCC-LTI-E Indoor Lighting
NRCC-LTO-E Outdoor Lighting
NRCC-LTS-E Sign Lighting
NRCC-ELC-E Electrical Power Distribution

Because lighting power trade-offs are not allowed between conditioned and unconditioned spaces, conditioned and unconditioned space types must show compliance separately.
**CERTIFICATES OF INSTALLATION**

Certificates of Installation, signed by approved professionals, certify that the lighting installed for the project corresponds with the lighting proposed on the Certificates of Compliance.

- **NRCI-LTI-E** Indoor Lighting
- **NRCI-LTO-E** Outdoor Lighting
- **NRCI-LTS-E** Sign Lighting
- **NRCI-ELC-E** Electrical Power Distribution

**NRCI-LTI-01-E** is required for all indoor lighting projects. **NRCI-LTO-01-E** is required for all outdoor lighting.

**CERTIFICATES OF ACCEPTANCE**

A CLCATT, trained and certified through a state-approved program, must complete Certificates of Acceptance when required. The forms are also signed by the responsible person and the documentation author. These signatories may be the CLCATT, but do not need to be. Information in these forms certifies that the lighting controls were tested and operate in compliance with the Energy Code:

- **NRCA-LTI-02-A** Shut-off Lighting Controls
- **NRCA-LTI-03-A** Automatic Daylighting Controls
- **NRCA-LTI-04-A** Demand Responsive Lighting Controls
- **NRCA-LTI-05-A** Institutional Tuning PAF
- **NRCA-LTO-02-A** Outdoor Lighting Controls
- **NRCA-ENV-03-F** Daylighting Design PAFs

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**NONRESIDENTIAL LIGHTING COMPLIANCE FORMS**

As part of the Energy Code compliance process, the design team must prepare and submit forms to verify compliance. (See Step 4.)

These forms are available at [energycodeace.com/NonresidentialForms/2022](http://energycodeace.com/NonresidentialForms/2022).
FINDING COMPLIANT PRODUCTS

Certain lighting products must be certified to the Energy Commission as meeting California’s Appliance Efficiency Regulations (Title 20, Section 1601–1609 of the California Code of Regulations). Others are regulated only under the Energy Code.

PRODUCTS REGULATED UNDER THE APPLIANCE EFFICIENCY REGULATIONS

The following lighting products are regulated under the Appliance Efficiency Regulations. The Energy Code references these requirements.

- Fluorescent lamp ballasts
- Ceiling fan light kits
- Lamps
- Emergency lighting
- Torchieres and metal halide luminaires
- Power supplies

PRODUCTS REGULATED UNDER THE ENERGY CODE

The following lighting control devices are regulated under Section 110.9 of the Energy Code only:

- Lighting control devices
  - Time-switch lighting controls: automatic time-switch controls, astronomical time-switch controls, multilevel astronomical time-switch controls, outdoor astronomical time-switch controls
  - Daylighting controls: automatic daylight controls, photo controls
  - Dimmers
  - Occupant sensing controls: occupancy sensors, motion sensors, vacancy sensors, partial-on sensors, partial-off sensors
  - Indicator lights
  - Track lighting integral current limiter
  - Supplementary overcurrent protection panels for use with line-voltage track lighting

MODERNIZED APPLIANCE EFFICIENCY DATABASE SYSTEM (MAEDBS)

The Energy Commission’s Modernized Appliance Efficiency Database System (MAEDBS) lists products certified as meeting the Appliance Efficiency Regulations or the Energy Code, including lighting control devices, lamps, ballasts and ceiling fan light kits.

Lighting specifiers wishing to work with a product not yet listed in the Appliance Efficiency Database can encourage the manufacturer or a pre-approved third-party certifier to submit appliance certification data to the Energy Commission.
ENERGY STAR®
While many ENERGY STAR® products meet California’s efficiency requirements, not all ENERGY STAR® labeled products comply with the Energy Code. In some cases, California’s compliance requirements are more stringent. Consult MAEDBS to see if an ENERGY STAR® product complies with California requirements.

DESIGNLIGHTS CONSORTIUM®
The DesignLights Consortium (DLC) maintains a Qualified Products List that provides information on available products for the commercial sector that passed a review of test results as verification of performance. Members of the DLC are comprised of regional, state, utility and energy efficiency programs throughout the United States and Canada. Products on the list do not necessarily ensure Energy Code compliance, but often are eligible for incentives promoting energy efficiency through participating programs.

FTC LABEL
The FTC label summarizes lighting characteristics for products from manufacturers who commit to testing products and reporting performance results according to industry standards. A product with this label does not ensure Energy Code compliance, but does indicate its quality specifications.
Adding task and accent lighting to spaces lit with general, ambient lighting allows total lighting loads to be reduced without compromising safety or visual comfort. Lighting designs that include task and accent lighting are also considered more attractive by some, as they provide variety and visual interest.

**AMBIENT LIGHTING**

Ambient lighting should provide a comfortable level of brightness without causing glare. Most rooms benefit from having an ambient light source in the form of a ceiling-mounted luminaire, recessed light, wall-mounted luminaire or a suspended pendant.

**TASK LIGHTING**

Task lighting supplements ambient lighting and maximizes efficiency by placing light closer to the work area. Users can switch it on when needed. Compact desktop task lighting, for example, provides extra light for document preparation and review. Undercabinet lighting in break rooms and commercial kitchens makes cooking and food preparation safer and easier.

Task lighting should be bright enough to prevent eye strain without causing glare and positioned to minimize shadows. It also allows for lower ambient light levels, reducing overall lighting energy use.

**ACCENT OR DISPLAY LIGHTING**

Track lighting, cove lighting and wall-mounted luminaires are common choices for accent lighting. These luminaires can highlight architectural features, artwork and interior design elements.

Color-tunable LED products are becoming more prevalent and more affordable, offering new options for accent lighting. For instance, retailers can wash their walls with colored light to temporarily accent key product displays.

**DAYLIGHTING**

Where daylight is available, electric light levels often can be lowered. In addition to reducing energy use, daylight is full spectrum that offers excellent color rendering. Controls and window or skylight treatments can be used to prevent glare and unwanted solar heat gain from daylight.
LIGHT OUTPUT, EFFICACY AND LIFE

Many estimate the light output of lamps and luminaires based on the amount of power they draw, but it is lumens (lm), not watts (W), that describe the amount of light output. Efficient light sources produce more light for less power.

LIGHT OUTPUT

The amount of visible light emitted by a light source is measured in lumens (lm). The more lumens, the more light emitted, but other factors also affect visibility and perception of brightness, such as contrast and color. In addition, the type of fixture or housing can greatly affect the amount of light reaching the intended target or task area.

RECOMMENDATIONS

• Compare the light output, not the power rating, of existing and replacement light sources to ensure adequate lighting is maintained.
• Consider other factors, such as contrast, light distribution and color rendering; these also affect vision and perceived brightness.
• Install lighting controls, such as dimmers or motion sensors, to maximize energy savings while automatically tailoring light levels to occupant needs.
• To avoid energy waste and excess light, factor task lighting and ambient lighting into the overall lighting design for a space.

LUMINOUS EFFICACY

The term 'luminous efficacy' typically refers to the ratio of light output (lm) produced by a light source to the power consumed by that source (W).

\[
\text{Luminous Efficacy} = \frac{\text{Lumens}}{\text{Watts}}
\]

Each light source technology has a typical efficacy level. For example, a 75W A19 incandescent lamp, a 16W A19 compact fluorescent lamp (CFL) lamp and a 15W A19 LED lamp use different amounts of power to produce approximately the same amount of light.

When assessing the overall value of a light source, efficacy and longevity should be considered along with initial product cost. The energy savings and longer life of a more efficient product often results in a lower life-cycle cost than a less efficient product with a lower initial cost.

WHAT IS A LAMP?

A light source packaged in a standardized shape with a standardized base that is designed to connect to the branch circuit via a standardized base, lamp holder or socket.

Common examples of lamps include the A19 (left) and MR16 (right) form factors.

INCENTIVE PROGRAMS

When purchasing an energy-efficient product, such as an LED light fixture, check with your local utility for rebates or incentives.

VISION NEEDS CHANGE WITH AGE

As we age, our eyes require more light to see clearly. The Illuminating Engineering Society (IES) sets lowest average minimum maintained light level (fc or lux) requirements based on the needs of occupants under 25 years old. These illuminance level recommendations are doubled for those ages 26–65 and quadrupled for those older than age 65.
PRODUCT LIFE

Electric light sources can fail due to several factors, including faulty electrical components and corrosion inside the lamp.

Incandescent lamps typically last 750–1,000 hours and lose about 10–15% of their initial light output before burning out completely. CFL lamps last 6,000–15,000 hours and lose about 10–15% of their light output before burning out completely. Linear fluorescent lamps typically last 25,000–40,000 hours and lose 5–10% of their original light output before they fail.

LEDs do not burn out or fail suddenly in the same way as incandescent or fluorescent light sources. Instead, their light output decreases gradually over time. Many LED A19 replacement lamps are rated to maintain 70% of initial light output for at least 25,000 hours. A few best practices can help maximize the life of LED lighting:

**RECOMMENDATIONS**

- Always follow manufacturer installation instructions, including references to base position for replacement lamps (e.g., base-up, base-down or horizontal).
- Pair lamps and luminaires with manufacturer-recommended dimmers and other controls.
- Observe manufacturers’ recommendations on operating temperature to prevent heat-related performance degradation. Only lamps rated for elevated temperatures should be used in enclosed fixtures.
COLOR CHARACTERISTICS

CORRELATED COLOR TEMPERATURE (CCT)
Correlated color temperature (CCT) indicates the warmth or coolness of the light emitted by a light source. CCT (or “light color”) is measured on the Kelvin (K) scale. Light sources with a low CCT (2,700–3,000K) emit light that is warm (more yellow) in appearance. Sources with higher CCT values (4,000–6,500K) provide light with a cool (more blue) appearance.

Selecting light sources with consistent CCTs helps maintain uniformity in the appearance of a lighting system that contains multiple luminaires. Check the Lighting Facts label for information on CCT, light output, power consumption and life.

COLOR RENDERING INDEX (CRI)
The color rendering index (CRI) measures how accurately a light source renders the colors of the objects it illuminates. The maximum CRI value is 100. Light sources measuring 90 CRI or above will provide excellent color rendering. Generally, the higher the CRI, the more accurate the color of the objects illuminated by the light source will appear.

Specifying lamps and luminaires with similar color rendering helps ensure that wall color, carpeting and other materials have a consistent appearance, especially in adjoining spaces.
INDIVIDUAL COLORS (R1–R15)

In the current CRI metric, 15 reference colors are used to compare color rendition. The average CRI (R_a) metric measures a light source against the first eight reference colors (R1–R8). The ninth reference color, R9, is used to measure how a light source renders vibrant reds. This measurement is especially critical to consider when illuminating items with saturated red elements, including clothing, jewelry, leather goods and wood finishes. Cosmetics and customers’ skin tones also appear more vibrant when illuminated by sources with an R9 measurement greater than 50.

While the R9 value is not always printed on the lighting facts label, many manufacturers can provide spectrum measurements, including R9 values. For LED light sources, request the product’s LM-79 report from the manufacturer for this information.

IES TM-30-20

An alternate method for evaluating light source color rendition, known as TM-30-20, was developed by the Illuminating Engineering Society (IES). TM-30-20 takes an objective and statistical approach to color rendition, quantifying the fidelity (closeness to a reference) and gamut (increase or decrease in chroma) of a light source.

COMPARING COLOR QUALITY

The LED MR16 lamps used for these photos both have a CCT of 3,000K and were produced by the same manufacturer. The image on the left is illuminated with an 80 CRI light source, while the image on the right is illuminated with a 95 CRI light source.

INDIVIDUAL COLOR PALETTES

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<tr>
<th>80 CRI, 3,000K CCT</th>
<th>95 CRI, 3,000K CCT</th>
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<td>R1</td>
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An effective lighting system combines the right source technology with the right fixture and the appropriate lighting controls for the desired function and effect. Selecting the right type of light source and lighting controls for nonresidential lighting needs means comparing a variety of factors, including:

- Light output
- Efficacy
- Distribution
- Color rendering
- Controls compatibility
- Correlated color temperature
- Spectral content
- Product life
- Manufacturer warranties
- Long-term energy and cost savings

In many cases, a higher up-front cost for a more efficient lighting system yields a higher return on investment in the long term as compared to lower up-front cost alternatives. This is especially true in retail applications where lighting quality can influence sales.

The following technology overview briefly describes the benefits and limitations of commercially-available lighting technology. It also offers guidance for selecting products that comply with the Energy Code and the Appliance Efficiency Regulations.
LIGHT SOURCES

A single luminaire often can accommodate different light sources. For example, screw-based fixtures are designed to accept incandescent, CFL or LED sources. Selecting the best source type for a particular application means considering several factors, including light quality, intensity, efficiency and longevity.

LED

LEDs are solid-state light sources capable of emitting colored light, white light or spectrally-tunable light. The color quality of white light LEDs depends on the design and manufacturing of the LED chip.

- Installing long-life LED luminaires can reduce maintenance costs and reduce time spent changing failed lamps. LED lighting is excellent for nearly all applications, indoors or outdoors.
- LEDs are dimmable and unaffected by frequent switching. In addition, their compatibility with cold temperatures make them an excellent choice for pairing with occupancy-based controls, such as those used in freezer case lighting and cold climate outdoor applications.
- Spectrally-tunable LEDs introduce a new element of flexibility for lighting. This technology has benefits in healthcare and hospitality applications, where spectral properties of all light sources can impact wake/sleep cycles, or circadian rhythms, if the exposure time is significant.

LED alternatives to fluorescent lighting products fall into three main categories: linear (or tubular) lamps, retrofit kits and dedicated luminaires. These LED replacement options have different safety precautions, photometric performance considerations and labor requirements.

LINEAR LED LAMPS

Linear fluorescent lamps comprise 80% of the lamp inventory in the commercial sector, or about 1.7 billion lamps, according to a U.S. Department of Energy report.

Replacing existing linear fluorescent lamps with similarly shaped linear LED lamps requires minimal new hardware, but this strategy also presents challenges that should be understood before purchase or installation.

Based on the particular LED replacement lamp product being considered, this approach typically requires changing the electrical wiring, replacing the ballast with an external driver or altering the existing lamp holders (or “tombstones”) to accommodate the new lamp.

A project that replaces both fluorescent lamps and ballasts with LED lamps and drivers is a regulated alteration. This applies to all similar retrofits regardless of source type (e.g., replacing the fluorescent lamps with an LED UL Type A lamp and new ballast, replacing the fluorescent lamp and ballast with a new fluorescent lamp and ballast).

LED lamps that replace the fluorescent lamps only, and do not require any lighting wiring alterations, are considered a repair and do not trigger the Energy Code compliance process.
LED RETROFIT KITS
An LED retrofit kit provides the required electrical components, optical elements and light sources in a prepackaged kit. This replacement option provides an efficient retrofit solution for the majority of light fixtures in today’s building stock. When updating existing light fixtures, it is critical to make sure they can accommodate the retrofit kit selected since not all retrofit kits are universally accepted by light fixtures. Any retrofit option should preserve the safety rating of the existing luminaire.

DEDICATED LED LUMINAIRES
Dedicated LED luminaires are an excellent alternative to linear fluorescent luminaires. While typically higher in cost than fluorescent products, this option often provides the LED technology in a well-designed package with a straightforward electrical installation.

LINEAR FLUORESCENT
Linear fluorescent lamps provide uniform levels of illumination for long periods of time, making them appropriate in buildings that require bright, uniform ambient lighting. Linear fluorescent lamps are typically appropriate in break rooms, bathrooms, storage spaces and other more utilitarian areas. In addition, these lamps are relatively inexpensive and can provide excellent color rendering.

- Linear fluorescent lamps are available in different wattages and sizes; the 4’ 32-watt (W) T8 is the most common. Low wattage, energy saving alternatives include 28W and 25W lamps. Other products include T5 lamps and lamps in 2’ and 8’ lengths.
- Not all fluorescent lamps are compatible with dimmable ballasts. Low-wattage lamps often are not recommended for dimming applications.

Programmed-start ballasts are best suited for frequently switched applications. Ensure fluorescent products selected are suited for the dimming and multilevel control requirements included in Section 130.1 of the Energy Code.

COMPACT FLUORESCENT LAMPS (CFL)
With CFLs, the linear tube design of traditional fluorescent lights has been curved into a more compact shape, facilitating an incandescent lamp replacement. An electronic ballast, either in the base of the CFL or installed separately, activates the lamp and regulates the electrical current. Not all CFLs are dimmable and some can have delayed start times, which can be problematic in some applications. These light sources are typically installed in commercial downlights.
INCANDESCENT

Incandescent lamps are highly inefficient, but their initial cost is low. These lamps do have excellent color, but they burn out quickly compared to other sources. This can increase maintenance costs over time. In addition, incandescent light sources often provide unwanted heat when used in certain applications.

HALOGEN

Halogen lamps burn hotter and last longer than standard incandescent lamps, producing a brighter, whiter light. Halogen lamps are about 25% more efficient than standard incandescent lamps. Halogens are a good alternative when incandescent lighting is necessary.

METAL HALIDE AND HIGH PRESSURE SODIUM

Metal halide (MH) and high pressure sodium (HPS) lighting often are found in outdoor applications. Both are used in some indoor spaces, such as warehouses and other high-bay applications. Metal halide is fairly efficient and long lived. It can provide a CRI of 60 or more. HPS is also very efficient, but it has poor color properties that produce a yellow light with low CRI. Neither is well-suited for use with occupancy controls or frequent switching. Once extinguished, these technologies take five minutes or more before they can be turned back on.

Ceramic metal halide (CMH) lamps are a newer variation of MH technology commonly used in spot and track lighting applications. CMH lamps can produce white light with a CRI as high as 96, making them suitable for color-critical applications. Similar to standard MH lamps, CMH can take up to 10 minutes to reach full light output.

INDUCTION

Induction lamps operate similarly to fluorescent lamps, but without the electrodes and filaments. Induction sources have long lifetimes and seldom need replacing. These lamps are very efficient and compatible with many types of lighting controls, and their long life (60,000–100,000 hours) means minimal maintenance. Induction lamps often are used in high bay, low bay and outdoor applications.
CONTROL STRATEGIES

Lighting controls increase the flexibility and functionality of commercial lighting systems. The control requirements of the Energy Code minimize energy consumption while ensuring sufficient lighting levels. There are many control strategies that can be deployed in nonresidential buildings in order to meet these requirements, including occupancy control, scheduling, tuning, daylighting and automated demand response.

Sensors and controls save energy by automatically adjusting lighting based on time of day, available task needs, daylight, occupancy and electricity supply or cost.

SCHEDULING

Time switches, commonly used in indoor and outdoor applications, switch lights on or off based on daylight hours and geographical location. Some time clocks and curfew dimming controls automatically adjust dimmable sources, such as LEDs or CMH lamps, to operate at different light levels according to a schedule. Dimming lights during the least active hours of operation reduces energy waste and light pollution.

WHAT IS THE CLCATT LOOKING FOR?

The Certified Lighting Controls Acceptance Test Technician (CLCATT) ensures that the following indoor lighting control devices and systems are installed and functioning as required by the Energy Code before the building is occupied:

- Automatic daylighting controls
- Automatic time-switch controls
- Occupancy sensors
- Demand responsive controls
- Institutional tuning controls

Time Clocks (left to right): Leviton EZ-MAX Plus B Relay Panel, Wattstopper LPB Peanut Lighting Control Panels
TUNING
Tuning, also known as high-end trim or institutional tuning, reduces the level of general lighting in an area. Luminaire specifications and layouts typically assume a light loss factor, so light levels often are brighter than necessary to allow for light output degradation over the luminaire’s life. Tuning allows the luminaires to be dimmed to the recommended light level initially and later restored to full output when light output has degraded. This strategy saves energy, maintains more consistent light levels over the life of the luminaire and extends lamp life.

WHAT FEATURES ARE REQUIRED FOR VACANCY SENSORS?
To be in compliance, a vacancy sensor must provide:
- The capability of a maximum time out of 20 minutes
- A 15–30 second grace period to automatically turn lighting on after the sensor has timed out
- No override switch that disables the sensor
- A visible status signal that indicates if the device is operating properly (this signal may have an override if the occupant prefers it off)

WHAT FEATURES ARE REQUIRED FOR OCCUPANCY SENSORS?
To be in compliance, an occupancy sensor must provide:
- A maximum time out of 20 minutes
- A visible status signal that indicates if the device is operating properly (this signal may have an override if the occupant prefers it off)
- Allowance for all lights to be manually turned off regardless of the status of occupancy

VACANCY AND OCCUPANCY SENSORS
Vacancy sensors automatically dim or switch lighting off when the sensor’s field of view has been vacant for a predetermined, programmed period of time. Lights controlled by vacancy sensors, or manual-on occupancy sensors, must be turned on manually (where the occupancy makes a deliberate decision to add electric lighting). This strategy can result in significant energy reductions when general lighting remains off for the majority of the day.

Occupancy sensors automatically turn lights on when an occupant is present in the sensor’s field of detection, in addition to performing the automatic-off function of a vacancy sensor. Occupancy sensors can be programmed to a strategy called partial-on or partial-off control, where only a portion of the controlled lights are programmed to turn on or off.
DAYLIGHTING
Also called photo controls, daylighting devices utilize daylight sensors to adjust lighting loads based on ambient light levels. Daylighting controls are required in all spaces that have:

- Skylights, windows or other daylight sources
- At least 24 ft² of glazing
  - For garage areas, the threshold is 36 ft² of glazing or opening.
- At least 120 watts of electric lighting in the combined skylit and primary sidelit daylit zone

WHAT IS GLAZING?
The term ‘glazing’ is used to describe any opening in a building envelope that is replaced with glass, such as a window or skylight.

AUTOMATED DEMAND RESPONSE
Utilities issue demand response (DR) events when demand for electricity is expected to exceed generation capacity. Commercial electricity customers may choose to participate in utility DR programs in exchange for financial incentives.

The Energy Code requires all commercial buildings with 4,000 watts of installed lighting power that are also required to have multilevel lighting controls (Section 130.1(b)) to be capable of receiving and automatically responding to DR signals by reducing lighting energy use. Spaces within the building where a health or life safety statute, ordinance or regulation does not permit the lighting to be reduced are not required to have demand responsive controls and do not count toward the 4,000 watt threshold.
LIGHTING CONTROL SYSTEM ARCHITECTURES

Control systems can be as simple as an on/off switch or as complex as a building-level networked control system that integrates daylighting, occupancy sensing, scheduling and demand response. There are four control architectures most commonly used in commercial spaces: self-contained lighting control, luminaire-integrated control, circuit-level control and networked control systems.

SELF-CONTAINED CONTROLS
This is the simplest category of control. This category includes on/off switches, dimmers, photo controls and occupancy sensors. Under the Energy Code, each area is required to be served by separate controls.

LUMINAIRE-INTEGRATED CONTROLS
Also known as on-board controls, these controls are integrated into the luminaire by the manufacturer. Typically, these controls only influence the luminaire it is integrated to. luminaires can come with occupancy or daylighting controls.

CIRCUIT-LEVEL CONTROL
This control strategy automatically addresses entire circuits serving lighting and certain plug loads, typically controlling them based on a programmed schedule or area occupancy.

The strategy can be implemented through a timer or time-clock feature that enables on/off control based on a schedule defined by hours of building operation. Daylighting and demand response control strategies also can be applied at the circuit level.
Networked lighting control systems can control select groups of luminaires or lighting for whole buildings, facilities or campuses. There are centralized, panel-based wired systems and distributed intelligence systems which are available in both wired and wireless forms. These systems can integrate daylighting, advanced scheduling, occupancy-based control, demand response and data monitoring.

Lighting also can be controlled as part of a computerized building management system (BMS) or energy management control system (EMCS) that can address HVAC and other systems in addition to lighting. Networked control systems may not override manual controls under the Energy Code.
There are two steps required to comply with the Energy Code.

1. Meet all mandatory requirements and ensure that they perform all required functions.
2. Select your method of compliance by choosing either the performance approach or the prescriptive approach.

**MANDATORY REQUIREMENTS**

All nonresidential buildings must meet mandatory requirements for lighting systems and lighting controls. Mandatory requirements include area controls, multilevel controls, shut-off controls, automatic daylighting controls, and demand responsive controls.

**PRESCRIPTIVE APPROACH**

The prescriptive approach is a set of performance levels for various building components, where each component must meet the required minimum efficiency. This approach often is used in retrofit projects.

**PERFORMANCE APPROACH**

The performance approach allows energy allotments (defined in the prescriptive requirements) to be traded between building systems, such as lighting, HVAC or the building envelope.

This compliance approach requires using energy analysis software approved by the Energy Commission to model the overall energy performance of a building. For new construction of nonresidential buildings, the prescriptive approach can be used for some building systems while the performance approach is used for others.

**APPROVED COMPUTER COMPLIANCE PROGRAMS**


Those following the performance approach to comply with the Energy Code must use software to model building energy use and that software must be approved by the Energy Commission.

More information on approved computer compliance programs is available through the Energy Commission’s website.
NAVIGATING THE ENERGY CODE: LIGHTING REQUIREMENTS

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CHAPTER 4  COMPLIANCE REQUIREMENTS

CONTROLS DEVICES AND SYSTEMS, BALLASTS AND LUMINAIRES

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Alterations

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§130.1, as applicable per Table 141.0-F §141.0(b)2I Table 141.0-F §141.0(b)3 Table 141.0-E

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Outdoor Lighting

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Section 130.1
MANDATORY REQUIREMENTS FOR INDOOR LIGHTING

Lighting control requirements constitute a large portion of the mandatory lighting requirements contained in the Energy Code. The requirements for indoor lighting controls are in Section 130.1. For new construction projects, including additions, all subsections within Section 130.1 must be considered. Certain types of alterations will trigger these requirements as well. Not all requirements must be implemented in every project.

Determining what control requirements will be required in an alteration project is connected to the quantity of luminaires affected by the project per enclosed space and the actual lighting energy use calculations. Some requirements may be bypassed if the lighting power of a space is under certain thresholds defined by the prescriptive requirements. Prescriptive lighting power allowance requirements are listed under Section 140.6.

Under the Energy Code, an alternate compliance option to the new construction pathway is available for lighting alteration projects. Projects in small buildings or tenant spaces (5,000 ft² or less) that include one-for-one luminaire alterations to 50 or more luminaires can opt to retrofit with new luminaires that achieve at least 40% power reductions over pre-alteration luminaires. Multilevel light controls, automatic daylighting controls and demand responsive controls are not required for these projects.

While most requirement triggers are based on a percentage of affected luminaires or a percentage of an allowed lighting power density (LPD), the demand responsive controls requirements are additionally triggered by reaching a total lighting load of 4,000 watts or greater and only apply to areas that are required to meet the Multilevel Lighting Control requirements in Section 130.1(b). New construction and alterations that involve 4,000 watts or less or are exempt from Section 130.1(b) within a single building are not required to comply with demand responsive controls requirements.

All lighting equipment and control devices specified to meet the requirements of the Energy Code must be installed according to manufacturer’s instructions and lighting controls should follow the performance, acceptance testing and certification requirements listed in the Energy Code.
Mandatory lighting control requirements include provisions for the use of manual area controls, multilevel lighting controls, automatic shut-off controls, automatic daylighting controls and demand response control systems. These requirements apply to nearly all new construction projects, both indoors and outdoors. Mandatory indoor lighting control requirements can be found in Section 130.1. Outdoor lighting control requirements are contained in Section 130.2. Acceptance test requirements are found in Section 130.4 and acceptance test procedures in Nonresidential Appendix (NA) 7.6, 7.7 and 7.8.

Section 130.1(a)
MANUAL AREA CONTROLS
The luminaires in each area must be independently controlled from luminaires in other areas by manual lighting controls that provide on/off functionality.

The Energy Code calls for a manual switch to be readily accessible and located in the same room or area as the lighting it controls. Spaces that are exempt from the readily accessible requirement include restrooms with two or more stalls, parking areas, stairwells, corridors, and areas of the building intended for access or use by the public. Spaces that are exempt from the requirement for controls to be located in the same room or area as the lighting it controls are listed in the sidebar to the right. Although lighting control software applications for mobile devices are available, it is still necessary to install a switch or device with on/off functionality. Other installed controls may not override manual controls.

SEPARATE CONTROL OF DIFFERENT LIGHTING SYSTEMS
Within each area enclosed by ceiling-height partitions:

- General lighting must be controlled separately from all other lighting systems.
- Ornamental and display lighting, including lighting for floor and wall displays, window displays, case displays and special effects lighting, must each be separately controlled.

EXCEPTIONS: SECTION 130.1(a)2
Exception 1: For malls and atria, main entry lobbies, auditorium areas, dining areas, retail merchandise sales areas, wholesale showroom areas, commercial and industrial storage areas, general commercial and industrial work areas, convention centers, arenas, psychiatric and secure areas in healthcare facilities and other areas where placement of a manual area control poses a health and safety hazard, the manual area control may instead be located so that a person using the control can see the lights or area controlled by that control, or visually signal or display showing the current state of the controlled lighting.

Exception 2: In healthcare facilities, for restrooms and bathing rooms intended for a single occupant, the lighting control may be located outside the enclosed area but directly adjacent to the door.
**EGRESS LIGHTING**

Up to 0.1 watts per ft² of indoor lighting may be continuously illuminated to allow for means of egress illumination consistent with California Building Code Section 1008 in building spaces designated for emergency egress on building plans. This lighting is not required to comply with the manual area control requirements, and egress lighting controls cannot be accessible to unauthorized personnel.

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**LIGHTING FOR MEANS OF EGRESS**

Requirements Under California’s Building Code and Energy Code

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**Recommended Light Levels When Occupied**

The Illuminating Engineering Society recommends that independent passageways and typical stairways be lit to five footcandles (fc) at the walking surface. High activity stairs are recommended to be lit to 10 fc.

---

**Exit Access**

That portion of a means of egress system that leads from any occupied portion of a building or structure to an exit.

**Exit Discharge**

That portion of a means of egress system between the termination of an exit and a public way.

**Exit**

That portion of a means of egress system between the exit access and the exit discharge. Areas in occupied exit passageways include interior and exterior stairways and ramps, stair passageways, exterior stairways and ramps, and horizontal exits.

**Public Way**

A street, alley or other parcel of land open to the outside air leading to a street and is permanently appropriated for public use.

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The requirements of CBC Section 1008 are applicable when applying mandatory partial-off occupancy control requirements from the Energy Standards, which means that the means of egress illumination levels shall not be less than 1 footcandle at the walking surface. This applies to the entire means of egress and includes exit access, exit and the exit discharge spaces.

Partial-off occupancy controls (Energy Standards Section 132.10) are required for stairways and stairways (means of egress) in newly constructed buildings and lighting alterations in existing buildings. Partial-off occupancy controls reduce lighting power by at least 50% during vacant periods and automatically return to full output when someone is detected in the space. Even during vacant periods when lighting is reduced, it must remain at least 1 fc at the walking surface per CBC Section 1008.
**Section 130.1(b)**

**MULTILEVEL LIGHTING CONTROLS**

Dimmable lighting provides the opportunity to reduce lighting energy use while allowing occupants to choose an appropriate light level for each area at any time. The number of mandatory control steps is based on the light source type, per Table 130.1-A. If multilevel lighting is required, multilevel controls must allow the user to activate all the required control steps.

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### Multilevel Lighting Controls and Uniformity Requirements for General Lighting

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<th>Luminaire Type</th>
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<th>Uniform Level of Illuminance Achieved By:</th>
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<td>Continuous Dimming 10–100%</td>
<td>Commercial applications, including recessed, downlight, accent and decorative</td>
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<td>Line-voltage sockets except GU-24</td>
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<td>Continuous Dimming 20–100%</td>
<td>Downlights</td>
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<tr>
<td>Fluorescent luminaires</td>
<td>Minimum one step between 30–70%</td>
<td>Continuous dimming; stepped dimming; or switching alternate lamps in a luminaire; or separately switching circuits in multi-circuit track with a minimum of two circuits.</td>
<td>Downlights, recessed</td>
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<tr>
<td>GU-24 sockets rated for fluorescent ≤ 20W</td>
<td>Minimum one step between 30–70%</td>
<td></td>
<td></td>
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<tr>
<td>Pin-based compact fluorescent ≤ 20W</td>
<td>Minimum one step between 30–70%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear fluorescent and U-bent fluorescent ≤ 13W</td>
<td>Minimum one step in each range</td>
<td>Stepped dimming; continuous dimming; or switching alternate lamps in each luminaire, having a minimum of four lamps per luminaire, illuminating the same area and in the same manner.</td>
<td>Accent and decorative</td>
</tr>
<tr>
<td>Track Lighting</td>
<td>Minimum one step in each range</td>
<td>Stepped dimming; continuous dimming; or switching alternate lamps in each luminaire, having a minimum of two lamps per luminaire, illuminating the same area and in the same manner.</td>
<td>Recessed, surface mount</td>
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<td>Linear and U-bent fluorescent &gt; 13W</td>
<td>Minimum one step between 50–70%</td>
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<td>High bay, low bay and outdoor</td>
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<tr>
<td>Other light sources, including HID and Induction</td>
<td>Minimum one step between 50–70%</td>
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* Full rated input power of ballast and lamp, corresponding to maximum ballast factor.

* Includes only pin-based lamps: twin tube, multiple twin tube and spiral lamps.

**NOTE:** Multilevel controls must not override the functionality of other controls required for compliance.
**Section 130.1(c)**

**SHUT-OFF CONTROLS**

Shut-off controls automatically reduce lighting power when a space is typically unoccupied. These controls are required in addition to the manual area lighting control and multilevel control requirements in **Section 130.1(a) and (b)**. For buildings not in continuous operation, almost all lighting should be off when a building is unoccupied for 20 minutes or more. Lighting must be controlled by one or more of the following types of automatic shut-off controls:

- Automatic time switches
- Occupant sensing controls
- Other control capable of automatically shutting off all of the lighting when the space is typically unoccupied, such as an Energy Management Control System

Lighting in each enclosed area and every building floor (except in stairwells) must separately and automatically shut off when the building is vacant. In addition, no more than 5,000 ft\(^2\) may be covered by a single control. Again, up to 0.1 W/ft\(^2\) may be left on for building egress. Also, emergency lighting that is connected to a separate emergency power supply and is on only when normal power fails is exempt from shut-off requirements.

**Countdown timer switches:** Countdown timer switches generally do not comply with shut-off requirements. However, they are allowed in the following specific applications:

- Closets smaller than 70 ft\(^2\)
- Server aisles in server rooms

In these two areas, the timer switch must be programmed for a maximum time period of 10 minutes for closets and 30 minutes for server room aisles.

**Automatic Time-Switch Control:** Where time-switch controls are installed instead of occupant sensing controls, occupants must have a manual override option that allows the lighting to remain on outside the scheduled time for a maximum of two hours, per **Section 130.1(c)3**, as well as automatic holiday shut-off, per **Section 130.1(c)4**. The automatic time-switch control may include a manual-on mode.

**Occupant Sensing Controls Required:** When the following rooms are unoccupied for 20 minutes or less, all the lighting should automatically be turned off by an occupant sensing control:

- Offices 250 ft\(^2\) or less
- Multipurpose room less than 1,000 ft\(^2\)
- Classrooms of any size
- Conference rooms of any size
- Restrooms of any size

**SHUT-OFF CONTROL SPECIAL CASES:**
The maximum size of the control zone increases to 20,000 ft\(^2\) in:

- Malls
- Auditoriums
- Single tenant retail spaces
- Industrial facilities
- Convention centers and arenas

The override may exceed 2 hours in the following spaces if captive-key override is utilized:

- Malls
- Auditoriums
- Single tenant retail spaces
- Industrial spaces
- Arenas

**HEALTHCARE FACILITIES**
Healthcare facilities are exempt from all shut-off control requirements.

**MEANS OF EGRESS EXCEPTION:**
Lighting providing means of egress illumination shall be configured to provide at least the amount of light required by California Building Code Section 1008 while in the partial-off mode (see page 38).
The Energy Code also specifies how the lighting in these spaces can be activated by the occupancy sensor. For spaces that also require multilevel lighting controls, sensors must act as a partial-on device or a vacancy sensor. The partial-on strategy may only automatically activate between 50 and 70% of the controlled lighting power. For areas not required to have multilevel controls, the sensor may be a traditional auto-on occupancy sensor, a vacancy sensor or employ a partial-on strategy.

All controls must allow for lights to be manually shut off regardless of sensor status.

**FULL OR PARTIAL-OFF OCCUPANCY CONTROLS**

Full or partial-off occupancy controls are required in select areas. When a partial-off strategy is used, lighting systems must be reduced by at least 50% during vacant periods. This is in addition to meeting Section 130.1(c)1, which means that there must be an automatic shut-off control to turn lighting off when the space is typically unoccupied (e.g., after hours when the building is closed).

- Aisle ways and open areas in warehouses
- Library book stack aisles
- Corridors
- Stairwells
- Offices greater than 250 ft²

For offices greater than 250 ft², control zones should:

- Be 600 ft² or smaller,
- Utilize a 20 minute or less timeout to:
  - Reduce lighting by at least 80 percent power in each control zone when unoccupied
  - Turn lighting off when the whole office is unoccupied
- Turn lighting on automatically to any level, up to full power, when a control zone becomes occupied

**PARTIAL-OFF OCCUPANCY CONTROLS**

Parking garages, parking areas and loading/unloading areas must use a partial-off strategy. Additionally, common area corridors and stairwells that provide access to hotel or motel guest rooms must use a partial-off strategy. In these areas, lighting is not required to be fully shut off.

**HOTEL AND MOTEL GUEST ROOM CONTROLS**

Hotel and motel guest rooms must use captive card-key controls, occupancy sensing controls or other automatic controls to meet shut-off requirements. For hotel and motel guest rooms, the lighting must be shut off no more than 20 minutes after the room is vacated. One high-efficacy luminaire (as defined in Table 150.0-A) is exempt from these requirements so long as it is switched separately by a switch located within six feet of the entry door.
Section 130.1(d)

DAYLIGHTING CONTROLS

The Energy Code addresses three types of daylit zones:

1. Skylit zones: Areas illuminated by one or more skylights
2. Primary sidelit zones: Daylit areas directly adjacent to one or more windows
3. Secondary sidelit zones: Areas not directly adjacent to a window but close enough to still receive some daylight

GENERAL LIGHTING IN DAYLIT ZONES

Automatic daylighting controls are required for luminaires that meet these criteria:

- Provide general lighting (as opposed to display lighting, decorative chandeliers or ornamental lighting)
- Located at least 50% in a skylit, primary sidelit, or secondary sidelit zone

Additionally, luminaires in skylit, primary sidelit daylit, and secondary sidelit daylit zones must be controlled separately from each other. Luminaires installed where a skylit and primary sidelit daylit zone overlap must be controlled as part of the skylit daylit zone. Luminaires installed where a primary and secondary sidelit daylit zone overlap must be controlled as part of the skylit daylit zone.

DAYLIGHTING CONTROL REQUIREMENTS

When compliance with this section is required, general lighting will be adjusted with automatic daylighting controls that:

- Provide multilevel lighting in accordance with Table 130.1-A
- Maintain design light levels for each space (i.e., at or above those provided by electric lighting when no daylight is available)
- Reduce general lighting power in a daylit zone by at least 90% when the daylight contribution in that zone is more than 150% of the general lighting system’s design light level at full power (for areas other than parking garages)

When photosensors are located within the daylit zone, at least one photosensor must be located so that they are not readily accessible to unauthorized personnel. The location where calibration adjustments are made to the automatic daylighting controls must be accessible to authorized personnel but may be inside a locked case or under a cover requiring a tool for access.

PARKING GARAGES

For parking garage areas with 36 ft² or more of glazing or opening, automatic daylighting controls shall be used to control luminaires that provide general lighting that are in the primary and secondary sidelit daylit zones. All primary and secondary sidelit daylit zones shall be shown on the plans.
Automatic daylighting controls in parking garages must be configured to operate according to the previously stated daylighting control requirements. They also must reduce general lighting power in a daylit zone to zero when illuminance levels measured at the farthest edge of the secondary sidelit zone away from the glazing or opening are greater than 150% of the controlled lighting's illuminance when no daylight is available. The combined illuminance from the controlled lighting and daylight shall not be less than the illuminance from controlled lighting when no daylight is available.

**DAYLIGHTING CONTROL REQUIREMENTS FOR ALTERATIONS**

In projects that qualify as alterations, the daylighting requirements in this section often can be bypassed if the actual lighting power is 80% or lower of the lighting power allowance required using the area category method. Additionally, only altered luminaires need to comply with the daylighting control requirements.

**PRESCRIPTIVE REQUIREMENTS**

Enclosed spaces with a roof, located in Climate Zones 2–15 that are larger than 5,000 ft² with a ceiling height greater than 15 feet and a lighting power density of 0.5 watts per square foot or more, must have at least 75% of their total floor area in daylit zones, per Section 140.3(c).

**CALIFORNIA CLIMATE ZONES**

www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/climate-zone-tool-maps-and

California has a diversity of climates not seen in other states, and the Energy Code accounts for these variations using a set of sixteen climate zones. Certain Energy Code requirements depend on the specific climate zone that the building is located in. Thus, it is important for builders and building officials to know which climate zones apply to their projects.

**EXCEPTIONS: PARKING GARAGES**

- Luminaires located in the daylight adaptation zone. Daylight adaptation zone is defined in Section 100.1.
- Parking garage areas where the total combined general lighting power in the primary and secondary sidelit daylight zones is less than 60 watts.

**DEFINING “PARTIALLY IN” THE DAYLIGHTING ZONE**

The Nonresidential Compliance Manual defines “partially in” as being at least 50% inside the secondary sidelit daylit zone.
DETERMINING DAYLIT ZONES

All skylit daylit zones, primary sidelit daylit zones and secondary sidelit daylit zones must be shown on building plans that are submitted for plan check when applying for a permit. Combined primary and secondary sidelit daylit zones in parking garages must also be shown on the plans.

CALCULATING A SKYLIT DAYLIT ZONE

1. Define the shape of the skylight. A rectangular skylight produces a rectangular daylight zone and a circular skylight produces a circular zone.

2. Determine the average ceiling height (CH) surrounding the skylight. The ceiling height is the vertical distance from the finished floor level to the ceiling.

3. Multiply the CH by 0.7.

4. Add the value determined in Step 3 in all directions around the skylight (starting at the edges of the opening).

5. Subtract any area blocked from receiving daylight by a permanent obstruction taller than half of the distance from the floor to the bottom of the skylight.
CHAPTER 4  COMPLIANCE REQUIREMENTS

CALCULATING A PRIMARY SIDELIT DAYLIT ZONE

The diagram on this page demonstrates how to calculate the primary sidelit daylit zone.

1. **Determine the window head height for each window.**
   The window head height (WHH) is the vertical distance from the finished floor level to the top of the glazing.

2. **Determine the depth of the zone.** The zone depth is one window head height into the area adjacent to the window.

3. **Calculate the width of the zone.** The zone width is the window’s width added to half the window head height on each side of the window.

4. **Subtract any area blocked from receiving daylight by a permanent obstruction that is six feet or taller.** Modular furniture is not considered a permanent obstruction.

### EXCEPTION FOR VERTICAL GLAZING WITH OVERHANGS

It is important to remember that areas adjacent to vertical glazing below an overhang, where the overhang covers the entire width of the vertical glazing, and there is no vertical glazing above the overhang, and where the ratio of the overhang projection to the overhang rise is greater than 1.5 for South, East and West orientations or greater than 1 for North orientations are exempt from daylighting requirements.
CALCULATING A SECONDARY SIDELIT DAYLIT ZONE

A secondary sidelit daylit zone extends one additional window head height beyond the primary sidelit daylit zone(s) adjacent to it.

1. Add one additional window head height to the depth of the primary sidelit daylit zone to determine the depth of the secondary sidelit daylit zone. The width of the secondary zone is the same as the width of the primary zone.

2. Subtract any area that is blocked from receiving daylight by a permanent obstruction that is six feet or taller.

Section 130.1(e) and Section 110.12
DEMAND RESPONSIVE CONTROLS

Lighting demand responsive controls requirements are listed under Section 110.12—Demand Management, which also include demand response (DR) requirements for other air conditioning units, electronic message boards, and controlled receptacles.

Automated demand response (ADR) programs use energy management technologies and controls to reduce peak demand and stabilize the grid more quickly and reliably than manual DR. An automated DR signal is sent from a utility or system operator to energy management control systems enrolled in ADR programs. The automated systems then reduce electricity use temporarily, according to pre-programmed load shed strategies.

Buildings that have 4,000 watts of installed lighting load or greater must include demand responsive controls in spaces that are equipped with multilevel lighting controls per Section 130.1(b). Spaces exempted from multilevel lighting control requirements are not required to be equipped with demand responsive lighting controls.

While demand responsive controls are required by the Energy Code, participation in utility DR programs is not. Building owners have the option to enroll in DR programs.
Demand responsive lighting controls are required to either be a certified OpenADR 2.0a, OpenADR 2.0b Virtual End Node (VEN) or be certified by the manufacturer as being capable of responding to a DR signal from a certified OpenADR 2.0b VEN.

The Energy Code requires that the controls be capable of communicating with the VEN using a wired or wireless bi-directional communication pathway. This allowance is ideal for cloud-based systems that offer DR capabilities. When communications are disabled or unavailable, all DR controls must continue to perform all other control functions provided by the control.

For compliance testing, the lighting controls must be able to demonstrate a 15% or greater reduction in lighting power.

Controlled receptacles must be capable of automatically turning off all loads connected to the receptacle in response to a demand response signal.

Section 130.1(f)
CONTROL INTERACTIONS
A new section has been added to the Energy Code defining the interactions of all mandatory indoor lighting controls (manual on/off, multilevel lighting, shut-off controls, automatic daylighting controls and demand responsive controls). Section 130.1(f) outlines how each system should operate to ensure that all functions of the mandatory lighting controls are permitted or incorporated by the system as a whole.

1. For general lighting, the manual area control must permit the amount of light provided while the lighting is on to be set, or adjusted, by the multilevel, shut-off, automatic daylighting and demand responsive controls specified in Section 130.1(b), (c), (d) and Section 110.12.

2. The manual area control must permit the shut-off control to turn the lighting down or off.

3. The multilevel lighting control must permit the automatic daylighting control to adjust the electric lighting level in response to changes in the amount of daylight in the daylit zone.

4. The multilevel lighting control must permit the demand responsive control to adjust the lighting during a demand response event and to return it to the level set by the multilevel control after the event.

5. The shut-off control must permit the manual area control to turn the lighting on. If the on request occurs while an automatic time-switch control would turn the lighting off, the on request must be treated as an override request consistent with Section 130.1(c)3.

6. The automatic daylighting control must permit the multilevel lighting control to adjust the level of lighting.

7. For lighting controlled by multilevel lighting controls and by occupancy sensing controls with an automatic-on function, the controls shall provide a partial-on function that is capable of automatically activating between 50–70% of controlled lighting power.

8. For space conditioning system zones serving only spaces that are required to have occupant sensing controls as specified in Section 130.1(c)5, 6 and 7, and where Table 120.1-A allows the ventilation air to be reduced to zero when the space is in occupied-standby mode, the space conditioning system shall be controlled by occupancy sensing controls as specified in Section 120.2(e)3.
Section 130.2
MANDATORY REQUIREMENTS FOR OUTDOOR LIGHTING

The Energy Code requirements for outdoor lighting apply to hardscape areas and other applications such as building façades. This typically consists of the paved, gravel or dirt portions of an outdoor building site but also may include planters or other small areas of landscaping within the application area. Sections 10-114, 110.9, 130.0, 130.2, 130.4 and 140.7 apply to newly constructed outdoor lighting systems. Section 141.0 applies to outdoor lighting systems that are either additions or alterations.

Additional information on sign lighting for indoor and outdoor applications is provided in the Sign Lighting section on page 87 of this guide.

Section 10-114
LIGHTING ZONES

Lighting Zones are based on U.S. Census Bureau data. They are designed to help limit light pollution and ensure light levels are appropriate for the purposes different areas serve.

Beginning with the 2005 Energy Code, the Energy Commission has specified lighting power allowances based on project locations and whether the surrounding environment is undeveloped (dark), rural (characterized by low ambient light levels) or urban (characterized by higher ambient light levels).

Lighting Zone 0 (LZ0) is designated specifically for undeveloped areas in parks and preserves, where no continuous lighting is installed. While continuous lighting in LZ0 is explicitly prohibited, sites may utilize a single luminaire of 15W or less at entrances to parking lots, trail heads or other areas in order to safely illuminate site facilities. In addition, luminaires installed in LZ0 cannot exceed the maximum zonal lumen limits for backlight, uplight and glare specified in Section 130.2(b) and Title 24, Part 11, Section 5.106.8.

Lighting Zone 1 (LZ1) maintains the lowest illumination level with the lowest lighting power allowances. This is the default designation for rural areas, like single or dual family residential areas, parks, agricultural districts and developed portions in government parks, recreation areas and wildlife preserves.

Lighting Zone 2 (LZ2) is the state default designation for urban clusters, which may have building types such as multifamily housing, mixed use residential neighborhoods, religious facilities, schools and light commercial business or industrial districts.

DARK-SKY ORDINANCES
A growing number of local governments have passed dark-sky ordinances that have lower lighting power allowances than the Energy Code. Check with the local permitting authority to determine if the project site’s default Lighting Zone designation has been altered by local jurisdiction.

The Energy Commission must review and approve any changes to LZ designation. Local jurisdictions that have been approved by the Energy Commission and additional resources are available at localenergycodes.com/content/adopted-ordinances.
Lighting Zone 3 (LZ3) is the state default designation for urban areas, which may have building types like high intensity commercial corridors, entertainment centers and heavy industrial or manufacturing districts.

There are no Lighting Zone 4 (LZ4) areas in California, but LZ4 allows the highest lighting power allowances.

To determine the Lighting Zone for a project, visit the U.S. Census Bureau’s website, tigerweb.geo.census.gov/tigerweb. Select the Urban Areas checkbox in the layers sidebar on the right, then enter the site address to determine if the site is within an urban area. If this is not indicated, the site is designated as rural.

**WHAT IS THE INTERNATIONAL DARKSKY ASSOCIATION (IDA)?**
darksky.org
The International Dark-Sky Association works to protect the night skies for present and future generations. In 2011, IDA and the Illuminating Engineering Society of North America approved the Model Lighting Ordinance (MLO), an outdoor lighting template designed to help municipalities develop outdoor lighting standards that reduce glare, light trespass and skyglow.

Learn more about the MLO here: www.darksky.org/our-work/lighting/public-policy/model-lighting-laws-policy/

**NOTE:** LZ4 is not a default designation. LZ4 designation can be granted only by the Energy Commission when a local government applies for exceptionally high lighting power allowances.
Section 130.2(b)
BACKLIGHT, UPLIGHT AND GLARE (BUG) RATING SYSTEM

Conscientious lighting designers long have sought to minimize adverse effects of nighttime lighting with luminaires that limit backlight (or light trespass), uplight (sky glow or light pollution) and glare (high-angle brightness). The Illuminating Engineering Society (IES) began implementing the TM-15-11/BUG rating system in 2011 to supplement its older cutoff system of luminaire classification.

The BUG rating system helps lighting designers select luminaires that meet state and local requirements for different outdoor Lighting Zones (LZ0–LZ4). The BUG system also allows for better comparison of solid-state luminaires with traditional HID luminaires. The Energy Code includes requirements limiting backlight, uplight and glare in certain applications. These requirements are based on best practices for lighting different applications while minimizing light pollution and energy waste.

A BUG rating consists of three parts that indicate how well the luminaire controls backlight, uplight and glare. Lower ratings indicate minimal amounts of stray light, light pollution or glare and are appropriate for use in less populated Lighting Zone areas. The numeric BUG rating corresponds to the Lighting Zone where it is appropriate to install.

The best possible rating in each category is 0 (B0, U0 or G0). Higher ratings, the highest being 5 (B5, U5 or G5), indicate poorer control. For example, a luminaire rated B2-U0-G1 delivers mediocre control of backlight, offers excellent control of uplight, and controls glare well.

BUG ratings correspond with the amount of light emitted at each secondary solid angle within the backlight, uplight or glare angles. Title 24, Part 11, Section 5.106.8 (CALGreen) lists the zonal lumen maximums allowed for backlight, uplight and glare within each outdoor Lighting Zone, which are provided on the next page of this guide. The BUG ratings for outdoor luminaires are included in most manufacturers’ photometric reports.

WHAT IS CALGREEN?
www.dgs.ca.gov/BSC/CALGreen
CALGreen, also known as Title 24, Part 11, was developed in an effort to meet the California Global Warming Solutions Act of 2006 (AB 32). The purpose of CALGreen is to improve public health, safety and general welfare by enhancing the design and construction of buildings through the use of building concepts having a reduced negative impact or increased positive environmental impact and encouraging sustainable construction practices.

The backlight, uplight and glare requirements for outdoor lighting are contained in CALGreen as part of the light pollution reduction section.
### Maximum Allowable Backlight, Uplight and Glare (BUG) Ratings\(^1,2\)

<table>
<thead>
<tr>
<th>Allowable Rating</th>
<th>LZ0</th>
<th>LZ1</th>
<th>LZ2</th>
<th>LZ3</th>
<th>LZ4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Allowable Backlighting Rating(^3) (B)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminaire greater than 2 mounting heights (MH) from property line</td>
<td>N/A</td>
<td>No Limit</td>
<td>No Limit</td>
<td>No Limit</td>
<td>No Limit</td>
</tr>
<tr>
<td>Luminaire back hemisphere is 1–2 MH from property line</td>
<td>N/A</td>
<td>B2</td>
<td>B3</td>
<td>B4</td>
<td>B4</td>
</tr>
<tr>
<td>Luminaire back hemisphere is 0.5–1 MH from property line</td>
<td>N/A</td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>B3</td>
</tr>
<tr>
<td>Luminaire back hemisphere is less than 0.5 MH from property line</td>
<td>N/A</td>
<td>B0</td>
<td>B0</td>
<td>B1</td>
<td>B2</td>
</tr>
<tr>
<td><strong>Maximum Allowable Uplight Rating (U)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For area lighting(^4)</td>
<td>N/A</td>
<td>U0</td>
<td>U0</td>
<td>U0</td>
<td>U0</td>
</tr>
<tr>
<td>For all other outdoor lighting, including decorative luminaires</td>
<td>N/A</td>
<td>U1</td>
<td>U2</td>
<td>U3</td>
<td>U4</td>
</tr>
<tr>
<td><strong>Maximum Allowable Glare Rating(^5) (G)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminaire greater than 2 MH from property line</td>
<td>N/A</td>
<td>G1</td>
<td>G2</td>
<td>G3</td>
<td>G4</td>
</tr>
<tr>
<td>Luminaire front hemisphere is 1–2 MH from property line</td>
<td>N/A</td>
<td>G0</td>
<td>G1</td>
<td>G1</td>
<td>G2</td>
</tr>
<tr>
<td>Luminaire front hemisphere is 0.5–1 MH from property line</td>
<td>N/A</td>
<td>G0</td>
<td>G0</td>
<td>G1</td>
<td>G1</td>
</tr>
<tr>
<td>Luminaire front hemisphere is less than 0.5 MH from property line</td>
<td>N/A</td>
<td>G0</td>
<td>G0</td>
<td>G0</td>
<td>G1</td>
</tr>
</tbody>
</table>

Based on Table 5.106.8 from CALGreen

\(^1\) IESNA Lighting Zones 0 are not applicable; refer to Lighting Zones as defined in the California Energy Code and Chapter 10 of the California Administrative Code.

\(^2\) For property lines that abut public walkways, bikeways, plazas and parking lots, the property line may be considered to be 5 feet beyond the actual property line for purpose of determining compliance with this section. For property lines that abut public roadways and public transit corridors, the property line may be considered to be the centerline of the public roadway or public transit corridor for the purpose of determining compliance with this section.

\(^3\) If the nearest property line is less than or equal to two mounting heights from the back hemisphere of the luminaire distribution, the applicable reduced Backlight rating shall be met.

\(^4\) General lighting luminaires in areas such as outdoor parking, sales or storage lots shall meet these reduced ratings. Decorative luminaires located in these areas shall meet U-value limits for "all other outdoor lighting."

\(^5\) If the nearest property line is less than or equal to two mounting heights from the front hemisphere of the luminaire distribution, the applicable reduced Glare rating shall be met.
### Uplight Ratings (Maximum Zonal Lumens)

<table>
<thead>
<tr>
<th>Secondary Solid Angle</th>
<th>Maximum Zonal Lumens per Outdoor Lighting Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LZ0 (U0)</td>
</tr>
<tr>
<td>Backlight High (UH)</td>
<td>0</td>
</tr>
<tr>
<td>100 to 180 degrees</td>
<td>0</td>
</tr>
<tr>
<td>Backlight Low (UL)</td>
<td>0</td>
</tr>
<tr>
<td>90 to &lt; 100 degrees</td>
<td>0</td>
</tr>
</tbody>
</table>

### Backlight Ratings (Maximum Zonal Lumens)

<table>
<thead>
<tr>
<th>Secondary Solid Angle</th>
<th>Maximum Zonal Lumens per Outdoor Lighting Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LZ0 (B0)</td>
</tr>
<tr>
<td>Backlight High (BH)</td>
<td>110</td>
</tr>
<tr>
<td>60 to 80 degrees</td>
<td>110</td>
</tr>
<tr>
<td>Backlight Medium (BM)</td>
<td>220</td>
</tr>
<tr>
<td>30 to &lt; 60 degrees</td>
<td>220</td>
</tr>
<tr>
<td>Backlight Low (BL)</td>
<td>110</td>
</tr>
<tr>
<td>0 to &lt; 30 degrees</td>
<td>110</td>
</tr>
</tbody>
</table>

### Glare Ratings (Maximum Zonal Lumens)

**GLARE RATING FOR ASYMMETRICAL LUMINAIRE TYPES (TYPE I, TYPE II, TYPE III, TYPE IV)**

<table>
<thead>
<tr>
<th>Secondary Solid Angle</th>
<th>Maximum Zonal Lumens per Outdoor Lighting Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LZ0 (G0)</td>
</tr>
<tr>
<td>Forward Very High (FVH)</td>
<td>10</td>
</tr>
<tr>
<td>80 to 90 degrees</td>
<td>10</td>
</tr>
<tr>
<td>Backlight Very High (BVH)</td>
<td>10</td>
</tr>
<tr>
<td>80 to 90 degrees</td>
<td>10</td>
</tr>
<tr>
<td>Forward High (FH)</td>
<td>660</td>
</tr>
<tr>
<td>60 to &lt; 80 degrees</td>
<td>660</td>
</tr>
<tr>
<td>Backlight High (BH)</td>
<td>110</td>
</tr>
<tr>
<td>60 to &lt; 80 degrees</td>
<td>110</td>
</tr>
</tbody>
</table>

**GLARE RATING FOR QUADRILATERAL SYMMETRICAL LUMINAIRE TYPES (TYPE V, TYPE V SQUARE)**

<table>
<thead>
<tr>
<th>Secondary Solid Angle</th>
<th>Maximum Zonal Lumens per Outdoor Lighting Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LZ0 (G0)</td>
</tr>
<tr>
<td>Forward Very High (FVH)</td>
<td>10</td>
</tr>
<tr>
<td>80 to 90 degrees</td>
<td>10</td>
</tr>
<tr>
<td>Backlight Very High (BVH)</td>
<td>10</td>
</tr>
<tr>
<td>80 to 90 degrees</td>
<td>10</td>
</tr>
<tr>
<td>Forward High (FH)</td>
<td>660</td>
</tr>
<tr>
<td>60 to &lt; 80 degrees</td>
<td>660</td>
</tr>
<tr>
<td>Backlight High (BH)</td>
<td>660</td>
</tr>
</tbody>
</table>
CHAPTER 4 COMPLIANCE REQUIREMENTS

Applications with BUG Limits: Outdoor luminaires rated 6,200 lumens or greater must comply with backlight, uplight, and glare limitations. This applies even when a project is exempt from wattage allowances (Section 140.7(a)) and for all alterations of any size.

Applications without BUG Limits: Lamps and luminaires in these applications are not required to comply with BUG requirements:

1. Signs
2. Lighting for building façades, public monuments, statues and vertical surfaces of bridges
3. Lighting not permitted by a health or life safety statute, ordinance or regulation to be a cutoff luminaire
4. Temporary outdoor lighting
5. Replacement of existing pole-mounted luminaires in areas where all of the following are true:
   • Existing luminaire does not meet the luminaire BUG requirements
   • Spacing between poles is greater than six times the mounting height of the existing luminaires
   • No additional poles are being added
   • No new wiring is being installed
   • Connected lighting power is not increased
6. Luminaires that illuminate the public right of way on publicly maintained roadways, sidewalks and bikeways
7. Outdoor lighting attached to a hotel or motel building and separately controlled from the inside of a guest room

The Energy Code does not require luminaires selected for these purposes to comply with BUG limits, but best practices dictate limiting light trespass and preserving dark skies whenever possible.
REQUIRED OUTDOOR LIGHTING CONTROLS

Section 130.2(c)1, 130.2(c)2
ALL OUTDOOR LIGHTING

Outdoor lighting must be independently controlled from other electrical loads, and the controls must meet the following requirements in Section 130.2(c)1 and Section 130.2(c)2.

All outdoor lighting must be equipped with photo controls, astronomical time switch devices or other controls capable of automatically shutting off all lighting when daylight is available.

Automatic scheduling controls are required for all outdoor lighting and may be installed in combination with motion sensing controls or other outdoor lighting controls. The automatic scheduling controls must have the following capabilities:

- Reduce outdoor lighting power by at least 50% but no more than 90% and be capable of turning the lighting off separately during scheduled unoccupied periods
- Allow scheduling of a minimum of two nighttime periods with independent lighting levels and may include an override function that turns lighting on during its scheduled dim or off state for no more than two hours when an override is initiated
- Pass the required Acceptance Tests for outdoor lighting controls in Section 130.4(a)6

Using part-night outdoor lighting controls can fulfill the automatic scheduling control requirements.

Section 130.2(c)3
MOTION SENSING CONTROLS

Motion sensing controls are required to be installed in combination with the following luminaires:

- Outdoor luminaires where the bottom of the luminaire is mounted 24 feet above grade or lower, other than those providing building façade, ornamental hardscape, outdoor dining and outdoor sales frontage lighting
- Bilaterally symmetric outdoor wall mounted luminaires mounted 24 feet above grade or lower that are installed for building façade, ornamental hardscape or outdoor dining lighting

Motion sensing controls may be installed for other outdoor lighting and in combination with other outdoor lighting controls. Motion sensing controls shall be capable of:

- Reducing the outdoor lighting power of each controlled luminaire by at least 50% but no more than 90%
- Turning the luminaire off during unoccupied periods
- Reducing the lighting to its dim or off state no longer than 15 minutes after the area has been vacated
- Returning the lighting to its on state when the area becomes occupied

EXCEPTIONS:
OUTDOOR LIGHTING CONTROLS
Outdoor lighting not permitted by a health or life safety statute, ordinance or regulation to be turned off or reduced is exempt from these requirements.

Lighting in tunnels required to be illuminated 24 hours per day and 365 days per year is exempt from these requirements.

OUTDOOR LUMINAIRES
Where the bottom of an outdoor luminaire is mounted 24 feet above grade or lower, the luminaire must be controlled by a motion sensing control that automatically reduces lighting power by 50–90% during vacant periods. If the luminaire is 40 watts or less, it is exempt.
No more than 1,500 watts of lighting power shall be controlled by a single sensor.

**EXCEPTIONS TO MOTION SENSING CONTROL REQUIREMENTS**

1. Luminaires with a maximum rated wattage of 40 watts each are not required to have motion sensing controls.
2. Applications listed as exceptions to Section 140.7(a).
3. Lighting subject to a health or life safety statute, ordinance or regulation may have a minimum time-out period longer than 15 minutes or a minimum dimming level above 50% when necessary to comply with the applicable law.

**Section 130.4**

**ACCEPTANCE TESTING**

Lighting control systems must be tested by a certified lighting controls acceptance test technician after they are installed and commissioned. Acceptance tests are required under the Energy Code and ensure that controls operate in accordance with Energy Code requirements. Functional test results also must be included in commissioning documents when required under Section 120.8.

Acceptance testing is required for the following lighting control systems:

- Automatic daylighting controls
- Shut-off controls
- Demand responsive controls
- Institutional tuning controls used to earn a power adjustment factor (PAF)
- Outdoor lighting controls
- Demand responsive controls required to control controlled receptacles

Acceptance testing also is required for daylighting envelope features, documented in NRCA-ENV-03-F.
Section 130.5
MANDATORY REQUIREMENTS FOR ELECTRICAL POWER DISTRIBUTION SYSTEMS

Electrical power distribution system requirements are intended to improve building energy efficiency by providing the electrical infrastructure necessary to enable energy use metering and plug-load shut-off controls. When building owners and operators understand the energy use of specific building systems and appliances, they can more easily make decisions regarding efficiency programs and upgrades. These mandatory requirements apply to new construction, additions and select alterations.

Section 130.5(a)
SERVICE ELECTRICAL METERING
A building’s electrical service must have an electrical metering system to measure instantaneous demand and electrical energy use. The electrical service meter must display instantaneous demand in kW and measure kWh usage over time for a user-definable period.

Services rated more than 250kVA require historical peak demand in kW. Services rated more than 1,000kVA require kWh per rate period.

Section 130.5(b)
SEPARATION OF ELECTRICAL LOADS FOR ELECTRICAL ENERGY MONITORING
Requirements for separation of electrical load types are based on the rating of the building’s electrical service. Separation of electrical loads, when required, allows for measurement devices to monitor electricity usage for different load types.

All services require renewables and electric vehicle charging to be separated. For services up to 50kVA, no additional separation is required. Buildings with an electrical service rated greater than 50kVA are required to separate additional load types. Buildings must be wired to be capable of monitoring load types separately. This requirement does not require any metering and is a mandatory requirement and affecting newly constructed buildings. For alterations, the requirements will apply to entirely new or complete replacement of the electrical power distribution system. If the switchboard, feeders, panel boards and branch circuits remain unchanged, this requirement is not triggered.

Section 130.5(c)
VOLTAGE DROP
The maximum combined voltage drop on both installed feeder conductors and branch circuit conductors to the farthest connected load or outlet cannot exceed 5%. Exceptions to Section 130.5(c) are voltage drops permitted by Sections 647.4, 695.6 and 695.7 of the California Electrical Code for sensitive electronic devices, fire pump transformers and fire pump power wiring. This applies to new construction projects as well as alteration projects that add, modify or replace feeder and branch circuits. For these alterations, requirements only apply to the altered circuits (Section 141.0(b)2P).
Table 130.5-A: Minimum Requirements for Metering of Electrical Load

<table>
<thead>
<tr>
<th>Metering Functionality</th>
<th>Electrical Services rated 50kVA or less</th>
<th>Electrical Services rated more than 50kVA and less than or equal to 250kVA</th>
<th>Electrical Services rated more than 250kVA and less than or equal to 1000kVA</th>
<th>Electrical Services rated more than 1000kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instantaneous (at the time) kW demand</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>Historical peak demand (kW)</td>
<td>Not required</td>
<td>Not required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>Tracking kWh for a user-definable period</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>kWh per rate period</td>
<td>Not required</td>
<td>Not required</td>
<td>Not required</td>
<td>Required</td>
</tr>
</tbody>
</table>

Table 130.5-B: Minimum Requirements for Separation of Electrical Load

<table>
<thead>
<tr>
<th>Electrical Load Type</th>
<th>Electrical Services rated 50kVA or less</th>
<th>Electrical Services rated more than 50kVA and less than or equal to 250kVA</th>
<th>Electrical Services rated more than 250kVA and less than or equal to 1000kVA</th>
<th>Electrical Services rated more than 1000kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting including exit and egress lighting and exterior lighting</td>
<td>Not required</td>
<td>All lighting in aggregate</td>
<td>All lighting disaggregated by floor, type or area</td>
<td>All lighting disaggregated by floor, type or area</td>
</tr>
<tr>
<td>HVAC systems and components including chillers, fans, heaters, furnaces, package units, cooling towers and circulation pumps associated with HVAC</td>
<td>Not required</td>
<td>All HVAC in aggregate</td>
<td>All HVAC in aggregate and each HVAC load rated at least 50kVA</td>
<td>All HVAC in aggregate and each HVAC load rated at least 50kVA</td>
</tr>
<tr>
<td>Domestic and service water system pumps and related systems and components</td>
<td>Not required</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
</tr>
<tr>
<td>Plug load including appliances rated less than 25kVA</td>
<td>Not required</td>
<td>All plug load in aggregate</td>
<td>All plug load separated by floor, type or area</td>
<td>All plug load separated by floor, type or area</td>
</tr>
<tr>
<td>Elevators, escalators, moving walks and transit systems</td>
<td>Not required</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
</tr>
<tr>
<td>Other individual non-HVAC loads or appliances rated 25kVA or greater</td>
<td>Not required</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
</tr>
<tr>
<td>Industrial and commercial load centers 25kVA or greater including theatrical lighting installations and commercial kitchens</td>
<td>Not required</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
</tr>
<tr>
<td>Renewable power source (net or total)</td>
<td>Each group</td>
<td>Each group</td>
<td>Each group</td>
<td>Each group</td>
</tr>
<tr>
<td>Loads associated with renewable power source</td>
<td>Not required</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
</tr>
<tr>
<td>Charging stations for electric vehicles</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
<td>All loads in aggregate</td>
</tr>
</tbody>
</table>
Section 130.5(d)
CIRCUIT CONTROLS FOR 120-VOLT RECEPTACLES

In new construction, alterations where the entire electrical power distribution system is replaced, and spaces being built out for the first time such as a tenant improvement (TI), both controlled and uncontrolled 120 volt receptacles must be provided in office areas, lobbies, conference rooms, kitchen areas in office spaces and copy rooms. Licensed healthcare facilities are exempt from these requirements.

Controlled receptacles must meet all of the following requirements, as applicable:

1. Install a control, such as automatic time-switch or occupancy sensor, capable of automatically shutting off the controlled receptacles when the space is typically unoccupied, either at the receptacle or circuit level.
   - When an automatic time-switch control is installed, it must use an override control that allows the controlled receptacle to remain on for no more than 2 hours when an override is initiated and an automatic holiday “shut-off” feature that turns off all loads for least 24 hours and then resumes the normally scheduled operation.
   - Countdown timer switches cannot be used to comply with the automatic time-switch control requirements.

2. Install at least one controlled receptacle within six feet from each uncontrolled receptacle or install a split-wired receptacle with at least one controlled and one uncontrolled receptacle. Where receptacles are installed in modular furniture in open office areas, at least one controlled receptacle shall be installed at each workstation.

3. Provide a permanent marking for controlled receptacles or circuits to differentiate them from other uncontrolled receptacles or circuits.

4. For hotel and motel guest rooms, install controlled receptacles for at least one-half of the 120 volt receptacles in each guest room. Electric circuits serving controlled receptacles in guest rooms shall have captive card key controls, occupancy sensing controls or automatic controls so the power is switched off no longer than 30 minutes after the guest room has been vacated.

For entirely new or complete replacement of electrical power distribution systems in alteration projects, the entire system shall meet these requirements.

Section 130.5(e)
DEMAND RESPONSIVE CONTROLS AND EQUIPMENT

Requirements for demand responsive controls and equipment, including demand responsive controls for controlled receptacles, can be found in Section 110.12.
PERFORMANCE APPROACH

The performance approach to compliance is a software-based method that uses energy modeling to allow for tradeoffs between building areas. This method is more commonly used in new construction projects, compared to alterations.

SYSTEM TRADE-OFFS ALLOWED

In addition to meeting mandatory requirements, actual lighting power may not exceed the lighting power allowances set forth by the Energy Code, unless traded with other energy features of the building using the performance approach.

Under the performance approach, trade-offs may be made between different systems within a building. For example, using lighting that is more efficient than prescriptively required allows using envelope features that are less efficient than prescriptively required. There is no trade-off benefit to using this method on projects that only affect the lighting system. It is important to note that outdoor lighting and indoor lighting are not allowed system trade-offs, and that the prescriptive secondary daylighting controls can only be traded using the detailed software options (e.g., IESVE, CBECC/SketchUp).

APPROVED SOFTWARE REQUIRED

The performance approach is recommended for professionals with experience using software modeling to manage energy budgets. Those choosing the performance approach must use software to model building energy use, and that software must be approved by the Energy Commission.

Section 140.6

PRESCRIPTIVE APPROACH FOR INDOOR LIGHTING

Under this approach, the actual lighting power is compared to an allowed lighting power total. If the actual lighting power is less than or equal to the allowed lighting power, the project complies with the lighting power budget requirements. With the prescriptive approach, trade-offs are limited to general lighting power and restricted to certain space types.

When using the prescriptive approach to lighting power compliance for new construction, one of the following methods is chosen to calculate the allowed indoor lighting power for each room or area of a building:

1. Complete building method
2. Area category method
3. Tailored method

All three methods involve multiplying the area of a space (ft²) by the allowed lighting power density (W/ft²) for that space and adding special allowances such as display lighting and decorative or ornamental lighting. Adjusted lighting power, which includes the use of power adjustment factors, select lighting wattage exclusions, and luminaire classification and power adjustments, may not exceed this allowance.
The complete building method is used when 90% or more of the building is the same space type. The area category method is used to allow flexibility in lighting allowances for buildings with multiple space types and can be used in combination with the tailored method. The tailored method is an option for areas that utilize lighting to highlight unique features, such as retail spaces, lobbies or waiting areas where awards or artwork are displayed.

Table 140.6-B/C/D
LIGHTING POWER ALLOWANCES
The Energy Code regulates installed lighting power by space or building type. The lighting power allowances affect projects using any of the three compliance methods: complete building, area category or tailored. The lighting power densities (LPD) used to calculate the lighting power allowance (LPA) for each space or building type for each method are provided in the Appendix.

Table 140.6-A
POWER ADJUSTMENT FACTORS
Power adjustment factors (PAFs) provide flexibility when developing a lighting design, effectively allowing projects to reduce their reported lighting power use. PAFs incentivize the additional use of specific lighting controls and daylighting strategies.

During design, projects may receive credits toward the total installed power by installing certain types of lighting controls. These PAFs reflect control strategies that exceed requirements contained in the Energy Code. PAFs are available for:

- Daylight dimming plus off control
- Occupant sensing controls in large open plan offices
- Institutional tuning controls
- Demand responsive controls
- Clerestory fenestration
- Horizontal slats
- Light shelves
PAFs are provided in Table 140.6-A, which includes the type of control, type of area it applies, the factor that can be used if the PAF is included in the project and which factors may be combined. Complete information on lighting power allowances and power adjustment factors for indoor spaces can be found in Section 140.6.

OTHER LIGHTING POWER EXCLUSIONS

The power used by certain lighting applications may be excluded from indoor lighting power calculations. The list of exclusions, per Section 140.6(a)3, is as follows:

- In theme parks: Lighting for themes and special effects.
- Studio lighting for film or photography, provided that these lighting systems are in addition to and separately switched from a general lighting system.
- Lighting for dance floors, lighting for theatrical and other live performances and theatrical lighting used for religious worship, provided that these lighting systems are additions to a general lighting system and are separately controlled by a multiscene or theatrical cross-fade control station accessible only to authorized operators.
- Lighting intended for makeup, hair and costume preparation in performing arts facility dressing rooms, provided that the lighting is separately switched from the general lighting system, switched independently at each dressing station and is controlled with a vacancy sensor.

Table 140.6-A: Lighting Power Adjustment Factors (PAF)

<table>
<thead>
<tr>
<th>Type of Control</th>
<th>Type of Area</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daylighting</td>
<td>Luminaires in skylit daylit zone or primary sidelit daylit zone.</td>
<td>0.10</td>
</tr>
<tr>
<td>Continuous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimming plus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupant</td>
<td>Luminaires in non-daylit areas.</td>
<td>0.10</td>
</tr>
<tr>
<td>Sensing</td>
<td>Luminaires that qualify for other PAFs in this table may also qualify for</td>
<td></td>
</tr>
<tr>
<td>Controls in</td>
<td>this tuning PAF.</td>
<td></td>
</tr>
<tr>
<td>Offices Larger</td>
<td>No larger than 125 ft²</td>
<td>0.30</td>
</tr>
<tr>
<td>than 250 Square</td>
<td>From 126 to 250 ft²</td>
<td>0.20</td>
</tr>
<tr>
<td>Feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institutional</td>
<td>Luminaires in daylit areas.</td>
<td>0.05</td>
</tr>
<tr>
<td>Tuning</td>
<td>Luminaires that qualify for other PAFs in this table may also qualify for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>this tuning PAF.</td>
<td></td>
</tr>
<tr>
<td>Demand</td>
<td>General lighting luminaires not in the scope of Section 110.12(c).</td>
<td>0.05</td>
</tr>
<tr>
<td>Responsive</td>
<td>Luminaires that qualify for other PAFs in this table may also qualify for</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>this PAF.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Luminaires in daylit areas adjacent to the clerestory.</td>
<td>0.05</td>
</tr>
<tr>
<td>Clerestory</td>
<td>Luminaires in daylit areas adjacent to vertical fenestration with interior</td>
<td></td>
</tr>
<tr>
<td>Fenestration</td>
<td>or exterior horizontal slats. Luminaires that qualify for daylight dimming</td>
<td></td>
</tr>
<tr>
<td></td>
<td>plus off control may also qualify for this PAF.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Luminaires that qualify for daylight dimming plus off control may also</td>
<td></td>
</tr>
<tr>
<td></td>
<td>qualify for this PAF.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Luminaires in daylit areas adjacent to clerestory fenestration with</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>interior or exterior light shelves. This PAF may be combined with the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAF for clerestory fenestration.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Luminaires that qualify for daylight dimming plus off control may also</td>
<td></td>
</tr>
<tr>
<td></td>
<td>qualify for this PAF.</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Based on Table 140.6-A in the Energy Code
• In civic facilities, transportation facilities, convention centers and hotel function areas: Lighting for temporary exhibits, if the lighting is in addition to a general lighting system and is separately controlled from a panel accessible only to authorized operators.
• Lighting installed by the manufacturer in walk-in coolers or freezers, vending machines, food preparation equipment and scientific and industrial equipment.
• Examination and surgical lights, low-ambient night-lights and lighting integral to medical equipment, provided that these lighting systems are additions to and separately switched from a general lighting system.
• Lighting for plant growth or maintenance in non-CEH spaces, if it is controlled by a multilevel astronomical time-switch control that complies with the applicable provisions of Section 110.9.
• Lighting equipment that is for sale.
• Lighting demonstration equipment in lighting education facilities.
• Lighting that is required for exit signs subject to the CBC. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.
• Exit way or egress illumination that is normally off and that is subject to the CBC.
• In hotel and motel buildings: Lighting in guest rooms (lighting in hotel and motel guest rooms shall comply with Section 130.0(b)). Indoor lighting not in guest rooms shall comply with all applicable nonresidential lighting requirements in the Energy Code.
• Temporary lighting systems, as defined in Section 100.1.
• Lighting in occupancy group U buildings less than 1,000 ft².
• Lighting in unconditioned agricultural buildings less than 2,500 ft².
• Lighting systems in qualified historic buildings, as defined in the California Historical Building Code (Title 24, Part 8), are exempt from the Lighting Power Density allowances if they consist solely of historic lighting components or replicas of historic lighting components. If lighting systems in qualified buildings contain some historic lighting components or replicas of historic components, combined with other lighting components, only those historic or historic replica components are exempt. All other lighting systems in qualified historic buildings shall comply with the lighting power density allowances.
• Lighting in nonresidential parking garages for seven or less vehicles: Lighting in nonresidential parking garages for seven or less vehicles shall comply with the applicable residential parking garage provisions of Section 150.0(k).
• Lighting for signs: Lighting for signs shall comply with Section 140.8.
• Lighting in refrigerated cases less than 3,000 ft². (Lighting in refrigerated cases less than 3,000 ft² shall comply with the Appliance Efficiency Regulations.)
• Lighting in elevators where the lighting meets the requirements in Section 120.6(f).
• Lighting connected to a Life Safety Branch or Critical Branch, as specified in Section 517 of the California Electrical Code.
• Horticultural lighting in CEH spaces (indoor growing and greenhouses) complying with Section 120.6(h).
Section 140.6(a)4  
**LUMINAIRE CLASSIFICATION AND POWER ADJUSTMENT**

For modular lighting systems, such as track lighting, that allow the addition or relocation of luminaires without altering the wiring of the system, the wattage can be determined three ways, depending on the devices in the system:

1. The wattage is the greater of either:
   1. 30 watts per linear foot of track or plug-in busway
   2. The rated wattage of all of the luminaires included in the system, where the luminaire wattage is determined as specified in Section 130.0(c)1

2. For line-voltage lighting track and plug-in busway served by a track lighting integral current limiter or a dedicated track lighting supplementary overcurrent protection panel, the wattage can be determined in either of the following ways:
   1. The volt-ampere rating of the current limiter as specified by UL 1077
   2. The sum of the ampere (A) rating of all of the current protection devices times the branch circuit voltages for track lighting supplementary overcurrent protection panel

3. For other modular lighting systems with power supplied by a driver, power supply or transformer, including but not limited to low-voltage lighting systems, the wattage of the system is the maximum rated input wattage of the driver, power supply or transformer published in the manufacturer’s catalogs, as specified by UL 2108 or 8750.

In the Energy Code, luminaire classification and power adjustments have been added for small aperture tunable-white and dim-to-warm luminaires.

For qualifying small aperture tunable-white and dim-to-warm LED luminaires, the adjusted indoor lighting power of these luminaires shall be calculated by multiplying their maximum rated wattage by 0.80. This means that there is a 20% power adjustment reduction when qualifying luminaires are selected for your project.

Additionally, there are new requirements for the tailored method display lighting mounting height lighting power adjustment. For wall or floor display luminaires where the bottom of luminaires are at least 10 feet and 7 inches above the finished floor, the adjusted indoor lighting power is calculated by multiplying the maximum rated wattage and the mounting height adjustment factor from Table 140.6-E.
Section 140.6(c)1
DETERMINING ALLOWED POWER UNDER THE COMPLETE BUILDING METHOD

The complete building method may be used only on projects involving buildings with one primary type of use or in mixed-use buildings and tenant spaces where at least 90% of the leased space has one primary use. This is the simplest way to comply with the Energy Code.

This method provides a single lighting power allowance for each building type listed in Table 140.6-B (provided in the Appendix of this guide). The lighting power allowance is calculated by multiplying the complete building area (ft²) by the allowed lighting power density (watt/ft²) for that building type.

\[
\text{Allowed Lighting Power} = (\text{W/ft}^2 \text{ from Table 140.6-B}) \times (\text{floor area})
\]

When applying the complete building method on a project where a parking garage is included, the parking structure and building(s) must be calculated separately using the appropriate use type for each. This means that you must calculate and submit the compliance forms for the two spaces separately using the complete building method.

Section 140.6(c)2
DETERMINING ALLOWED POWER UNDER THE AREA CATEGORY METHOD

The area category method provides a single lighting power allowance for each primary function area listed in Table 140.6-C (provided in the Appendix of this guide). This exact value is calculated by multiplying the entire area (ft²) of each functional area (including floor space used by partitions) by the allowed lighting power density (watt/ft²) for that functional area. The total allowed lighting power is the sum of the lighting power allotments for all the areas covered by the permit application.

\[
\text{Allowed Lighting Power} = \sum \left[ (\text{W/ft}^2 \text{ from Table 140.6-C}) \times (\text{Primary Function floor area}) \right]
\]

ADDITIONAL LIGHTING POWER ALLOTMENTS

Additional lighting energy use is allowed for some areas under the area category method including, but not limited to:

- Adjustable or directional accent, display and feature lighting
- Decorative lighting
- Task lighting
DETERMINING ALLOWED POWER UNDER THE TAILORED METHOD

The tailored method is only used for projects that include space types listed in Table 140.6-D (provided in the Appendix of this guide) of the Energy Code. Within nonresidential applications, these space types include:

- Auditorium areas
- Convention, conference, multipurpose and meeting center areas
- Dining areas
- Exhibit and museum areas
- Hotel areas
- Main entry lobbies
- Religious worship areas
- Retail sales
- Theater areas

GENERAL LIGHTING POWER ALLOTMENTS

Under the tailored method, general lighting power allotments are tailored to each space or area based on the dimensions of the space, including luminaire mounting height and Table 140.6-D illumination levels. The process includes the following steps:

1. Determine the primary function area and the illuminance value (listed in lux) per Table 140.6-D
2. Determine the room cavity ratio (RCR) according to Table 140.6-F
3. Use the illuminance value and the RCR to find the allowed LPD according to Table 140.6-G

Areas with high ceilings have a high RCR, making them more difficult to light. The tailored method allows greater LPD allowances as the RCR increases. The RCR trigger points for increased LPD allowances start at 2.0, then increase at 3.5 and 7.0.

GENERAL LIGHTING TRADE-OFFS

The tailored method allows for certain LPD trade-offs for general lighting only. Trade-offs must be documented using compliance forms and must be calculated separately for conditioned and unconditioned areas. Trade-offs are allowed:

- From one conditioned area using the tailored method to another conditioned area using either the tailored or area category method
- From one unconditioned area using the tailored method to another unconditioned area using either the tailored or area category method
ADDITIONAL LIGHTING POWER ALLOTMENTS

In addition to general lighting power allotments, the tailored method provides lighting power allotments for special tasks that use lighting as a way to draw attention to an area by providing visual contrast to what is contributed from the general lighting. The following is a sample selection of lighting power allotments in the Energy Code. The complete list can be found in Section 140.6(c)3G–J:

- **Wall display lighting**: Supplementary lighting required to highlight features such as artwork or awards displayed on perimeter walls. It provides a higher level of illuminance to a specific area than the level of surrounding ambient illuminance.
- **Decorative or special effects lighting**: Decorative indoor luminaires are typically chandeliers, sconces, theatrical projectors, dynamic or moving lighting or illuminated colored panels that are not providing general illumination.

ROOM CAVITY RATIO

The room cavity ratio (RCR) describes the configuration of a room. Rooms with high ceilings are typically more difficult to illuminate and have a high RCR. Because luminaires are not as effective in areas with a high RCR, the Energy Code allows a higher lighting power density.

The RCR must be calculated for any function area using the tailored method. Table 140.6-F provides the equations for the calculations. The RCR is based on the entire space bounded by floor-to-ceiling partitions. If a task area with a larger space is not bounded by floor-to-ceiling partitions, the RCR of the entire space must be used for the task area.

**Table 140.6-F: Room Cavity Ratio (RCR) Equations**

<table>
<thead>
<tr>
<th>Equation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \text{RCR} = \frac{5 \times H \times (L + W)}{L \times W} ]</td>
<td>Room cavity ratio for rectangular rooms:</td>
</tr>
<tr>
<td>[ \text{RCR} = \frac{2.5 \times H \times P}{A} ]</td>
<td>Room cavity ratio for irregularly shaped rooms:</td>
</tr>
</tbody>
</table>

- **H** = Vertical distance from the work plane to the center line of the lighting fixture
- **L** = Length of room
- **W** = Width of room
- **P** = Perimeter of room
- **A** = Area of room
EXAMPLE EXERCISE: CALCULATE ACTUAL AND ALLOWED LIGHTING POWER

J.S.H. ASSOCIATES 1,944 FT² OFFICE BUILDING

The following example shows the steps to determine whether the office lighting design complies with mandatory requirements and the prescriptive requirements. The floor plan below shows both the lighting controls and luminaires specified for the office. Steps to show compliance with mandatory control requirements are included in this section, as well as the following steps to show compliance with prescriptive requirements.

[Diagram of office layout with labels and symbols for lighting controls and luminaires]

- Occupancy control with manual on/off switch
- Combined manual dimming plus partial-on occupant sensing control for the downlights and pendant
- Partial-on occupancy sensor
- Partial-off occupancy control
- 360-degree View Occupancy Sensor (covering 126 to 250 ft² for PAF of 0.2)
- Daylighting sensor
- Light shelf
- Primary Sidelit Daylit Zone
- Secondary Sidelit Daylit Zone
- Switch with dimming and manual on/off (*)
- Three-way dimming switch (*)

Ceiling height: 12'
Whiteboard (in Conference Room) length: 7'
Window height: 6'
Scale: 1/8' = 1'

(*) Dimming must have the number of control steps specified in Table 130.1-A.
## LIGHTING SCHEDULE

<table>
<thead>
<tr>
<th>Name</th>
<th>Symbol</th>
<th>Luminaire</th>
<th>Quantity</th>
<th>System Wattage</th>
<th>Total Watts</th>
<th>Efficacy (lm/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2 x 2 LED RECESSED TROFFER</td>
<td>15</td>
<td>35</td>
<td>525</td>
<td>90–100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cree CR22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1 x 4 1-LAMP FLUORESCENT RECESSED TROFFER</td>
<td>4</td>
<td>28</td>
<td>112</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finelite HPR with Sylvania 32W T8 lamp; Sylvania Quicktronic Ballast</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2 x 4 2-LAMP FLUORESCENT RECESSED TROFFER</td>
<td>2</td>
<td>54</td>
<td>108</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finelite HPR with Sylvania 32W T8 lamp; Sylvania Quicktronic Ballast</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>8' LED SUSPENDED LUMINAIRE</td>
<td>1</td>
<td>85</td>
<td>85</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visa Linesse</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>6&quot; LED RECESSED DOWNLIGHT</td>
<td>12</td>
<td>12</td>
<td>144</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cree CR6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>LED WALL SCONCE</td>
<td>6</td>
<td>8</td>
<td>48</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tech Lighting Mura</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>LED PENDANT</td>
<td>3</td>
<td>10</td>
<td>30</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Philips Vetro</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>LED SUSPENDED LUMINAIRE</td>
<td>2</td>
<td>22.5</td>
<td>45</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Philips Ledino Cinta Suspension Light</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>8</td>
<td>LED EXIT SIGN</td>
<td>2</td>
<td>2</td>
<td>Exempt per §140.6(a)3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ciata Lighting Exit Sign and Emergency Lights</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL INSTALLED LIGHTING WATTS:** 1,097 W

### PORTABLE LIGHTING

<table>
<thead>
<tr>
<th>Name</th>
<th>Symbol</th>
<th>Luminaire</th>
<th>Quantity</th>
<th>System Wattage</th>
<th>Total Watts</th>
<th>Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>9</td>
<td>45&quot; LED UNDERCABINET TASK LIGHTING</td>
<td>10</td>
<td>12.2</td>
<td>122</td>
<td>62.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finelite Edge Undercabinet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>LED TASK LIGHT</td>
<td>1</td>
<td>6.5</td>
<td>6.5</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Koncept Z Bar Mini Task Light</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL PORTABLE LIGHTING WATTS:** 128.5 W

### DAYLIGHTING DEVICES

<table>
<thead>
<tr>
<th>Name</th>
<th>Symbol</th>
<th>Luminaire</th>
<th>Quantity</th>
<th>Efficacy</th>
<th>W</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td></td>
<td>LIGHT SHELF</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Architectural Grilles &amp; Sunshades (AGS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL WATTS:** 1,225.5 W
DETERMINING COMPLIANCE WITH MANDATORY REQUIREMENTS

The lighting control plan is compliant if the controls fulfill all mandatory requirements per Section 130.1. These requirements are discussed in depth starting on page 37 of this guide.

For the 2022 Energy Code cycle, compliance form NRCC-LTI-E is filled out using Energy Code Ace’s Virtual Compliance Assistant tool. This tool guides users through NRCC-LTI-E by asking questions to determine whether their project is compliant and also provides a filled-out PDF copy of NRCC-LTI-E based on the user’s responses to these questions.

This section of this guide follows the Virtual Compliance Assistant to fill out NRCC-LTI-E for the provided office lighting design example to determine its compliance. Below is an outline for each step of the Virtual Compliance Assistant and their corresponding section(s) of NRCC-LTI-E as it pertains to our example.

**SCOPE**
Filling out the questions in this section of the project on Virtual Compliance Assistant corresponds to Section A: General Information and Section B: Project Scope of NRCC-LTI-E.

**LUMINAIRES**
Filling out this section of the project on Virtual Compliance Assistant corresponds to Section F: Indoor Lighting Fixture Schedule of NRCC-LTI-E.

**CONTROLS**
Filling out this section of the project on Virtual Compliance Assistant corresponds to Section H: Indoor Lighting Controls (Not Including PAFs) of NRCC-LTI-E.

**ALLOWANCES**
Filling out this section of the project on Virtual Compliance Assistant corresponds to Section I: Lighting Power Allowance, Section J: Additional Allowance, Area Category Method Qualifying Lighting System (area category method only), and Section P: Power Adjustment, Lighting Control Credit (Power Adjustment Factor (PAF)) of NRCC-LTI-E.

**DWELLING UNIT**
This section does not apply to the occupancy type of our example.

**SUMMARY**
This section of the project on Virtual Compliance Assistant provides a summary on the information filled out in previous steps and corresponds to Section C: Compliance Results of the NRCC-LTI-E. Ultimately, this section indicates the project’s compliance to the Energy Code.
DETERMINING COMPLIANCE WITH THE PRESCRIPTIVE REQUIREMENTS

The lighting plan complies if the total adjusted installed lighting power is less than or equal to the allowed lighting power. If the total lighting power is greater than what the Energy Code allows, the lighting design does not comply and it will have to be revised.

Steps to show compliance with the prescriptive requirements include:

1. Determine the lighting scope of the project.
2. Calculate the total installed lighting power for all planned and portable lighting from a lighting schedule.
3. Document the building lighting controls for each area.
4. Calculate the lighting power allowance.
5. Apply power adjustment factors (PAFs) earned by specifying lighting controls that go beyond the Energy Code requirements.
6. Determine the adjusted lighting power using answers from steps 1 through 5.
7. Compare the adjusted installed lighting power to the allowed lighting power.

This section includes an example calculation of allowed lighting power using the area category method and the complete building method. Using Energy Code Ace’s Virtual Compliance Assistant, the process will be the same for both the complete building and area category methods, but the method used must be specified in Step 1 (Lighting Scope) to determine which lighting power density to use and whether additional allowances apply later in the process.

This example also offers notes on what sections of the Certificates of Compliance for Nonresidential Indoor Lighting are necessary to support the compliance process.

Section C: Compliance Results of NRCC-LTI-E, shown below, will be completed for both compliance methods at the end of this example.

WHAT’S THE DIFFERENCE BETWEEN THE COMPLETE BUILDING METHOD AND THE AREA CATEGORY METHOD?

For the complete building method, the allowed lighting power is calculated by multiplying the square footage of the project by one lighting power density for the whole project. This method can be used for any building type, but may only be used in projects involving entire buildings with one primary use or in mixed-use buildings and tenant spaces where 90% of the spaces have one primary use.

For the area category method, the allowed lighting power of the spaces within the building is calculated separately, area by area, for conditioned and unconditioned spaces type. All conditioned areas in the project are added together and all unconditioned areas in the project are added together.

NRCC-LTI-E, SECTION C. COMPLIANCE RESULTS

Section C: Compliance Results in NRCC-LTI-E ultimately determines whether or not the space is compliant (Column 09).
LIGHTING SCOPE
The lighting scope of the project establishes general information about the project, including the occupancy types involved, scope of the project (addition, alteration, addition and alteration, or new construction), type of lighting system installed, grade stories, planned calculation method to determine wattage allowance and square footage of conditioned space.

In this section, the Virtual Compliance Assistant will ask if the complete building method will be used to determine compliance. Select 'Yes', if determining compliance through the complete building method, or 'No', if determining compliance through the area category method or tailored method.

Document the answers to these questions specific to your project to fill out Section A: General Information and Section B: Project Scope of NRCC-LTI-E.

**NRCC-LTI-E, SECTION A. GENERAL INFORMATION & SECTION B. PROJECT SCOPE FOR COMPLETE BUILDING METHOD**

Section A: General Information and Section B: Project Scope in NRCC-LTI-E provide general information about the project.

**A. GENERAL INFORMATION**

<table>
<thead>
<tr>
<th>01 Project Location (city)</th>
<th>Sacramento</th>
<th>04 Total Conditioned Floor Area (ft²)</th>
<th>1,826</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 Climate Zone</td>
<td>1</td>
<td>05 Total Unconditioned Floor Area (ft²)</td>
<td>0</td>
</tr>
<tr>
<td>03 Occupancy Types Within Project (select all that apply):</td>
<td>04 No of Stories (Nonvisible Above Grade)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>- Office</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**B. PROJECT SCOPE**

This table includes any lighting systems that are within the scope of the permit application and are demonstrating compliance using the prescriptive path outlined in 140.6 / 170.2(e) or 141.2(2)(e) and 180.31(b) for additions.

<table>
<thead>
<tr>
<th>Scope of Work</th>
<th>Conditioned Spaces</th>
<th>Unconditioned Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calculation Method</td>
<td>Area (ft²)</td>
</tr>
<tr>
<td>My Project Consists of (check all that apply):</td>
<td>Complete Building Method</td>
<td>1,826</td>
</tr>
<tr>
<td>New Lighting System</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Area of Work (ft²): 1,826

**NRCC-LTI-E, SECTION A. GENERAL INFORMATION & SECTION B. PROJECT SCOPE FOR AREA CATEGORY METHOD**

Section A: General Information and Section B: Project Scope in NRCC-LTI-E provide general information about the project.

**A. GENERAL INFORMATION**

<table>
<thead>
<tr>
<th>01 Project Location (city)</th>
<th>Sacramento</th>
<th>04 Total Conditioned Floor Area (ft²)</th>
<th>1,826</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 Climate Zone</td>
<td>1</td>
<td>05 Total Unconditioned Floor Area (ft²)</td>
<td>0</td>
</tr>
<tr>
<td>03 Occupancy Types Within Project (select all that apply):</td>
<td>04 No of Stories (Nonvisible Above Grade)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>- Office</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**B. PROJECT SCOPE**

This table includes any lighting systems that are within the scope of the permit application and are demonstrating compliance using the prescriptive path outlined in 140.6 / 170.2(e) or 141.2(2)(e) and 180.31(b) for additions.

<table>
<thead>
<tr>
<th>Scope of Work</th>
<th>Conditioned Spaces</th>
<th>Unconditioned Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calculation Method</td>
<td>Area (ft²)</td>
</tr>
<tr>
<td>My Project Consists of (check all that apply):</td>
<td>Area Category Method</td>
<td>1,826</td>
</tr>
<tr>
<td>New Lighting System</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Area of Work (ft²): 1,826
2 INSTALLED LIGHTING POWER

The installed lighting power includes all planned permanent and portable lighting. Document the luminaires used in this project in the Luminaire Schedule section of the Virtual Compliance Tool to calculate the total lighting power to use for compliance purposes. This section corresponds to Section F: Indoor Lighting Fixture Schedule of NRCC-LTI-E.

After adding the wattage of the luminaires for this project together, the total installed lighting power adds up to 1,225.5 W.

NRCC-LTI-E, SECTION F. INDOOR LIGHTING FIXTURE SCHEDULE
The luminaire schedule is used to fill in Section F: Indoor Lighting Fixture Schedule in NRCC-LTI-E.

### LUMINAIRE CLASSIFICATION BY RATED POWER

Section 130.0(c)

The Energy Code considers the maximum rated power of a luminaire instead of the amount of energy used by a lamp inside of that luminaire.

For example, a luminaire that can accommodate a 100W incandescent lamp is considered a 100W luminaire for compliance purposes, even if it currently contains a 20W LED lamp.
### Building Lighting Controls

Lighting controls for both conditioned and unconditioned spaces are documented at both the Building and area level. For area level lighting controls, areas can be entered by space type, control type or room by room. Information can typically be found on the equipment cut sheet. This section corresponds to Section H: Indoor Lighting Controls (Not Including PAFs) of NRCC-LTI-E.

#### NRCC-LTI-E, Section H. Indoor Lighting Controls (Not Including PAFs)

Completing all columns in the table in Section H of NRCC-LTI-E computes whether or not the controls in the space are compliant.

<table>
<thead>
<tr>
<th>Area Description</th>
<th>Complete Building or Area Category Primary Function Area</th>
<th>Manual Area Controls: 130.1(c) / 160.5(b)(4A)</th>
<th>Multi-Level Controls: 130.1(b) / 160.5(b)(4E)</th>
<th>Shut-Off Controls: 130.1(c) / 160.5(b)(4C)</th>
<th>Primary/Sky Lighting Controls: 130.1(d) / 160.5(b)(4D)</th>
<th>Secondary Daylighting Controls: 130.1(e) / 160.5(b)(4D)</th>
<th>Interlocked Systems: 140.6(a)(1) / 170.2(c)(2)A</th>
<th>Field Inspector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Plan Office</td>
<td>Office (&gt;250 square feet)</td>
<td>Readily Accessible</td>
<td>Dimmer</td>
<td>Occupancy Sensor</td>
<td>Included</td>
<td>Included</td>
<td>No</td>
<td>Field Inspector</td>
</tr>
<tr>
<td>Private Office</td>
<td>Office (&lt;250 square feet)</td>
<td>Readily Accessible</td>
<td>Dimmer</td>
<td>Partially On 130.1(c) / 160.5(b)(4C)</td>
<td>NA: General Lyle &lt; 120W</td>
<td>NA: General Lyle &lt; 120W</td>
<td>No</td>
<td>Field Inspector</td>
</tr>
<tr>
<td>Conference Room</td>
<td>Conference, Conference, Multipurpose and Meeting Center</td>
<td>Readily Accessible</td>
<td>Dimmer</td>
<td>Occupancy Sensor</td>
<td>Included</td>
<td>Included</td>
<td>No</td>
<td>Field Inspector</td>
</tr>
<tr>
<td>Main Lobby</td>
<td>Main Entry Lobby</td>
<td>Readily Accessible</td>
<td>Dimmer</td>
<td>Occupancy Sensor</td>
<td>NA: General Lyle &lt; 120W</td>
<td>NA: General Lyle &lt; 120W</td>
<td>No</td>
<td>Field Inspector</td>
</tr>
<tr>
<td>Kitchen</td>
<td>Kitchen/Food Preparation</td>
<td>Readily Accessible</td>
<td>Dimmer</td>
<td>Occupancy Sensor</td>
<td>NA: General Lyle &lt; 120W</td>
<td>NA: General Lyle &lt; 120W</td>
<td>No</td>
<td>Field Inspector</td>
</tr>
<tr>
<td>Corridors</td>
<td>Corridor</td>
<td>Readily Accessible</td>
<td>Dimmer</td>
<td>Partially Off 130.1(c) / 160.5(b)(4C)</td>
<td>NA: General Lyle &lt; 120W</td>
<td>NA: General Lyle &lt; 120W</td>
<td>No</td>
<td>Field Inspector</td>
</tr>
<tr>
<td>Restroom #1</td>
<td>Restroom</td>
<td>Readily Accessible</td>
<td>NA: Restrooms</td>
<td>Occupancy Sensor</td>
<td>NA: Not Daylight Zone</td>
<td>NA: Not Daylight Zone</td>
<td>No</td>
<td>Field Inspector</td>
</tr>
<tr>
<td>Copy Room</td>
<td>Copy Room</td>
<td>Readily Accessible</td>
<td>NA: Enclosed area into 1000F</td>
<td>Occupancy Sensor</td>
<td>NA: Not Daylight Zone</td>
<td>NA: Not Daylight Zone</td>
<td>No</td>
<td>Field Inspector</td>
</tr>
<tr>
<td>Restroom #2</td>
<td>Restroom</td>
<td>Readily Accessible</td>
<td>NA: Restrooms</td>
<td>Occupancy Sensor</td>
<td>NA: Not Daylight Zone</td>
<td>NA: Not Daylight Zone</td>
<td>No</td>
<td>Field Inspector</td>
</tr>
</tbody>
</table>

[Plan Sheet Showing Daylight Zones]
**LIGHTING POWER ALLOWANCE**

Lighting power allowances are calculated for each section area for both the complete building and area category method.

1. There are eight primary function areas in this space.
   - For the complete building method, the lighting power density of each area is determined according to the occupancy type of the project input during the Lighting Scope step, according to Table 140.6-B.
   - For the area category method, the lighting power density of each area, according to Table 140.6-C, is automatically input in the form depending on the primary function area selected by the user.

2. Determine the size (ft²) of each area type from the inside of the wall.
   - Total area of the project: 1,825.75 ft²

3. The wattage allowance is calculated by multiplying the square footage of each area type by the allowed lighting power density.

4. Allowed watts are automatically totaled as areas are added.
   - Total allowed wattage using the complete building method: 1,095.45 W
   - Total allowed wattage using the area category method: 1,162.23 W

This section corresponds to Section I: Lighting Power Allowance, Complete Building or Area Category Methods of NRCC-LTI-E (example on next page).

**AREA CATEGORY METHOD: ADDITIONAL LIGHTING WATTAGE ALLOWANCE & TOTAL ADDITIONAL ALLOWANCE**

If using the area category method, some of the areas in the example are eligible for an additional wattage allowance for specialized lighting. The Additional Lighting Power column in Table 140.6-C is used to determine how much can be allocated. This is a “use it, or lose it” allowance; if there is no lighting in the schedule that qualifies for the additional allowance, it cannot be used.

The suspended luminaire in the lobby is classified as “Decorative lighting,” as defined in Section 100.1 and in accordance with Section 140.6(c)2. Additionally, the office spaces qualify for the portable office lighting wattage allowance.

1. Determine the applicable qualifying lighting system from Table 140.6-C.
2. Determine the lighting area, length or number.
3. The additional wattage allowance is automatically calculated by multiplying the area, length, or number determined in Step 2 by the additional wattage per allowance. Compare to the specified fixture for both scenarios.
4. The smaller of either the newly calculated allowed watts or the total design watts of the luminaire is chosen automatically.

In this example, there are 22.5 watts for decorative lighting, 6.5 watts for portable office lighting in the private office, and 99.6 watts for portable office lighting in the open plan office, totaling 128.6 watts of additional allowed lighting wattage.

This section corresponds to Section J: Additional Allowance, Area Category Method Qualifying Lighting System of NRCC-LTI-E (example on next page).

The total lighting power allowance is calculated by adding the additional lighting wattage allowance to the general lighting power allowance.

\[1,162.23W + 128.6W = 1,290.83W\]
NRCC-LTI-E, SECTION I. LIGHTING POWER ALLOWANCE FOR COMPLETE BUILDING METHOD

Documenting each area of the project completes columns 1 through 4 in Section I of NRCC-LTI-E and calculates total allowed wattage.

### Table I. LIGHTING POWER ALLOWANCE: COMPLETE BUILDING OR AREA CATEGORY METHODS

<table>
<thead>
<tr>
<th>Conditioned Spaces</th>
<th>01</th>
<th>02</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Plan Office</td>
<td>Office</td>
<td>Office</td>
<td>0.6</td>
<td>498</td>
<td>298.8</td>
<td>No</td>
</tr>
<tr>
<td>Private Office</td>
<td>Office</td>
<td>Office</td>
<td>0.6</td>
<td>222</td>
<td>139.19</td>
<td>No</td>
</tr>
<tr>
<td>Conference Room</td>
<td>Office</td>
<td>Office</td>
<td>0.6</td>
<td>252</td>
<td>151.19</td>
<td>No</td>
</tr>
<tr>
<td>Main Lobby</td>
<td>Office</td>
<td>Office</td>
<td>0.6</td>
<td>228</td>
<td>136.3</td>
<td>No</td>
</tr>
<tr>
<td>Kitchen</td>
<td>Office</td>
<td>Office</td>
<td>0.6</td>
<td>156</td>
<td>93.6</td>
<td>No</td>
</tr>
<tr>
<td>Corridors</td>
<td>Office</td>
<td>Office</td>
<td>0.6</td>
<td>278.5</td>
<td>167.1</td>
<td>No</td>
</tr>
<tr>
<td>Restroom R1</td>
<td>Office</td>
<td>Office</td>
<td>0.6</td>
<td>51</td>
<td>32.9</td>
<td>No</td>
</tr>
<tr>
<td>Restroom R2</td>
<td>Office</td>
<td>Office</td>
<td>0.6</td>
<td>51</td>
<td>32.9</td>
<td>No</td>
</tr>
<tr>
<td>Copy Room</td>
<td>Office</td>
<td>Office</td>
<td>0.6</td>
<td>89.25</td>
<td>53.55</td>
<td>No</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td></td>
<td>1,825.75</td>
<td>1,395.45</td>
<td>See Tables I, or II for details</td>
<td></td>
</tr>
</tbody>
</table>

NRCC-LTI-E, SECTION I. LIGHTING POWER ALLOWANCE FOR AREA CATEGORY METHOD

Documenting each area of the project completes columns 1 through 4 in Section I of NRCC-LTI-E and calculates total allowed wattage.

### Table II. LIGHTING POWER ALLOWANCE: COMPLETE BUILDING OR AREA CATEGORY METHODS

<table>
<thead>
<tr>
<th>Conditioned Spaces</th>
<th>01</th>
<th>02</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Plan Office</td>
<td>Office (&lt;250 square feet)</td>
<td>Office</td>
<td>0.6</td>
<td>498</td>
<td>298.8</td>
<td>Yes</td>
</tr>
<tr>
<td>Private Office</td>
<td>Office (&lt;250 square feet)</td>
<td>Office</td>
<td>0.6</td>
<td>222</td>
<td>139.19</td>
<td>Yes</td>
</tr>
<tr>
<td>Conference Room</td>
<td>Convention, Conference, Multipurpose and Meeting Center</td>
<td>Office</td>
<td>0.75</td>
<td>252</td>
<td>189</td>
<td>Yes</td>
</tr>
<tr>
<td>Main Lobby</td>
<td>Main Entry Lobby</td>
<td>Office</td>
<td>0.7</td>
<td>228</td>
<td>139.6</td>
<td>Yes</td>
</tr>
<tr>
<td>Kitchen</td>
<td>Kitchen/ Food Preparation</td>
<td>Office</td>
<td>0.95</td>
<td>156</td>
<td>148.13</td>
<td>No</td>
</tr>
<tr>
<td>Corridors</td>
<td>Corridor</td>
<td>Office</td>
<td>0.4</td>
<td>278.5</td>
<td>111.4</td>
<td>No</td>
</tr>
<tr>
<td>Restroom R1</td>
<td>Restroom</td>
<td>Office</td>
<td>0.65</td>
<td>51</td>
<td>33.15</td>
<td>No</td>
</tr>
<tr>
<td>Restroom R2</td>
<td>Restroom</td>
<td>Office</td>
<td>0.6</td>
<td>51</td>
<td>33.15</td>
<td>No</td>
</tr>
<tr>
<td>Copy Room</td>
<td>Copy Room</td>
<td>Office</td>
<td>0.5</td>
<td>89.25</td>
<td>44.63</td>
<td>No</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td></td>
<td>1,825.75</td>
<td>1,362.33</td>
<td>See Tables I, or II for details</td>
<td></td>
</tr>
</tbody>
</table>

NRCC-LTI-E, SECTION J. ADDITIONAL LIGHTING ALLOWANCE: AREA CATEGORY METHOD QUALIFYING LIGHTING SYSTEM

Document lighting systems qualifying for additional lighting allowances to complete all columns in Section J of NRCC-LTI-E to calculate the additional lighting allowances that can be factored into the area category method calculation.

### Table III. ADDITIONAL ALLOWANCE: AREA CATEGORY METHOD QUALIFYING LIGHTING SYSTEM

<table>
<thead>
<tr>
<th>Conditioned Spaces</th>
<th>01</th>
<th>02</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>06</th>
<th>07</th>
<th>08</th>
<th>09</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Plan Office</td>
<td>Office (&lt;250 square feet)</td>
<td>Office</td>
<td>0.2</td>
<td>498</td>
<td>99.6</td>
<td>45&quot; LED UNDERCABINET TASK LIGHTING</td>
<td>12.2</td>
<td>1</td>
<td>122</td>
<td></td>
</tr>
<tr>
<td>Private Office</td>
<td>Office (&lt;250 square feet)</td>
<td>Office</td>
<td>0.2</td>
<td>222</td>
<td>44.4</td>
<td>LED TASK LIGHT</td>
<td>6.5</td>
<td>1</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>Main Lobby</td>
<td>Main Entry Lobby</td>
<td>Office</td>
<td>0.25</td>
<td>228</td>
<td>57</td>
<td>LED SUSPENDED LUMINAIRE</td>
<td>22.5</td>
<td>1</td>
<td>22.5</td>
<td></td>
</tr>
<tr>
<td><strong>Total Additional Allowance (Watts) CONDITIONED SPACES</strong></td>
<td></td>
<td></td>
<td>128.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All areas indicated in Table I can use an additional allowance using the Area Category Method have been included in this table to calculate the additional allowance per Table 140-E-C.1(2,2).M
**POWER ADJUSTMENT FACTORS**

The lighting plan is evaluated for potential lighting power adjustment factors (PAFs) that can be used in your calculations.

Lighting control requirements that are mandatory (Section 130.1) do not qualify, only lighting PAFs listed in Table 140.6-A. This lighting design is eligible for the occupant sensing control in offices larger than 250 square feet PAF, as well as the light shelf PAF (luminaires in daylit areas adjacent to clerestory fenestration with interior or exterior light shelves). The light shelf PAF may be combined with the PAF for clerestory fenestration. Luminaires that qualify for daylight dimming plus off control may also qualify for this PAF.

To calculate the occupant sensing control in offices larger than 250 square feet PAF, the factor of 0.2 is multiplied by the total wattage of the general luminaires installed in the control zone (420 watts, from the 12 LED recessed troffers).

$$420W \times 0.20 = 84W$$

To calculate the light shelf PAF, the installed lighting power in the daylit area adjacent to the clerestory fenestration with light shelves is multiplied by the allowance factor. In our example, the light shelf is in the conference room. The daylit zone is determined to encompass the whole conference room, which has one 8’ pendant that is 85 watts and four downlights that are 12 watts each for a total of 48 watts.

$$133W \times 0.10 = 13.3W$$

For this example, the total power adjustment is 97.3 watts.

$$84W + 13.3W = 97.3W$$

This section corresponds to Section P: Power Adjustment, Lighting Control Credit (Power Adjustment Factor (PAF)) of NRCC-LTI-E.
**ADJUSTED LIGHTING POWER**

The adjusted installed lighting power is calculated by subtracting the PAF from the total installed lighting. This calculation is displayed in Column 8 of the table in Section C of NRCC-LTI-E.

\[
1,225.5W - 97.3W = 1,128.2W \text{ of adjusted lighting power}
\]

**COMPLIANCE RESULTS**

The compliance results for the project are provided in the Summary section of the Virtual Compliance Assistant and corresponds to Section C: Compliance Results of NRCC-LTI-E. Ultimately, column 09 of the table in Section C of NRCC-LTI-E determines if this lighting schedule is compliant. Column 05 must be greater than or equal to column 08 for the lighting design to be compliant.

**Using the complete building method, this example’s lighting schedule is not compliant.**

The total adjusted lighting power of 1,128.2 watts is greater than the total allowed lighting power of 1,095.45 watts.

**Using the area category method, this example’s lighting schedule is compliant.**

The total adjusted lighting power of 1,128.2 watts is less than the total allowed lighting power of 1,290.83 watts.
PRESCRIPTIVE APPROACH FOR OUTDOOR LIGHTING

The prescriptive requirements for outdoor lighting apply only to hardscape areas. A lighting installation is in compliance if its installed lighting power is less than the allowed lighting power for the site. The Energy Code specifies different lighting power allowances for different lighting zones. Continuous lighting in Lighting Zone 0 is explicitly prohibited, but sites may utilize a single luminaire that is 15 watts or less at entrances to parking lots.

**WHAT IS HARDSCAPE?**

Hardscape is the area of an improvement to a site that is paved or has other structural features such as curbs, plazas, entries, parking lots, site roadways, driveways, walkways, sidewalks, bikeways, water features and pools, storage or service yards, loading docks, amphitheaters, outdoor sales lots, and private monuments and statuary.

**General Hardscape Lighting Power Allowances**

<table>
<thead>
<tr>
<th>Type of Power Allowance</th>
<th>Lighting Zone 0</th>
<th>Lighting Zone 1</th>
<th>Lighting Zone 2</th>
<th>Lighting Zone 3</th>
<th>Lighting Zone 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area Wattage Allowance (AWA)</td>
<td>No allowance¹</td>
<td>0.016 W/ft²</td>
<td>0.019 W/ft²</td>
<td>0.021 W/ft²</td>
<td>0.024 W/ft²</td>
</tr>
<tr>
<td>Linear Wattage Allowance (LWA)</td>
<td>0.13 W/lf</td>
<td>0.15 W/lf</td>
<td>0.20 W/lf</td>
<td>0.29 W/lf</td>
<td></td>
</tr>
<tr>
<td>Initial Wattage Allowance (IWA)</td>
<td>150W</td>
<td>200W</td>
<td>250W</td>
<td>320W</td>
<td></td>
</tr>
</tbody>
</table>

¹ Continuous lighting is explicitly prohibited in Lighting Zone 0. A single luminaire of 15 watts or less may be installed at an entrance to a parking area, trail head, fee payment kiosk, outhouse or toilet facility, as required to provide safe navigation of the site infrastructure. Luminaires installed shall meet the maximum zonal lumens as specified in Section 130.2(b).

² Reserved.

³ Narrow band spectrum light sources with a dominant peak wavelength greater than 580 nm — as mandated by local, state or federal agencies to minimize the impact on local, active professional astronomy or nocturnal habitat of specific local fauna — shall be allowed a 2.0 lighting power allowance multiplier.

Based on Table 140.7-A from the Energy Code
CALCULATING ALLOWED LIGHTING POWER

GENERAL HARDSCAPE LIGHTING ALLOWANCE AND ADDITIONAL LIGHTING POWER ALLOWANCES
Identify which Lighting Zone the project falls under (LZ0–LZ4) and if the project site is subject to any local ordinances that exceed Energy Code requirements. Guidance on how to determine Lighting Zones is provided on pages 48–49 of this guide. Use the plan view for all area and distance measurements, unless otherwise noted:

1. **Calculate the illuminated hardscape area:** This area is square, centered on each luminaire or pole and is 10 times the luminaire mounting height. Subtract from this any areas within the square that are within a building, obstructed by a structure, beyond the hardscape area or beyond property lines. The illuminated hardscape area shall include portions of planters and landscaped areas that are within the lighting application and are less than or equal to 10 feet wide in the short dimensions and are enclosed by hardscape or other improvement on at least three sides.

2. **Determine the general hardscape lighting allowance:** Multiply the illuminated hardscape area (from Step 1) by the area wattage allowance (AWA) for the appropriate Lighting Zone. See the “General Hardscape Lighting Power Allowances” table on the previous page for AWA values.

3. **Calculate the perimeter length and linear wattage allowance (LWA):** Multiply the hardscape perimeter by the LWA for the appropriate Lighting Zone (see “General Hardscape Lighting Power Allowances” table). Perimeters of excluded areas may be included in calculation of the Linear Wattage Allowance (LWA).

4. **Find the total general hardscape lighting allowance:** Add the allowed wattage from steps 2 and 3. This total is the general hardscape lighting allowance for the illuminated hardscape area.

5. **Add any additional lighting power allowances for specific applications:** Check Table 140.7-B for any additional lighting power allowances that apply and add these to the sum from step 4. The additional allowance for specific applications is the smaller of that allowed in Table 140.7-B or the installed lighting for the specific application. Allowed lighting power for specific applications cannot be added to the total power allowance unless lighting for that specific application is installed.

6. **Add the initial wattage allowance (IWA).** The IWA for the project lighting zone (listed in “Lighting Power Allowances”) can be added to the site’s total lighting power allowance — but just once for the entire site. For example, an alteration project where the IWA was included in the lighting power allowance calculation for the original outdoor lighting system will not use the IWA for the lighting power allowance calculation of the altered lighting system.
EXCEPTIONS TO PRESCRIPTIVE REQUIREMENTS FOR OUTDOOR LIGHTING

When more than 50% of the light is part of one of the following categories, it is exempt from the prescriptive requirements for outdoor lighting. It is important to remember that these applications are still subject to the mandatory requirements.

- Temporary outdoor lighting
- Lighting required and regulated by the Federal Aviation Administration and the Coast Guard
- Lighting for public streets, roadways, highways and traffic signage lighting, including lighting for driveway entrances occurring in the public right-of-way
- Lighting for sports and athletic fields and children’s playgrounds
- Lighting for industrial sites, including but not limited to, rail yards, maritime shipyards and docks, piers and marinas, chemical and petroleum processing plants and aviation facilities
- Lighting of public monuments
- Lighting of signs complying with the requirements of Section 130.3 and Section 140.8
- Lighting of tunnels, bridges, stairs, wheelchair elevator lifts for American with Disabilities Act (ADA) compliance and ramps that are other than parking garage ramps
- Landscape lighting
- In theme parks: outdoor lighting only for themes and special effects
- Lighting for outdoor theatrical and other outdoor live performances, provided that these lighting systems are additions to area lighting systems and are controlled by a multiscene or theatrical cross-fade control station accessible only to authorized operators
- Outdoor lighting systems for qualified historic buildings, as defined in the California Historic Building Code (Title 24, Part 8), if they consist solely of historic lighting components or replicas of historic lighting components
### CALCULATING ACTUAL LIGHTING POWER

Add the wattage of all non-exempt lighting systems (including ballast, driver or transformer losses) to determine the actual installed lighting power (W) of an installation and ensure it is less than the allowed lighting power.

#### Additional Lighting Power Allowance for Specific Applications

Based on Table 140.7-B from the Energy Code

<table>
<thead>
<tr>
<th>Lighting Application</th>
<th>Lighting Zone 0</th>
<th>Lighting Zone 1</th>
<th>Lighting Zone 2</th>
<th>Lighting Zone 3</th>
<th>Lighting Zone 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WATTAGE ALLOWANCE PER APPLICATION. Use all that apply as appropriate.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building Entrances or Exits</td>
<td>N/A</td>
<td>9 watts</td>
<td>15 watts</td>
<td>19 watts</td>
<td>21 watts</td>
</tr>
<tr>
<td>Primary Entrances to Senior Care Facilities, Police Stations, Healthcare Facilities, Fire Stations and Emergency Vehicle Facilities</td>
<td>N/A</td>
<td>20 watts</td>
<td>40 watts</td>
<td>57 watts</td>
<td>60 watts</td>
</tr>
<tr>
<td>Drive Up Windows</td>
<td>N/A</td>
<td>16 watts</td>
<td>30 watts</td>
<td>50 watts</td>
<td>75 watts</td>
</tr>
<tr>
<td>Vehicle Service Station Uncovered Fuel Dispenser</td>
<td>N/A</td>
<td>55 watts</td>
<td>77 watts</td>
<td>81 watts</td>
<td>135 watts</td>
</tr>
<tr>
<td>Automated Teller Machine (ATM) Lighting</td>
<td>N/A</td>
<td></td>
<td>100 watts for first ATM, 35 watts for each additional ATM</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WATTAGE ALLOWANCE PER UNIT LENGTH (W LINEAR FT.). May be used for one or two frontage side(s) per site.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor Sales Frontage</td>
<td>N/A</td>
<td>No Allowance</td>
<td>11 W/linear ft.</td>
<td>19 W/linear ft.</td>
<td>25 W/linear ft.</td>
</tr>
<tr>
<td><strong>WATTAGE ALLOWANCE PER HARDSCAPE AREA (W/FT²). May be used for any illuminated hardscape area on the site.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardscape Ornamental Lighting</td>
<td>N/A</td>
<td>No Allowance</td>
<td>0.007 W/ft²</td>
<td>0.013 W/ft²</td>
<td>0.019 W/ft²</td>
</tr>
<tr>
<td><strong>WATTAGE ALLOWANCE PER SPECIFIC AREA (W/FT²). Use as appropriate, provided that none of the following specific applications shall be used for the same area.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building Facades</td>
<td>N/A</td>
<td>No Allowance</td>
<td>0.1 W/ft²</td>
<td>0.17 W/ft²</td>
<td>0.225 W/ft²</td>
</tr>
<tr>
<td>Outdoor Sales Lots</td>
<td>N/A</td>
<td>0.06 W/ft²</td>
<td>0.21 W/ft²</td>
<td>0.28 W/ft²</td>
<td>0.485 W/ft²</td>
</tr>
<tr>
<td>Vehicle Service Station Hardscape</td>
<td>N/A</td>
<td>0.006 W/ft²</td>
<td>0.068 W/ft²</td>
<td>0.138 W/ft²</td>
<td>0.2 W/ft²</td>
</tr>
<tr>
<td>Vehicle Service Station Canopies</td>
<td>N/A</td>
<td>0.22 W/ft²</td>
<td>0.43 W/ft²</td>
<td>0.58 W/ft²</td>
<td>1.01 W/ft²</td>
</tr>
<tr>
<td>Sales Canopies</td>
<td>N/A</td>
<td>No Allowance</td>
<td>0.47 W/ft²</td>
<td>0.622 W/ft²</td>
<td>0.74 W/ft²</td>
</tr>
<tr>
<td>Non-sales Canopies and Tunnels</td>
<td>N/A</td>
<td>0.057 W/ft²</td>
<td>0.137 W/ft²</td>
<td>0.27 W/ft²</td>
<td>0.37 W/ft²</td>
</tr>
<tr>
<td>Guard Stations</td>
<td>N/A</td>
<td>0.081 W/ft²</td>
<td>0.176 W/ft²</td>
<td>0.325 W/ft²</td>
<td>0.425 W/ft²</td>
</tr>
<tr>
<td>Student Pick-up or Drop-off Zone</td>
<td>N/A</td>
<td>No Allowance</td>
<td>0.056 W/ft²</td>
<td>0.2 W/ft²</td>
<td>No Allowance</td>
</tr>
<tr>
<td>Outdoor Dining</td>
<td>N/A</td>
<td>0.004 W/ft²</td>
<td>0.03 W/ft²</td>
<td>0.05 W/ft²</td>
<td>0.075 W/ft²</td>
</tr>
<tr>
<td>Special Security Lighting for Retail Parking and Pedestrian Hardscape</td>
<td>N/A</td>
<td>0.004 W/ft²</td>
<td>0.005 W/ft²</td>
<td>0.01 W/ft²</td>
<td>No Allowance</td>
</tr>
<tr>
<td>Security Cameras</td>
<td>N/A</td>
<td>No Allowance</td>
<td>0.018 W/ft²</td>
<td>0.018 W/ft²</td>
<td>0.018 W/ft²</td>
</tr>
</tbody>
</table>
EXAMPLE EXERCISE: DETERMINING COMPLIANCE WITH MANDATORY AND PRESCRIPTIVE REQUIREMENTS FOR A PARKING LOT

SCENARIO
An outdoor parking lot 15,000 ft² in size is located in a commercial area categorized as Lighting Zone 3. The project team is planning to install three 200W luminaires (29,000 lumens each) that are mounted at a height of 25' in a 5' by 50' island in the middle of the lot paired with an astronomical timer and auto-scheduling controls. It is important to note for the hardscape calculation that the parking lot has 20' by 20' landscaped areas in each corner and the 10' by 15' driveway is included.

What is the total power allowance for this parking lot? Does the lighting design comply with the prescriptive and mandatory Energy Code requirements?

The lighting plan complies if the total adjusted installed lighting power is less than or equal to the allowed lighting power. If the total lighting power is greater than what the Energy Code allows, the lighting design does not comply and it will have to be revised.

For the 2022 Energy Code cycle, compliance form NRCC-LTO-E is filled out using Energy Code Ace’s Virtual Compliance Assistant tool. This tool guides users through NRCC-LTO-E by asking questions to determine whether their project is compliant and also provides a filled-out PDF copy of NRCC-LTO-E based on the user’s responses to these questions. This section of this guide follows the Virtual Compliance Assistant to fill out NRCC-LTO-E for the provided parking lot lighting design example.
CHAPTER 4  COMPLIANCE REQUIREMENTS

STEPS

Steps to show compliance with the prescriptive requirements include:

1. Determine the lighting scope of the project.
   - The lighting scope of the project establishes general information about the project, including the scope of the project (addition, alteration, addition and alteration, or new construction), type of lighting system installed, Outdoor Lighting Zone and total illuminated hardscape area.
   - When calculating the illuminated hardscape area, remember to subtract any landscape areas over 10′ x 10′. The illuminated area for each 25′ pole is 250′ x 250′, so it extends beyond the actual hardscape of the parking lot and encompasses the 150 ft² entrance. Because the lot is not adjacent to other hardscapes on the site, use the 15,000 ft² area of the lot itself, add the 15′ x 10′ entrance and subtract the four 400 ft² landscaped corners of the lot.
     \[ 15,000 \text{ ft}^2 + 150 \text{ ft}^2 - 1,600 \text{ ft}^2 = 13,550 \text{ ft}^2 \]
     - Answering these questions specific to your project fills out Section A: General Information and Section B: Project Scope of NRCC-LTO-E.

---

NRCC-LTO-E, SECTION C. COMPLIANCE RESULTS

Section C: Compliance Results in NRCC-LTO-E ultimately determines whether or not the area is compliant (Column 09).

### C. COMPLIANCE RESULTS

Results in this table are automatically calculated from data input and calculations in Tables F through M. Note: If any cell on this table says “COMPLIES with Exceptional Conditions” refer to Table G: Exceptional Conditions for guidance or see applicable Table referenced below.

<table>
<thead>
<tr>
<th>Calculations of Total Allowed Lighting Power (Watts)</th>
<th>Compliance Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>140.7 / 170.2</td>
<td>Total Allowed (Watts)</td>
</tr>
<tr>
<td>140.7 / 170.2</td>
<td>628.55</td>
</tr>
</tbody>
</table>

| 01 | General Hardscape Allowance (140.7 / 170.2 | 02 | For Application (140.7 / 170.2) (See Table A) |
| 03 | Sales Frontage (140.7 / 170.2) (See Table A) | 04 | Ornamental (140.7 / 170.2) (See Table A) |
| 05 | shaded area (140.7 / 170.2) (See Table A) | 06 | Existing Power Allowance (140.7 / 170.2) (See Table A) |
| 07 | Total Allowed (Watts) | 08 | Total Actual (Watts) |
| 09 | 628.55 | 600 |

---

NRCC-LTO-E, SECTION A. GENERAL INFORMATION & SECTION B. PROJECT SCOPE FOR COMPLETE BUILDING METHOD

Section A: General Information and Section B: Project Scope in NRCC-LTO-E provide general information about the project.

### A. GENERAL INFORMATION

| 01 | Project Location (City) | Sacramento  |
| 02 | Climate Zone | 12 |
| 03 | Outdoor Lighting Zone per Title 24 Part 1 10.114 or as designated by Authority Having Jurisdiction (AHJ): | 2-1: Low - Rural Areas | 2-2: Moderate - Urban Clusters | 2-3: Moderately High - Urban Areas |
| 04 | Total Illuminated Hardscape Area (ft²) | 13550 |

### B. PROJECT SCOPE

This table includes outdoor lighting systems that are within the scope of the permit application and are demonstrating compliance using the prescriptive path outlined in 140.7 / 170.2 or 141.0 / 180.3 (160.3 MBH) for alterations.

My Project Consists of:

- [X] New Lighting System
- [ ] Altered Lighting System

| 01 | New Lighting System |
| 02 | Altered Lighting System |

| 03 | % of Existing Luminaires Being Altered |
| 04 | % of Existing Luminaires Being Altered |
| 05 | Calculation Method |

Please proceed to Table F: Outdoor Lighting Fixture Schedule to define the project’s luminaires.

---

FOOTNOTES: % of Existing Luminaires Being Altered = (Sum Total of Luminaires Being Added or Altered) / (Existing Luminaires within the Scope of the Permit Application) x 100.
2. Calculate the total installed lighting power for all luminaires to be installed, to be moved, or are currently existing, from a lighting schedule.

- Document the luminaires used in this project in the Luminaire Schedule section of the Virtual Compliance Assistant to calculate the total lighting power to use for compliance purposes and shielding (BUG) requirements.
- After adding the wattage of the luminaires for this project together, the total installed lighting power adds up to 600 W.
- Completing the luminaire schedule for your project fills out Section F: Indoor Lighting Fixture Schedule and Section G: Shielding Requirements (BUG) of NRCC-LTO-E.
3. Calculate the general hardscape allowance, based on the project’s hardscape design and site plan.

- Lighting power allowances are calculated for each section area of the project in the Allowances section of the Virtual Compliance Assistant. The General Hardscape Allowance is calculated by adding the Area Wattage Allowance (AWA), Linear Wattage Allowance (LWA) and Initial Wattage Allowance (IWA) together.

- To calculate the AWA, multiply the square footage of the illuminated area of each section area (previously calculated in step 1) by the Area Wattage Allowed Density for Lighting Zone 3 (found in Table 140.7-A).
  \[ 13,550 \text{ ft}^2 \times 0.021 \text{ W/ft}^2 = 284.55 \text{ W} \]

- To calculate the LWA, multiply the perimeter length by the Linear Allowed Density for Lighting Zone 3 (found in Table 140.7-A).
  \[ 520 \text{ If} \times 0.2 \text{ W/lf} = 104 \text{ W} \]

- For this project, the IWA is 250 W. The IWA for a site in Lighting Zone 3 is listed in Table 140.7-A.

- The general hardscape allowance adds up to 638.55 W. This figure is documented in Section I: Lighting Power Allowance (per 140.7 / 170.2(e)) of NRCC-LTO-E.
  \[ 284.55 \text{ W} + 104 \text{ W} + 250 \text{ W} = 638.55 \text{ W} \]
4. Document the lighting controls for each area.
   - Lighting controls are documented at both the site level and task/luminaire level. Because our project includes an astronomical timer and auto-scheduling controls, the project controls are compliant.
   - Completing this section determines whether the lighting controls comply for the project and corresponds to Section H: Outdoor Lighting Controls of NRCC-LTO-E.

5. Compare the installed lighting power to the allowed lighting power.
   - The compliance results for this project are provided in the Summary section of the Virtual Compliance Assistant and corresponds to Section C: Compliance Results of NRCC-LTO-E. Ultimately, column 09 of the table in Section C of NRCC-LTO-E determines if this lighting schedule is compliant. Column 07 must be greater than or equal to column 08 for the lighting design to be compliant.
   - This example’s lighting schedule is compliant, as the installed lighting power of 600 watts is less than the total allowed lighting power of 638.55 watts.

**ANSWER**

Total power allowance for this hardspace area: 638.55W.

YES — the lighting installation complies. The parking lot luminaires use a total of 600 watts, which is less than the allowed power of 638.55 watts. This lighting installation also adheres to the mandatory requirements for luminaire cutoff and controls.
SIGN LIGHTING

Both indoor and outdoor sign lighting are addressed by the Energy Code. Control requirements are established for all illuminated signs (Section 130.3) and lighting power requirements are established for internally illuminated and externally illuminated signs (Section 140.8).

Sign lighting requirements are the same throughout the state and are independent of outdoor Lighting Zones. Additionally, sign requirements are the same in conditioned and unconditioned spaces.

The requirements for sign lighting set minimum control requirements, maximum allowable power levels and minimum efficacy requirements. The Energy Code does not allow trade-offs between sign lighting power allowances and other end uses, including outdoor lighting, indoor lighting, HVAC, building envelope or water heating.

### Sign Lighting Code Sections

<table>
<thead>
<tr>
<th>Code Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>130.3</td>
<td>Controls</td>
</tr>
<tr>
<td>140.8(a)</td>
<td>Maximum allowed lighting power</td>
</tr>
<tr>
<td>140.8(b)</td>
<td>Alternate lighting sources</td>
</tr>
</tbody>
</table>

#### Section 130.3

**MANDATORY REQUIREMENTS**

All indoor sign lighting other than exit sign lighting must be equipped with an automatic time-switch control or an astronomical time-switch control.

All outdoor sign lighting must be equipped with either a photo control with an automatic time-switch control, or an astronomical time-switch control.

**SIGNS ILLUMINATED NIGHT AND DAY**

All outdoor signs that are on during the day and night must be equipped with a dimmer that can automatically reduce lighting power by at least 65% at night. This applies to signs illuminated for more than one daylight hour in addition to nighttime hours.

**ELECTRONIC MESSAGE CENTERS**

An electronic message center (EMC) with a connected lighting power load greater than 15kW must have a control that can reduce lighting power by at least 30% in response to a demand response (DR) signal.

#### EXCEPTION: SECTION 130.3

Signs inside tunnels and signs in large, permanently covered outdoor areas that are intended to be illuminated both day and night.

#### EXCEPTIONS: ELECTRONIC MESSAGE CENTERS

Electronic message centers (EMCs) that must remain at full lighting power due to health or safety regulations are exempt and not required to respond to DR signals.
**Section 140.8**

**PRESCRIPTIVE REQUIREMENTS**

In addition to the mandatory requirements for signs, the prescriptive approach requires that all internally and externally illuminated signs must use approved sources or comply with maximum allowed lighting power limits.

**Section 140.8(a)**

**MAXIMUM ALLOWED LIGHTING POWER**

Signs with source types not listed above must adhere to these lighting power limits:

- **Internally Illuminated Signs:** 12 W/ft² of the illuminated sign area
  
  For double-faced signs, count the area of just one face.

- **Externally Illuminated Signs:** 2.3 W/ft² of the illuminated sign area
  
  For luminaires with permanently installed ballasts or transformers, use the operating input wattage of the lamp/ballast or lamp/transformer combination.

**Section 140.8(b)**

**ALTERNATE LIGHTING SOURCES**

Signs equipped with one or more of the following source types do not need to adhere to allowed lighting power limits:

- High-pressure sodium (HPS) lamps
- Metal halide (MH) lamps that are:
  - Pulse start or ceramic with a minimum ballast efficiency of 88%, or
  - Pulse start MH lamps using no more than 320W, but not 250W or 175W lamps, with a minimum ballast efficiency of 80%
- Neon or cold cathode lamps with a minimum transformer or power supply efficiency of at least 75% for a rated output current less than 50mA or a minimum efficiency of 68% when the rated output current is 50mA or greater
- Fluorescent lighting systems that only use lamps with a minimum CRI of 80 or electronic ballasts with a fundamental output frequency of at least 20kHz
- LEDs with a power supply efficiency of at least 80%
- CFLs that do not use medium screw-based sockets

**EXCEPTIONS TO SECTION 140.8**

**Exception 1:** Unfiltered incandescent lamps that are not part of an electronic message center (EMC), an internally illuminated sign or an externally illuminated sign.

**Exceptions 2 and 3:** Exit signs and traffic signs shall meet the requirements of the Appliance Efficiency Regulations, instead of Section 140.8.

**EXCEPTION TO SECTION 141.0:**

**HEALTHCARE FACILITIES**

Alterations and additions to healthcare facilities are not required to comply with Section 141.0.

**ADDITIONS, ALTERATIONS AND REPAIRS**

**Section 141.0(a)**

**ADDITIONS**

Lighting for building additions must meet the same mandatory and prescriptive or performance standards as lighting installed for a new construction project. If the performance approach is followed, the lighting power allowance for the general lighting systems in conditioned spaces may be traded off with other building features.
Section 141.0(b)2I
ALTERED INDOOR LIGHTING SYSTEMS
Requirements for indoor lighting alterations (Section 141.0(b)2I) that include at least 10% of the luminaires in the space being updated are categorized into three types of alterations and need to meet one of the following:

1. Comply with the indoor lighting power and lighting control requirements for new construction (second from the right column, Table 141.0-F on page 90).
2. Alterations using 80% or less of the indoor lighting power allowances at a minimum must adhere to the lighting control requirements in the right column of Table 141.0-F.
3. Projects in buildings or tenant spaces that are 5,000 ft² or less that include 'one-for-one luminaire alterations' can retrofit with new luminaires or component modifications that achieve at least 40% power reductions over pre-alteration luminaires. The project must include the lighting controls shown in the right column of Table 141.0-F.

It is important to note that the following project scenarios are exempt from lighting alteration requirements:

- Alteration of portable luminaires, luminaires affixed to movable partitions or lighting excluded as specified in Section 140.6(a)3.
- Any enclosed space with only one luminaire.
- Any alteration that would directly cause the disturbance of asbestos, unless the alteration is made in conjunction with asbestos abatement.
- Any alteration limited to adding lighting controls, replacing only lamps or replacing only ballasts or drivers. When both the lamp and ballast/driver are replaced during the same project, the alteration requirements apply.
- One-for-one luminaire alteration of up to 50 luminaires either per complete floor of the building or per complete tenant space, annually.

LIGHTING WIRING ALTERATIONS
Alterations to lighting wiring are considered alterations to the lighting system. Alterations to indoor lighting systems are not required to separate existing general, floor, wall, display or decorative lighting on shared circuits or controls. New or completely replaced lighting circuits shall comply with the control separation requirements of Sections 130.1(a)3 and 130.1(c)1D. For projects where new feeders and branch circuits are added, the voltage drop requirements from Section 130.5(c) apply.

REPAIRS
Repairs of lighting components, systems or equipment already installed in an existing building do not trigger the Energy Code. No compliance requirements are required.

The Energy Code defines repairs as:

- Replacing lamps only
- Replacing ballasts or drivers only
- Replacing diffusers, shades, or luminaire covers
### Control Specifications

<table>
<thead>
<tr>
<th>Control Specifications</th>
<th>Trigger</th>
<th>Projects Complying with Section 141.0(b)2li</th>
<th>Projects Complying with Sections 141.0(b)2lii &amp; 141.0(b)2lii</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manual Area Controls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>130.1(a)1 – Be readily accessible.</td>
<td>Required</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>130.1(a)2 – Be located in the same enclosed area with the lighting fixture it controls.</td>
<td>Required</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>130.1(a)3 – Provide separate control of general, display, ornamental and special effects lighting.</td>
<td>Only required for new or completely replaced circuits</td>
<td>Only required for new or completely replaced circuits</td>
<td></td>
</tr>
<tr>
<td><strong>Multilevel Controls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>130.1(b) – Allow level of lighting to adjust up and down.</td>
<td>Required</td>
<td>Not Required</td>
<td></td>
</tr>
<tr>
<td>130.1(c)1 – Be controlled by an occupant sensing control, automatic time-switch control or other control capable of automatically shutting off all lighting when the space is typically unoccupied; provide separate controls as specified in 130.1(c)1B-D; and include a manual-on mode for automatic time-switch controls.</td>
<td>Required; 130.1(c)1D only required for new or completely replaced circuits</td>
<td>Required; 130.1(c)1D only required for new or completely replaced circuits</td>
<td></td>
</tr>
<tr>
<td>130.1(c)2 – Countdown timer switches may be used to comply with shut-off control requirements in closets less than 70 ft² and server aisles in server rooms.</td>
<td>Required</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>130.1(c)3 – Manual override for automatic time-switch controls shall turn lighting off after 2 hours.</td>
<td>Required</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>130.1(c)4 – Holiday override for automatic time-switch controls shall turn lighting off for at least 24 hours and be able to resume normal scheduled operation.</td>
<td>Required</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>130.1(c)5 – Spaces required to use occupant sensing controls to shut off all lighting.</td>
<td>Required</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>130.1(c)6 – Spaces required to use full or partial-off occupant sensing controls to shut off all lighting.</td>
<td>Required</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>130.1(c)7 – Spaces required to use partial-off occupant sensing controls.</td>
<td>Required</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>130.1(c)8 – Hotel and motel guest rooms must have captive card key controls, occupancy sensing controls or automatic time-switch controls.</td>
<td>Required</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td><strong>Automatic Daylighting Controls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>130.1(d) – Automatically adjust the power of the installed lighting up and down to keep the total light level stable as the amount of incoming daylight changes.</td>
<td>General lighting totaling at least 120 watts in a room’s combined skylit daylit zones and primary sidelit daylit zones with at least 24 ft² of glazing.</td>
<td>Required</td>
<td>Not Required</td>
</tr>
<tr>
<td><strong>Demand Responsive Controls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>130.1(e) – Lighting reduction in response to an automated demand response signal.</td>
<td>Projects with more than 10,000 ft² of spaces with more than 0.5 watts per ft². Healthcare buildings are exempt.</td>
<td>Required</td>
<td>Not Required</td>
</tr>
</tbody>
</table>
CHAPTER 4  COMPLIANCE REQUIREMENTS

Additionally, when 50 or fewer luminaires are upgraded or modified within a 12-month period in a building floor or tenant space, it is treated as a repair rather than an alteration, per Exception 6 to Section 141.0(b)21.

Section 141.0(b)2L
ALTERED OUTDOOR LIGHTING SYSTEMS

Alterations to existing outdoor lighting systems in an application listed in Table 140.7-A or 140.7-B that increase the connected lighting load must comply with the same mandatory and prescriptive requirements as a new construction project.

Requirements for alterations to existing outdoor lighting systems in an application listed in Table 140.7-A or 140.7-B that do not increase the connected load of the outdoor lighting system vary based on the number or percentage of the lighting fixtures being changed, moved or replaced, per the table below.

Section 141.0(b)2M
SIGN ALTERATIONS

Certain alterations to existing signs, whether internally or externally illuminated, require compliance with the Energy Code (Section 140.8):

1. The connected lighting load is increased
2. Over 50% of the ballasts are replaced and rewired
3. The sign is relocated, either on the same site or to a new site

Altered Outdoor Lighting Systems — Triggers and Requirements

<table>
<thead>
<tr>
<th>Alteration Compliance Method Used</th>
<th>Mandatory Lighting Controls Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance testing requirements of Section 130.4 are not required for alterations where lighting controls are added or altered to control ≤ 20 luminaires for the entire permitted project (indoor, outdoor and sign lighting)</td>
<td></td>
</tr>
<tr>
<td>Luminaire Cutoff (i.e., BUG) when ≥ 6,200 lumens</td>
<td>Daylight Available</td>
</tr>
<tr>
<td>Section 130.2(b)</td>
<td>Section 130.2(c)1</td>
</tr>
<tr>
<td>Automatic Scheduling</td>
<td>Motion Sensing</td>
</tr>
<tr>
<td>Section 130.2(c)2</td>
<td>Section 130.2(c)3</td>
</tr>
<tr>
<td>Adding to the Connected Load</td>
<td>Yes</td>
</tr>
</tbody>
</table>

EXCEPTION TO SECTION 141.0(b)2L
Acceptance testing requirements are not required for indoor or outdoor alteration projects where controls are added to 20 or fewer luminaires.

RETROFITTING LUMINAIRES
If retrofitting an existing luminaire with new technology (i.e., rewiring HID shoebox with LED technology) in which the fixture head remains, it is not considered an alteration unless the connected load is increased (see below). If the fixture head is being replaced, but the pole is remaining, this is considered a luminaire alteration.

EXCEPTIONS
Replacement of parts of an existing sign, including replacing lamps, the sign face or ballast, that do not require rewiring or that are done at a time other than when the sign is relocated is not considered an alteration.
The Energy Code allows designers and builders to choose from a variety of lighting strategies and technologies. Options are available across a broad range of price points and can suit a variety of aesthetics. The sample lighting designs presented in this chapter represent just some of the many possibilities on the market today.

**MINIMIZE LIGHTING POWER DENSITY, MAXIMIZE CONTROL**

Designing nonresidential buildings to meet or exceed the Energy Code requires lighting requirements that maximize the use of controls to minimize lighting power density. Following this approach reduces lighting energy use.

Lighting should help people in the space perform their tasks effectively and comfortably. In most office applications, this involves maximizing illumination while minimizing the visibility of light sources to allow employees to focus on the workspaces being lit rather than the lighting itself. Energy savings can be achieved while maintaining the quality of lighting for occupants’ comfort and satisfaction.

A critical step in lighting design is determining the visual needs of the space and identifying the type of lighting to use. This step helps inform which energy-efficient lighting technologies and control strategies to use.

This chapter discusses how the Energy Code applies to ambient lighting, task lighting, daylighting and transitional spaces. Recommendations for nonresidential applications are provided to help design with the lighting Energy Code requirements in mind, considering the building’s architecture, atmosphere and aesthetics.
ARCHITECTURE
Lighting can emphasize, soften or balance certain architectural features. Examples include making a small boutique feel more spacious, playing up (or playing down) the texture of a wall or accenting coves and valances. It is also helpful to consider the materials used in the space; for example, dark, polished granite reflects light differently than wood or brick.

ATMOSPHERE
The atmosphere of your project should be considered at the start of your lighting design. Consider what activities or tasks will take place in different areas. High-contrast lighting is typically used in upscale boutiques, while higher, more uniform light levels are commonly found in big box retail stores to support high-volume sales tasks.

AESTHETICS
The style, or aesthetic, of the lighting design should complement the building’s style. Light source choices should include careful consideration of appropriate CCT and color rendering. CCT-adjustable products allow users to adjust light intensity and color to change the visual appearance of the space.

APPLYING REQUIREMENTS FOR OFFICE LIGHTING

LAYERED LIGHTING
Many nonresidential spaces rely on general lighting, where ceiling-mounted luminaires provide an overall level of illumination for all space uses. This strategy often results in a level of illumination that is sufficient for tasks in all locations, regardless of whether tasks are being performed or not. Recent studies have shown that reducing this general, ambient lighting and using localized light for specific visual tasks creates a more comfortable experience and can significantly reduce energy use.

In partnership with lighting manufacturers and the Energy Commission’s Public Interest Energy Research Program, CLTC evaluated the benefits of a layered lighting design for office applications. The studies found that including LED task lighting as a primary layer of lighting in offices resulted in a 50% savings in lighting energy and significantly increased user satisfaction. A summary of some of the research follows:

INTEGRATED LIGHTING SYSTEM
Task and ambient lighting, a strategy to illuminate office spaces, is a total systems approach. Dimmable overhead luminaires provide the majority of the lighting, supplemented by vertical surface lighting and task lighting.

This approach achieves significant energy savings by reducing the overhead lighting load without sacrificing user comfort or visual detail.
THE BENEFITS OF LED TASK LIGHTING

The “Portable Office Lighting Systems Final Report” summarizes the research to design, develop and test prototype workstation luminaires. The study in the report implemented lighting controls in these luminaires to provide both workstation and office-level lighting control.

COMPLIANCE REQUIREMENTS

LPD requirements for office-related areas now range from 0.6 to 0.65 W/ft². This LPD maximum can be achieved by carefully adding lighting only where it is needed and by using LED technologies where possible. Review Table 140.6-C in theAppendix for the allowed lighting power densities in the area category method.

RECOMMENDATIONS

1. Visual Comfort and Uniformity: Use indirect lighting to minimize glare on computer screens, and use task lighting to provide light when and where it is needed. Indirect lighting illuminates the ceiling, which reflects light down to the vertical surfaces, task areas and floor. If the lighting design provides uniform distribution, the resulting illumination can be soft and nearly shadow-free.

2. Vertical Illumination: Vertical illumination is the amount of light output per unit area measured on a vertical surface. Adding lighting for vertical surfaces where the task and ambient strategy is applied reduces contrast and gives the space a softer, more appealing visual appearance. This additional effect also offers energy reduction opportunities when the luminaires illuminating the vertical surfaces are controlled in a separate lighting layer. This layer can be dimmed or shut off during typically vacant periods or during a demand response event.

3. Networked Controls: In an open office environment, overhead ambient lighting is typically controlled in large zones. As a result, large areas of a building may be illuminated for long periods of time, regardless of occupancy. Significant energy and maintenance savings can be achieved by using a combination of (1) low ambient lighting, (2) zonal controls for smaller areas, (3) high-quality task lighting and (4) personalized controls. Many control solutions involve connecting all luminaires into a network using either wired or wireless communication between sensors and luminaires or from luminaire to luminaire if integrated controls are used.

The Energy Code does not require that networked lighting controls be used. Yet, many current systems meet or exceed the requirements in Section 130.1 and utilize the Electric Power Distribution Systems separation requirements in Section 130.5.
MANAGING DAYLIGHT

лас требования

Мandatory automatic daylighting controls are required in indoor spaces that have 24 ft² or more of glazing and 120 watts or more of general illumination in the combined primary sidelit and skylit daylit zones. Not all requirements are required for all projects, and there are many exceptions. Review Section 130.1(d) (see page 42 of this guide) and Section 141.0(b)2I with Table 141.0-F (see page 90 of this guide) to determine what each project requires.

Рекомендации

Daylighting in commercial buildings can reduce electricity use for lighting by up to 50% or more but also presents complex challenges.


Daylight design guidelines and associated Energy Code requirements are provided in an easy-to-read, side-by-side layout, organized into sections for each building-related discipline that impacts daylight performance, from building siting, through architectural and interior design, to construction, commissioning and operation.

Технологии освещения: проектирование и назначение дневного света для зданий

store.ies.org/product/lp-3-20-lighting-practice-designing-and-specifying-daylighting-for-buildings/

The IES’ Lighting Practice: Designing and Specifying Daylighting for Buildings (LP-3-20) document provides up-to-date solutions and data for addressing the challenges of daylighting while maximizing its benefits.

LP-3-20, which is an authoritative reference guide for architects, engineers and lighting designers, includes information on daylight design techniques, delivery methods, glazing systems, shading techniques, control strategies and daylight performance simulation tools.
CHAPTER 5  REQUIREMENTS AND RECOMMENDATIONS

TASK LIGHTING

✔️ COMPLIANCE REQUIREMENTS
Task lighting can play a critical role when designing a compliant lighting system. In office space projects that trigger the plug load control requirements in Section 130.5, task lighting is required to be powered from occupancy-controlled outlets. Additionally, task lighting can be integrated into networked controls for maximum benefit.

★ RECOMMENDATIONS
Occupants have varying lighting requirements. Different visual tasks demand variations in ideal lighting conditions. Computer monitors require diffused, ambient light with low screen glare, while printed materials require more light directed to a specific task plane (typically a desk surface) to avoid eye fatigue caused by low light levels. These task requirements drive target illuminance levels. Task lighting equipped with personal control helps to meet visual task requirements and should be included in the lighting design.
LARGE STORES

COMPLIANCE IN PRACTICE

Section 130.1(a)

SWITCH PLACEMENT
In most areas, luminaires and manual on/off controls are required to be located in the same enclosed area. This may work well in office applications, but in retail settings, unauthorized persons should not have access to the lighting controls. In malls, retail and wholesale sales floors, the lighting control is required to be located so that a person using the lighting control can see the lights or area controlled by that lighting control; the switch does not have to be in that immediate vicinity and accessible to the public. Alternatively, it is permitted to use a lighting controls system where that area of the store is annunciated through the control interface, and the person controlling the lighting can see the effect of their actions remotely.

Section 130.1(a)

FLOOR, WALL, WINDOW AND CASE DISPLAYS
Floor, wall, window and case display lighting are required to be switched separately, as well as ornamental and special effects lighting. In the example on the next page, a separate switch in view of the window display lighting controls the window displays at the front of the store.

Section 130.0(c)

TRACK LIGHTING
Line-voltage track lighting is popular in retail because it can be adjusted to suit changing displays and focus attention on a small area. Use Section 130.0(c)6 to determine how much power to count towards the actual lighting power budget. More information on track lighting luminaire classification and power determination is on page 63 of this guide.

ADDITIONAL LIGHTING POWER ALLOWANCES
In areas approved to use the tailored method of the prescriptive approach, wall display, floor display, task, decorative/special effects and very valuable display case lighting may be eligible for additional lighting power allotments.

RECOMMENDATIONS

FLATTERING FITTING ROOMS
High-CRI luminaires enhance the colors and textures of merchandise. Choose luminaires that provide soft, even distribution and consider lighting mirrors along both vertical edges to prevent unflattering shadows. In small fitting rooms, cove lighting located behind mirrors can help make these spaces feel larger.

EXAMPLE LIGHTING DESIGN
An example lighting schedule and floor plan of a large store are provided on the next page. Examples of appropriate switch placement, display lighting and track lighting are shown.
## LIGHTING SCHEDULE

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Luminaire Type</th>
<th>Lamp</th>
<th>Quantity</th>
<th>Watts</th>
<th>Total Watts</th>
<th>Efficacy (lm/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>☀️</td>
<td>Pendant</td>
<td>Induction</td>
<td>5</td>
<td>55</td>
<td>275</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Decorative pendant</td>
<td>Dedicated LED</td>
<td>6</td>
<td>10</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>🕭</td>
<td>6” Recessed downlight</td>
<td>Dedicated LED</td>
<td>10</td>
<td>12</td>
<td>120</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>1 x 4 Ceiling-mounted troffer</td>
<td>Dedicated LED</td>
<td>4</td>
<td>38</td>
<td>152</td>
<td>105</td>
</tr>
<tr>
<td>🗑️</td>
<td>8’ track with 5 heads</td>
<td>LED track heads</td>
<td>8</td>
<td>240</td>
<td>1920</td>
<td>47</td>
</tr>
<tr>
<td>🗑️</td>
<td>4’ track with 3 heads</td>
<td>LED track heads</td>
<td>1</td>
<td>120</td>
<td>120</td>
<td>47</td>
</tr>
</tbody>
</table>

### Controls
- Manual on/off switch with dimming
- Automatic time switch connected to all lighting circuits

### TRACk LIGHTING:

The track lighting wattage claimed for compliance purposes used the method described in Section 130.0(c)6Ai (30 watts per linear foot of track). For compliance form NRCC-LTI-E, check the track lighting option in column 03 and fill out Section G (Modular Lighting Systems) to specify how wattage is determined.
SMALL STORES

COMPLIANCE IN PRACTICE

Section 130.1(c)  
OCCUPANCY CONTROLS

Placing occupancy sensors in stock rooms complies with the Energy Code for lighting controls in secondary spaces. Occupancy sensors will also turn lights on and off automatically for employees who typically have their hands full when entering or exiting these spaces.

RECOMMENDATIONS

ACCENT LIGHTING

Use accent lighting strategically to draw customers’ attention to certain displays and enhance merchandise details.

CONTRAST BETWEEN AMBIENT AND DISPLAY LIGHTING

Keeping lower ambient light levels heightens the impact of display lighting and accent lighting. This high-contrast lighting design strategy conveys a more upscale atmosphere and saves energy.

COLOR-SHIFTING DISPLAY LIGHTING

Consider tunable lighting to enhance displays and command customers’ attention. Color-tunable LED lighting is one effective option.

WINDOW DISPLAYS

Position lights to avoid glare in spaces with large front-facing windows.

EXAMPLE LIGHTING DESIGN

An example lighting schedule and floor plan of a small store is provided on the next page. Examples of appropriate occupancy controls, accent lighting, display lighting and window displays are shown.
## LIGHTING SCHEDULE

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Luminaire Type</th>
<th>Lamp</th>
<th>Quantity</th>
<th>Watts</th>
<th>Total Watts</th>
<th>Efficacy (lm/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>⭕️</td>
<td>6” Recessed downlight</td>
<td>Dedicated LED</td>
<td>12</td>
<td>9.5</td>
<td>114</td>
<td>67</td>
</tr>
<tr>
<td>⭕️</td>
<td>4” Adjustable recessed downlight</td>
<td>Dedicated LED</td>
<td>16</td>
<td>11</td>
<td>176</td>
<td>54.5</td>
</tr>
<tr>
<td>⭕️</td>
<td>48” Cove lighting</td>
<td>Dedicated LED</td>
<td>3</td>
<td>14</td>
<td>42</td>
<td>98</td>
</tr>
<tr>
<td>⭕️</td>
<td>1 x 4 Ceiling-mounted troffer with integrated occupancy sensor</td>
<td>Dedicated LED</td>
<td>1</td>
<td>38</td>
<td>38</td>
<td>105</td>
</tr>
<tr>
<td>⭕️</td>
<td>4’ Track with 3 heads</td>
<td>LED track heads</td>
<td>3</td>
<td>120</td>
<td>360</td>
<td>47</td>
</tr>
</tbody>
</table>

### Controls
- Manual on/off switch with dimming
- Automatic time switch

**Installed Watts Total:** 730W

### TRACK LIGHTING:
The track lighting wattage claimed for compliance purposes used the method described in Section 130.0(c)6Ai (30 watts per linear foot of track). For compliance form NRCC-LTI-E, check the track lighting option in column 03 and fill out Section G (Modular Lighting Systems) to specify how wattage is determined.

### LUMINAIRES WITH INTEGRATED CONTROLS

Occupancy-based lighting controls can save significant amounts of energy in areas such as stock rooms, which are often characterized by highly intermittent occupancy patterns. Integrated, occupancy-based lighting controls offer an opportunity for energy and cost savings. Integrate dimming or multilevel stepped lighting controls that include a lower light setting for periods of inactivity (to support safety) and additional settings to provide light levels for different activities.
NONRESIDENTIAL RESTROOMS

COMPLIANCE IN PRACTICE

Section 130.1(a)2
MANUAL CONTROLS

In public restrooms with two or more stalls, a manual switch that is only accessible to authorized personnel may be used. All other applicable lighting controls for the space are still required. Public restrooms are exempt from multilevel controls but must have occupancy sensing controls that shut off all lighting.

RECOMMENDATIONS

OCCUPANCY SENSORS

Ultrasonic occupancy sensors can detect occupants around corners. This prevents lights from turning off while the space is in use. Ceiling-mounted dual-technology sensors that include both ultrasonic and passive infrared (PIR) technologies are available to assure the lighting stays on when it is needed.

VANITY LIGHTING

Flattering lighting around mirrors contributes to users’ overall experience. Vertical bath bars placed parallel to mirrors minimize unflattering shadows.

EXAMPLE LIGHTING DESIGN

An example lighting schedule and floor plan of a commercial restroom is provided on the next page. Examples of appropriate controls, occupancy sensors and vanity lighting are provided.
## LIGHTING SCHEDULE

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Luminaire Type</th>
<th>Lamp</th>
<th>Quantity</th>
<th>Watts</th>
<th>Total Watts</th>
<th>Efficacy (lm/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 x 4 Recessed troffer</td>
<td>Dedicated LED</td>
<td>4</td>
<td>22</td>
<td>88</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>3' Vertical bath bar</td>
<td>Dedicated LED</td>
<td>8</td>
<td>15</td>
<td>120</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>6&quot; Recessed downlight</td>
<td>Dedicated LED</td>
<td>1</td>
<td>9.5</td>
<td>9.5</td>
<td>67</td>
</tr>
</tbody>
</table>

**Controls**
- $SD$ Manual on/off switch with dimming
- $VC$ Vacancy Control

**Installed Watts Total:** 217.5W
EDUCATIONAL FACILITIES

COMPLIANCE IN PRACTICE
There are several specific requirements pertaining to classrooms. Classrooms must have partial-on occupancy sensors or vacancy sensors if also meeting Section 130.1(b). Classrooms with a connected load of 0.6 W/ft² or less can have one control step between 30–70% instead of full multilevel control requirements.

RECOMMENDATIONS

ENERGY SAVINGS
Educational facilities often encompass many functional areas and end users. Traditional office spaces, classrooms, conference rooms and cafeterias are all typical areas in an educational facility. For this reason, it is recommended that continuous dimming light sources be paired with dimmers, occupancy sensors and automatic daylighting controls as appropriate. It is also an ideal application for the use of spectrally-tunable luminaires.

DIMMING DEVICES
It is critical to specify a dimmer that is compatible with the light source you are installing. This means you should reference the list of compatible dimmers provided by the manufacturer for the light source when designing your new system.

OCCUPANCY SENSORS
The correct specification of occupancy sensing technology is critical to the success of your lighting system. It is recommended that the use of the space be considered from a size and coverage pattern perspective, as well as a mounting location perspective. Use of sound-based technologies near air ducts will result in false triggers and can turn your light system on during periods of vacancy. It is also an acceptance requirement, per NA7.6.2.1, that occupant sensing lighting controls are installed per manufacturer’s instructions to minimize false triggers, such as installing an occupancy sensor away from HVAC diffusers.

AUTOMATIC DAYLIGHTING CONTROLS
Educational facilities often incorporate daylighting into the building’s design. For this reason, it is recommended to deploy an automatic daylighting control system so teachers and students alike can enjoy natural daylight conditions when it is available.

SPECTRALLY TUNABLE LUMINAIRES
Spectrally tunable luminaires allow the user to specify the warmth or coolness of the light. For educational facilities, this feature is ideal for setting a mood or scene during periods of scheduled activities such as recess, study hall or testing.

EXAMPLE LIGHTING DESIGN
An example lighting schedule and floor plan of a classroom is provided on the next page. Examples of appropriate controls, daylighting controls and ambient lighting are provided, as well as instructions on calculating skylit daylit zones.
CHAPTER 5 REQUIREMENTS AND RECOMMENDATIONS

APPLYING SKYLIT DAYLIT ZONE CALCULATIONS

The floor plan below has a circular skylight with a diameter of 4 feet, an average ceiling height of 20 feet, and the desks are 2.5 feet tall.

**SKYLIT DAYLIT ZONE**

1. Define the shape of the skylight. The circular skylight will produce a circular daylit zone.
2. Determine the average ceiling height. The average ceiling height is 20 feet.
3. Multiply the CH by 0.7 and add the value in all directions around the skylight. The skylit zone is 14 feet in all directions beyond the area directly under the skylight. The luminaires within the skylit zone must be paired with automatic daylighting controls.

---

**LIGHTING SCHEDULE**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Luminaire Type</th>
<th>Lamp</th>
<th>Quantity</th>
<th>Watts</th>
<th>Total Watts</th>
<th>Efficacy (lm/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Linear pendant with wireless communication and integrated occupancy sensor</td>
<td>Dedicated LED</td>
<td>18</td>
<td>38</td>
<td>684</td>
<td>100</td>
</tr>
</tbody>
</table>

Controls: $\text{SD}$ Manual on/off switch with dimming (*)&

(*) Dimming must have the number of control steps specified in Table 130.1-A.

---

Automatic Daylighting Control with wireless communication
TRANSITIONAL SPACES

COMPLIANCE IN PRACTICE

Lighting power for stairwell and corridor luminaires is required to be automatically reduced by at least 50% during vacant periods. Recommended light levels should be restored when occupants are detected from either direction. At 50% power, general lighting is often well above minimum levels required for egress lighting (see page 38 of this guide). Though only partial-off is required by the Energy Code, general lighting in stairwells and corridors can be shut off after typical occupied hours for deeper energy savings, assuming the lights will turn back on to recommended light levels when occupied.

RECOMMENDATIONS

RETROFIT OPTIONS

Bi-level luminaire retrofits are easy to implement and provide safe, reliable and efficient lighting. If fluorescent luminaires are in good condition, a lamp-and-ballast retrofit with the addition of an external sensor will provide the bi-level functionality to meet the Energy Code. These luminaires will also need to be completely shut off after occupied times, per Section 130.1(c).

LED LUMINAIRES WITH INTEGRATED CONTROLS

There are bi-level LED luminaires with integrated sensors made specifically for stairwells and corridors. If luminaires are old and need replacing, the best approach is installing new, dedicated LED luminaires with integrated dimming drivers rather than retrofitting.

SENSOR OPTIONS

Ultrasonic sensors typically offer a better level of detection in constricted stairwell configurations compared to passive infrared (PIR) sensors. PIR technology is effective when multiple sensors are integrated within the luminaire with different detection angles. In either case, make sure that the sensor technology is appropriately installed and commissioned for effective lighting control.

Stairwells are often located at the perimeter of buildings where large windows may offer a significant opportunity for daylighting. Luminaire-integrated photosensors provide lighting control on a per-luminaire basis, and a single photosensor can be used to control multiple luminaires. Daylighting systems are cost-effective in spaces that receive enough daylight, but like most lighting controls, they require careful installation and proper calibration to maximize efficiency.
Energy savings can be achieved in corridors and other secondary spaces with an occupancy-based adaptive lighting system. Such a system is generally composed of occupancy sensors, dimmable light sources and a communication platform. The system automatically lowers light levels during vacancy and raises light output to the recommended level for occupant comfort during occupied periods. The adaptive lighting system installed at the Latham Square office building, located in Oakland, California, is based on a stand-alone platform for adaptive lighting that employs cost-effective wireless control devices and programmable dimming ballasts.

The new 64W fluorescent light fixtures installed for this project are equipped with dimmable ballasts. Occupancy sensors were installed throughout the corridors to provide adequate passive infrared sensor coverage for the corridor areas and each point of entry. The wireless sensors work in tandem with dimming modules, which control the light levels of the fixtures.

**A**

**Accent or display lighting:** Lighting provided by directional light sources to illuminate specific areas or objects, such as display merchandise. Accent lighting sources can be recessed, surface mounted or mounted to a pendant, stem or track.

**Ambient or general lighting:** Lighting provided by non-directional light sources to provide low-level illumination for comfortable navigation through spaces. Ambient lighting is generally supplemented by **task lighting** and **accent lighting**.

**Astronomical time-switch control:** An automatic lighting control device that switches lights on or off at specified times of the day or at times relative to astronomical events, such as sunset and sunrise. These devices can account for geographic location and calendar date.

**C**

**Candela (cd):** Unit of measurement for luminous intensity. One candela (cd) is equal to one lumen per steradian (lm/sr). A candle flame emits light with a luminous intensity of approximately one candela.

**Case lighting:** Lighting designed for enclosed cases, such as glass display cases that display jewelry, electronics or other valuable items.

**Ceramic metal halide (CMH):** A type of high-intensity discharge (HID) lamp commonly used in retail lighting. Like **metal halide** lamps, CMH lamps generate light using a mixture of argon, mercury and metal halide vapors. CMH lamps are a newer variation of MH capable of producing white light with a CRI as high as 96. Full light output takes up to 10 minutes, making them less compatible with adaptive lighting controls. They use up to 90% less energy than incandescent sources.

**Chandelier:** A ceiling-mounted luminaire that often uses glass, crystal, ornamental metals or other decorative materials. Typically used as a significant element of interior architecture and may be mounted close to the ceiling or suspended.
Color Rendering Index (CRI): The current industry standard for measuring how accurately a light source renders the colors of the objects it illuminates when compared to an ideal light source. The maximum CRI value is 100.

Compact fluorescent lamp (CFL): A type of fluorescent lamp with a T5 glass tube (or smaller diameter) folded, bent or bridged to create a compact shape.

Correlated Color Temperature (CCT): Expressed in Kelvin (K), CCT indicates the warmth or coolness of light emitted from a particular source. Light sources with a low CCT (2,700–3,000K) have a warmer, more yellow appearance than those with higher CCT values (4,000–6,500K, for example), which appear cooler, or more blue, in color.

Countdown timer switch: A device featuring one or more preset countdown time periods that turns lighting (or other loads) on when activated and automatically switches off when the selected time period elapses.

Daylight control: An automatic lighting control device that uses one or more photosensors to detect changes in daylight contribution and automatically adjust electric lighting levels accordingly.

Daylit Zone: The floor area under skylights or next to windows. The Energy Code includes building and lighting control requirements for specific types of daylit zones, including Primary Sidelit, Secondary Sidelit and Skylit zones.

Decorative Lighting: Lighting provided for aesthetic purposes that is not meant to provide ambient, task or accent lighting.

Dimmer: A lighting control device that adjusts the light output of an electric lighting source by decreasing or increasing the power delivered to that system. Step Dimmers provide end users with one or more distinct light level settings (or steps) between maximum light output and off. Continuous Dimmers offer finer, more subtle control over a continuous range between maximum light output and the off setting.

Efficacy, lamp: The amount of light produced by a lamp or luminaire relative to the amount of electrical power it consumes (typically expressed in lm/W). To calculate lamp efficacy, divide the lamp’s rated initial lumens (lm) by the rated lamp power (watts) without including auxiliaries, such as ballasts, transformers and power supplies.

Energy Management Control System (EMCS): A computerized control system designed to regulate energy use by supporting monitoring and control of the operation of one or more building systems, such as lighting and HVAC. An EMCS can also be programmed to provide automated control based on signals from sensors or utilities.

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

General lighting: See ambient lighting.

GU-24: A lamp holder and socket configuration based on the International Energy Consortium coding system, where “G” stands for the broad type of two or more projecting contacts (pins or posts), “U” distinguishes between lamp and holder designs of similar but not interchangeable types and “24” indicates 24 millimeters between the center points of the electrical contact posts.
**High intensity discharge (HID) lamp**: An electric discharge lamp in which the light-producing arc is stabilized by bulb wall temperature. HID lamps include groups of lamps known as **mercury**, **metal halide** and **high pressure sodium**.

**Illuminance**: A measure of the density of incident light output on a surface (i.e., lumens per area). The unit is lux (lx) when the area is measured in square meters and footcandle (fc) when the area is measured in square feet.

**Illumination**: Density of light incident at a point on a surface, measured in footcandles (fc), perpendicular to the surface.

**Incandescent lamp**: A lamp in which a filament gives off light when heated by an electric current.

**Lamp**: A light source packaged in a standardized shape with a standardized base that is designed to connect to the branch circuit via a standardized base, lamp holder or socket.

**LED lamp**: A lamp that uses an LED as the light source.

**LED luminaire**: A luminaire that uses an LED as its light source.

**Light output**: The rate at which a light source emits visible light. This “flow rate” of light is measured as lumens through time and generally defines “light”, for purposes of lighting design and illuminating engineering. It is also referenced to as ‘luminous flux’.

**Light-emitting diode (LED)**: A solid-state light source that emits colored or white light. The acronym LED is often used to refer to an LED component, device or package.

**Lighting control system**: Technology consisting of two or more components and capable of providing full functionality for lighting control compliance.

**Lumen**: The unit of measurement that describes the amount of light emitted from a light source. Higher lumen output indicates a brighter light source.

**Luminaire**: A complete lighting unit consisting of a light source, the parts that distribute the light and protect the light source, and the parts to connect the light source to the power supply.

**Luminance (L)**: The intensity of light emitted from a light source or reflected off a surface, normalized by the area of the light source or the reflecting surface, projected on a plane vertical to the direction of view towards the light source or the surface (i.e., intensity or lumens per solid angle) per area. The units are Nit (cd/m²) and FootLambert (cd/ft²).

**Luminous flux**: See light output.

**Metal halide (MH)**: A high-intensity discharge (HID) light source commonly used in retail, industrial and outdoor applications. MH lamps use a mixture of argon, mercury and metal halide. A hard outer glass covering absorbs much of the UV radiation emitted by MH lamps, thereby reducing their efficacy. Full light output takes up to 10 minutes, making them less compatible with adaptive lighting controls.

**Motion sensor**: A device that automatically changes the light level after an area is vacated or occupied (depending on how it is commissioned) to a pre-defined level. The term ‘motion sensor’ applies to outdoor lighting controls and refrigerated display cases. When the device is used to control indoor lighting systems, it is called an occupant sensor, occupancy sensor, occupant sensing control or vacancy sensor.
Multilevel lighting control: A lighting control device that adjusts the output of electric lighting sources in multiple discrete steps.

Multiscene lighting control: In addition to all-off, this feature allows end-users to program or select pre-defined lighting settings for two or more groups of luminaires for multiple activities or displays within a space.

Occupancy sensor: A device that detects occupants, using motion or noise sensing as a proxy.

Pendant: A luminaire that is suspended from the ceiling.

Permanently installed lighting: All luminaires attached to the inside or outside of a building site, including track and flexible lighting systems; lighting attached to walls, ceilings, columns, inside or outside of permanently installed cabinets, internally illuminated case work, mounted on poles, in trees or in the ground; lighting attached to ceiling fans and lighting integral to exhaust fans other than exhaust hoods for cooking equipment. Does not include portable lighting or lighting that is installed by the manufacturer in appliances.

Photo controls: Automated lighting controls based on the signal of one or more photosensors, usually used for daylighting.

Pin-based luminaire: A luminaire that accepts lamps with a pin base. GU-24 pin-based luminaires are meant to prevent the use of low-efficacy lamps in high-efficacy luminaires.

Portable lighting: Lighting that is not permanently installed or hardwired but uses a plug-in connection for electric power (e.g., freestanding floor or table lamps, luminaires attached to modular furniture, workstation task lights, lights attached to workstation panels, movable displays and other impermanent luminaires). Requirements for portable lighting are covered by the Appliance Efficiency Regulations.

Readily accessible: Capable of being reached quickly for operation, repair or inspection, without climbing or removing obstacles or resorting to using portable access equipment.
Screw-based luminaire: A luminaire that accepts lamps with a screw base (e.g., incandescent, CFL or LED replacement lamps).

Skylight: A daylight aperture on a roof having a slope of less than 60 degrees from the horizontal plane.

Task lighting: Lighting that is not general lighting and that specifically illuminates a location where a task is performed.

Time switch: Also called a timer switch, this device is designed to automatically control lighting based on the time of day.

Track lighting: A lighting equipment system consisting of an electrified power channel (track) and removable luminaires (lamp holders; track heads) that can be mechanically attached anywhere along the power channel. The luminaires can be repositioned and re-aimed as desired.

Vacancy sensor: An occupancy sensor that requires occupants to turn lights on manually but automatically turns the lights off soon after an area is vacated. Also called a manual-on occupancy sensor or manual-on/automatic-off sensor.

Watt: The International System of Units (SI) unit of power, equivalent to one joule per second, corresponding to the power in an electric circuit in which the potential difference is one volt and the current one ampere.
APPENDIX

TABLES

The original versions of the tables in this section can be found in the 2022 Energy Code. These tables are used for determining what is required for compliance with the Energy Code and in the process of calculating lighting energy budgets.

Table 140.6-B: Complete Building Method Lighting Power Density Values (W/ft²)

<table>
<thead>
<tr>
<th>Type of Use</th>
<th>Allowed Lighting Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assembly Building</td>
<td>0.65</td>
</tr>
<tr>
<td>Bank or Financial Institution Building</td>
<td>0.65</td>
</tr>
<tr>
<td>Grocery Store Building</td>
<td>0.90</td>
</tr>
<tr>
<td>Gymnasium Building</td>
<td>0.60</td>
</tr>
<tr>
<td>Healthcare Facility</td>
<td>0.90</td>
</tr>
<tr>
<td>Industrial/Manufacturing Facility Building</td>
<td>0.60</td>
</tr>
<tr>
<td>Library Building</td>
<td>0.70</td>
</tr>
<tr>
<td>Motion Picture Theater Building</td>
<td>0.60</td>
</tr>
<tr>
<td>Museum Building</td>
<td>0.65</td>
</tr>
<tr>
<td>Office Building</td>
<td>0.60</td>
</tr>
<tr>
<td>Parking Garage Building</td>
<td>0.13</td>
</tr>
<tr>
<td>Performing Arts Theater Building</td>
<td>0.75</td>
</tr>
<tr>
<td>Religious Facility Building</td>
<td>0.70</td>
</tr>
<tr>
<td>Restaurant Building</td>
<td>0.65</td>
</tr>
<tr>
<td>Retail Store Building</td>
<td>0.90</td>
</tr>
<tr>
<td>School Building</td>
<td>0.60</td>
</tr>
<tr>
<td>Sports Arena Building</td>
<td>0.75</td>
</tr>
<tr>
<td>All other buildings</td>
<td>0.40</td>
</tr>
</tbody>
</table>
### Table 140.6-C: Area Category Method — Lighting Power Density Values (W/ft²)

<table>
<thead>
<tr>
<th>Primary Function Area</th>
<th>Allowed Lighting Power Density for General Lighting (W/ft²)</th>
<th>Additional Lighting Power¹</th>
<th>Qualified Lighting Systems</th>
<th>Additional Allowance (W/ft², unless noted otherwise)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corridor Area</td>
<td>0.70</td>
<td>Decorative / Display</td>
<td></td>
<td>0.30</td>
</tr>
<tr>
<td>Dining</td>
<td>0.80</td>
<td>Decorative / Display</td>
<td>Tunable white or dim-to-warm¹⁰</td>
<td>0.10</td>
</tr>
<tr>
<td>Lobby, Main Entry</td>
<td>0.85</td>
<td>Decorative / Display</td>
<td>Transition lighting off at night¹²</td>
<td>0.95</td>
</tr>
<tr>
<td>Lounge / Waiting Area</td>
<td>0.80</td>
<td>Decorative / Display</td>
<td>Tunable white or dim-to-warm¹⁰</td>
<td>0.10</td>
</tr>
<tr>
<td>Multipurpose Room</td>
<td>0.85</td>
<td>Decorative / Display</td>
<td>Tunable white or dim-to-warm¹⁰</td>
<td>0.10</td>
</tr>
<tr>
<td>Religious Worship Area</td>
<td>1.00</td>
<td>Decorative / Display</td>
<td>Tunable white or dim-to-warm¹⁰</td>
<td>0.10</td>
</tr>
<tr>
<td>Restroom</td>
<td>1.00</td>
<td>Decorative / Display</td>
<td></td>
<td>0.20</td>
</tr>
<tr>
<td>Stairwell</td>
<td>0.80</td>
<td>Decorative / Display</td>
<td></td>
<td>0.30</td>
</tr>
<tr>
<td>Audience Seating Area</td>
<td>0.50</td>
<td>Decorative / Display</td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>Auditorium Area</td>
<td>0.70</td>
<td>Decorative / Display</td>
<td></td>
<td>0.45</td>
</tr>
<tr>
<td>Auto Repair / Maintenance Area</td>
<td>0.55</td>
<td>Detailed task work¹</td>
<td></td>
<td>0.20</td>
</tr>
<tr>
<td>Barber, Beauty Salon, Spa Area</td>
<td>0.70</td>
<td>Detailed task work¹</td>
<td>Decorative / Display</td>
<td>0.30</td>
</tr>
<tr>
<td>Civic Meeting Place Area</td>
<td>0.90</td>
<td>Decorative / Display</td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>Classroom, Lecture, Training, Vocational Area</td>
<td>0.60</td>
<td>White or chalkboard¹</td>
<td>7 W/ft</td>
<td></td>
</tr>
<tr>
<td>Concourse and Atria Area</td>
<td>0.60</td>
<td>Decorative / Display</td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>Convention, Conference, Multipurpose and Meeting Area</td>
<td>0.75</td>
<td>Decorative / Display</td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>Copy Room</td>
<td>0.50</td>
<td>—</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Corridor Area</td>
<td>0.40</td>
<td>Decorative / Display</td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>Dining Area</td>
<td>Bar / Lounge and Fine Dining 0.45</td>
<td>Decorative / Display</td>
<td></td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td>Cafeteria / Fast Food 0.45</td>
<td>Decorative / Display</td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Family and Leisure 0.40</td>
<td>Decorative / Display</td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>Area Category Method</td>
<td>Lighting Power Density Values (W/ft²)</td>
<td>Continued</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------</td>
<td>------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical, Mechanical, Telephone Rooms</td>
<td>0.40</td>
<td>Detailed task work⁷</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Exercise / Fitness Center and Gymnasium Area</td>
<td>0.50</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Financial Transaction Area</td>
<td>0.70</td>
<td>Decorative / Display</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Healthcare Facility and Hospitals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exam / Treatment Room</td>
<td>1.15</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Imaging Room</td>
<td>0.60</td>
<td>Decorative / Display</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Medical Supply Room</td>
<td>0.55</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Nursery</td>
<td>0.80</td>
<td>Tunable white or dim-to-warm¹⁰</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Nurse’s Station</td>
<td>0.85</td>
<td>Tunable white or dim-to-warm¹⁰</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Operating Room</td>
<td>1.90</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Patient Room</td>
<td>0.70</td>
<td>Decorative / Display</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Physical Therapy Room</td>
<td>0.75</td>
<td>Tunable white or dim-to-warm¹⁰</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Recovery Room</td>
<td>0.90</td>
<td>Tunable white or dim-to-warm¹⁰</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Hotel Function Area</td>
<td>0.85</td>
<td>Decorative / Display</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Kitchen / Food Preparation Area</td>
<td>0.95</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Laboratory, Scientific</td>
<td>0.90</td>
<td>Specialized task work⁸</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Laundry Area</td>
<td>0.45</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Library</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading Area</td>
<td>0.80</td>
<td>Decorative / Display</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Stacks Area</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Lobby, Main Entry</td>
<td>0.70</td>
<td>Decorative / Display</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Locker Room</td>
<td>0.45</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Lounge, Breakroom, or Waiting Area</td>
<td>0.55</td>
<td>Decorative / Display</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Manufacturing, Commercial &amp; Industrial Work Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Bay</td>
<td>0.60</td>
<td>Detailed task work⁷</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>High Bay</td>
<td>0.65</td>
<td>Detailed task work⁷</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Precision</td>
<td>0.85</td>
<td>Precision specialized work⁹</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>Museum Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhibition / Display</td>
<td>0.60</td>
<td>Decorative / Display</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td>Restoration Room</td>
<td>0.70</td>
<td>Detailed task work⁷</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Office Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 250 ft²</td>
<td>0.60</td>
<td>Decorative / Display and Portable lighting for office areas⁶</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>≤ 250 ft²</td>
<td>0.65</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Parking Garage Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking Zone and Ramps</td>
<td>0.10</td>
<td>First ATM or Ticket Machine</td>
<td>100W</td>
<td></td>
</tr>
<tr>
<td>Daylight Adaptation Zones²</td>
<td>1.00</td>
<td>Additional ATM or Ticket Machine</td>
<td>50W each</td>
<td></td>
</tr>
<tr>
<td>Pharmacy Area</td>
<td>1.00</td>
<td>Specialized task work⁸</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------</td>
<td>------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>Retail Sales Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grocery Sales</td>
<td>1.00</td>
<td>Decorative / Display</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Retail Merchandise Sales</td>
<td>0.95</td>
<td>Decorative / Display</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Fitting Room</td>
<td>0.60</td>
<td>External illuminated mirror⁶</td>
<td>40W each</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Internal illuminated mirror⁵</td>
<td>120W each</td>
<td></td>
</tr>
<tr>
<td>Religious Worship Area</td>
<td>0.95</td>
<td>Decorative / Display</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Restrooms</td>
<td>0.65</td>
<td>Decorative / Display</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Stairwell</td>
<td>0.60</td>
<td>Decorative / Display</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Storage, Commercial / Industrial</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warehouse</td>
<td>0.40</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Shipping &amp; Handling</td>
<td>0.60</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Sports Arena—Playing Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class I Facility¹³</td>
<td>2.25</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Class II Facility¹³</td>
<td>1.45</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Class III Facility¹³</td>
<td>1.10</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Class IV Facility¹³</td>
<td>0.75</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Theater Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motion picture</td>
<td>0.50</td>
<td>Decorative / Display</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>0.80</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation Function</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baggage Area</td>
<td>0.40</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Ticketing Area</td>
<td>0.45</td>
<td>Decorative / Display</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Videoconferencing Studio</td>
<td>0.90</td>
<td>Videoconferencing¹⁴</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>All other</td>
<td>0.40</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>

Footnotes for this table are listed below:
1. Whiteboard or chalkboard — directional lighting dedicated to a whiteboard or chalkboard.
2. Daylight Adaptation Zones shall be no longer than 66 feet from the entrance to the parking garage.
3. Reserved.
4. Reserved.
5. Illuminated mirrors — lighting shall be dedicated to the mirror.
6. Portable lighting in office areas includes under shelf or furniture-mounted supplemental task lighting qualifies when controlled by a time clock or an occupancy sensor.
7. Detailed task work — lighting provides high level of visual acuity required for activities with close attention to small elements or extreme close up work.
8. Specialized task work — lighting provides for small-scale, cognitive or fast performance visual tasks; lighting required for operating specialized equipment associated with pharmaceutical or laboratory activities.
9. Precision specialized work — lighting for work performed within a commercial or industrial environment that entails working with low contrast, finely detailed or fast moving objects.
10. Tunable white luminaires capable of color change greater than or equal to 2,000K CCT, or dim-to-warm luminaires capable of color change greater than or equal to 500K CCT, connected to controls that allow color changing of the luminaires.
11. Aging Eye and low-vision areas can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and are or will be licensed by local or state authorities for either senior long-term care, adult day care, senior support and people with special visual needs.
12. Transition lighting off at night. Lighting power controlled by astronomical time clock or other control to shut off lighting at night. Additional LPD only applies to area within 30 feet of an exit. Not applicable to lighting in daylit zones.
13. Class I Facility is used for competition play for 5,000 or more spectators. Class II Facility is used for competition play for up to 5,000 spectators. Class III Facility is used for competition play for up to 2,000 spectators. Class IV Facility is normally used for recreational play and there is limited or no provision for spectators.
14. The additional videoconferencing lighting power shall be allowed provided the videoconferencing studio meets all the requirements of Section 140.6(c)2Gvii.
### Table 140.6-D: Tailored Method Lighting Power Allowances

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditorium Area</td>
<td>300</td>
<td>3.00</td>
<td>0.20</td>
<td>0.35</td>
</tr>
<tr>
<td>Convention, Conference, Multipurpose and Meeting Center Areas</td>
<td>300</td>
<td>2.00</td>
<td>0.30</td>
<td>0.35</td>
</tr>
<tr>
<td>Dining Areas</td>
<td>200</td>
<td>1.25</td>
<td>0.45</td>
<td>0.35</td>
</tr>
<tr>
<td>Exhibit and Museum Areas</td>
<td>150</td>
<td>11.20</td>
<td>0.70</td>
<td>0.35</td>
</tr>
<tr>
<td>Hotel Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ballroom and Events</td>
<td>400</td>
<td>1.80</td>
<td>0.12</td>
<td>0.35</td>
</tr>
<tr>
<td>Lobby</td>
<td>200</td>
<td>3.40</td>
<td>0.20</td>
<td>0.35</td>
</tr>
<tr>
<td>Lobby, Main Entry</td>
<td>200</td>
<td>3.40</td>
<td>0.20</td>
<td>0.35</td>
</tr>
<tr>
<td>Religious Worship Area</td>
<td>300</td>
<td>1.30</td>
<td>0.40</td>
<td>0.35</td>
</tr>
<tr>
<td>Retail Sales</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grocery</td>
<td>600</td>
<td>6.60</td>
<td>0.60</td>
<td>0.35</td>
</tr>
<tr>
<td>Merchandise Sales and Showroom Areas</td>
<td>500</td>
<td>11.50</td>
<td>0.70</td>
<td>0.35</td>
</tr>
<tr>
<td>Theater Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motion Picture</td>
<td>200</td>
<td>2.00</td>
<td>0.20</td>
<td>0.35</td>
</tr>
<tr>
<td>Performance Arts</td>
<td>200</td>
<td>7.30</td>
<td>0.20</td>
<td>0.35</td>
</tr>
</tbody>
</table>

### Table 140.6-E: Tailored Wall and Floor Display Mounting Height Adjustment Factors

<table>
<thead>
<tr>
<th>Height in feet above finished floor and bottom of luminaire(s)</th>
<th>Floor Display or Wall Display Mounting Height Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 10'-6&quot;</td>
<td>1.00</td>
</tr>
<tr>
<td>&gt; 10'-6&quot; to 14'-0&quot;</td>
<td>0.85</td>
</tr>
<tr>
<td>&gt; 14'-0&quot; to 18'-0&quot;</td>
<td>0.75</td>
</tr>
<tr>
<td>&gt; 18'-0&quot;</td>
<td>0.70</td>
</tr>
</tbody>
</table>
Table 140.6-F: Room Cavity Ratio (RCR) Equations

Determine the Room Cavity Ratio for Table 140.6-G using one of the following equations:

<table>
<thead>
<tr>
<th>Room cavity ratio for rectangular rooms:</th>
<th>Room cavity ratio for irregularly shaped rooms:</th>
</tr>
</thead>
<tbody>
<tr>
<td>$RCR = \frac{5 \times H \times (L + W)}{L \times W}$</td>
<td>$RCR = \frac{2.5 \times H \times P}{A}$</td>
</tr>
</tbody>
</table>

$H = \text{Vertical distance from the work plane to the centerline of the lighting fixture}$
$L = \text{Length of room}$
$W = \text{Width of room}$
$P = \text{Perimeter of room}$
$A = \text{Area of room}$

Table 140.6-G: Tailored Method General Lighting Power Allowed—By Illuminance and Room Cavity Ratio

<table>
<thead>
<tr>
<th>General Illuminance Level (lux)</th>
<th>General Lighting Power Density (W/ft²) for the following RCR values$^a$</th>
<th>RCR ≤ 2.0</th>
<th>RCR &gt; 2.0 and ≤ 3.5</th>
<th>RCR &gt; 3.5 and ≤ 7.0</th>
<th>RCR &gt; 7.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td></td>
<td>0.35</td>
<td>0.40</td>
<td>0.50</td>
<td>0.65</td>
</tr>
<tr>
<td>200</td>
<td></td>
<td>0.40</td>
<td>0.50</td>
<td>0.65</td>
<td>0.85</td>
</tr>
<tr>
<td>300</td>
<td></td>
<td>0.55</td>
<td>0.70</td>
<td>0.85</td>
<td>1.20</td>
</tr>
<tr>
<td>400</td>
<td></td>
<td>0.65</td>
<td>0.80</td>
<td>1.05</td>
<td>1.25</td>
</tr>
<tr>
<td>500</td>
<td></td>
<td>0.80</td>
<td>0.90</td>
<td>1.25</td>
<td>1.55</td>
</tr>
<tr>
<td>600</td>
<td></td>
<td>0.90</td>
<td>1.05</td>
<td>1.40</td>
<td>2.00</td>
</tr>
</tbody>
</table>

$^a$ Illuminance values from Column 2 of Table 140.6-D.
$^b$ RCR values are calculated using applicable equations in Table 140.6-F.
APPENDIX

RESOURCES

COMPLIANCE RESOURCES

BUILDING ENERGY EFFICIENCY STANDARDS
Visit the Energy Commission website to download the Building Energy Efficiency Standards. The Energy Code should be the first resource for any contractor, builder or designer with questions about the Energy Code regulations. Supporting documents and information on how to obtain public domain software for compliance are also available. The 2022 Nonresidential Compliance Manual and 2022 Nonresidential and Multifamily Alternative Calculation Method Reference Manual are among the related documents provided.

CALIFORNIA ENERGY COMMISSION MODERNIZED APPLIANCE EFFICIENCY DATABASE SYSTEM
 cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx
This online database allows users to verify if lighting products have been certified to the Energy Commission as meeting applicable requirements.

APPLIANCE EFFICIENCY REGULATIONS
Energy efficiency and performance standards for appliances, including ballasts, lamps, luminaires and lighting controls, are detailed in the Appliance Efficiency Regulations.

ENERGY CODE ACE
energycodeace.com
This site developed by the California Statewide Codes & Standards Program provides free tools, trainings and resources to help users meet the latest Energy Code and Appliance Efficiency Regulations requirements. Visitors can download fact sheets, trigger sheets, checklists and information on classes (online or in-person) and workshops.

CALIFORNIA LIGHTING TECHNOLOGY CENTER
cltc.ucdavis.edu
The California Lighting Technology Center (CLTC) was established through joint efforts by the Energy Commission and the University of California, Davis. CLTC develops and tests state-of-the-art, energy-saving lighting and daylighting innovations. CLTC also offers training and educational programs on energy-efficient lighting.

APPROVED ACCEPTANCE TEST TECHNICIAN CERTIFICATION PROVIDERS
www.energy.ca.gov/programs-and-topics/programs/acceptance-test-technician-certification-provider-program/acceptance
The California Energy Commission’s (CEC) approved Acceptance Test Technician Certification Providers (ATTCP) train, certify, and oversee the technicians and their employers. ATTCP maintain ATT contact information and current certification status. As of July 2014, the acceptance testing for lighting controls requires a certified ATT.
DESIGNLIGHTS CONSORTIUM QUALIFIED PRODUCTS LIST

designlights.org/qpl

This online database of quality, high-efficiency LED products for the commercial sector is maintained by the DesignLights Consortium, a project of the regional non-profit Northeast Energy Efficiency Partnerships. It allows users to search for LED products by criteria (such as CRI and light output), categories (including display case lighting and track lighting), manufacturer or keyword. Products listed may or may not meet Energy Code requirements.

ENERGY CODE CLASSES

BUILDING OPERATOR CERTIFICATION
CALIFORNIA TRAINING SCHEDULE
theboc.info/ca/ca-schedule.html

BUILDING OWNERS AND MANAGERS
ASSOCIATION ONLINE EDUCATION SCHEDULE
boma.org/education

MANUFACTURER TRAINING CENTERS

ACUITY BRANDS ACUITY ACADEMY
acuitybrands.com/resources/education-and-events/training-and-education#calendar
Berkeley, CA

COOPER LIGHTING EDUCATION – THE SOURCE
cooperlighting.com/global/resources/source-lighting-education
SOURCE Lighting Education Center

LUTRON EXPERIENCE CENTER
lutron.com/en-US/Experience-Light-Control/Pages/Inspiration/ExperienceCenter.aspx
California Experience and Training Center
Irvine, CA

UTILITY EDUCATION & DEMONSTRATION CENTERS

These California utility centers host lighting classes for Energy Code compliance. Some also house lighting technology demonstration spaces and tool lending libraries that can provide visitors with energy and light meters, data loggers, lighting design software, lighting design manuals and other resources.

Online calendars list training events and workshops. Some websites offer virtual video tours of the demonstration centers and information on resources and services. Visitors and class participants can also learn about the utility rebate and incentive programs.

PACIFIC GAS AND ELECTRIC COMPANY (PG&E)
pge.com/pec
Pacific Energy Center (PEC), San Ramon
Energy Training Center, Stockton

SACRAMENTO MUNICIPAL UTILITY DISTRICT
smud.org/etc
Community Energy & Technology Center, Sacramento

SAN DIEGO GAS & ELECTRIC
sdge.com/energyclasses

SOUTHERN CALIFORNIA EDISON (SCE)
sce.com/residential/energy-education-centers
Energy Education Centers (EEC), Irwindale and Tulare

ENERGY STANDARDS HOTLINE
Toll-free in California: (800) 772-3300
(916) 654-5106, title24@energy.ca.gov

The Energy Standards Hotline is a resource for any questions regarding the Energy Code.
For more information and resources about the Energy Code, visit the CLTC website at cltc.ucdavis.edu.