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6. Residential Lighting

This chapter covers Title 24 California Code of Regulations, Part 6 (Energy Code), lighting requirements for single-family buildings (including single-family homes, duplexes, triples, and all townhomes). It is for builders, manufacturers, electrical contractors, lighting designers, energy consultants, enforcement agency staff, those working on behalf of enforcement agencies, and those who provide outreach and education about the Energy Code.

6.1 Overview

For single-family buildings and spaces, all lighting requirements are mandatory. The residential lighting requirements differ from the nonresidential requirements in that there are no lighting power allowance threshold for spaces, no required lighting power calculations, and no prescriptive method for showing compliance. There are luminaire requirements and lighting control requirements for residential lighting installations.

The residential luminaire requirements apply to permanently installed luminaires, including luminaires with interchangeable lamps. They do not apply to portable luminaires such as table lamps or freestanding floor lamps. The lighting control requirements are focused on dimming controls and automatic off controls requirements for applicable spaces.

All section (§) and table references in this chapter refer to sections and tables contained in the Energy Code.

6.1.1 What's New for the 2022 Energy Code

- Requirements for indoor luminaires and indoor lighting controls have been reorganized according to the subject requirements to improve readability.
- The lumen maintenance and rated-life requirements from Joint Appendix JA8 have been eliminated.
- Requirements for previously low-rise residential family requirements have been moved to the new multifamily chapters. (Nonresidential Compliance Manual Chapter 11 addresses multifamily buildings.)

6.1.2 Scope

The residential lighting requirements in the Energy Code apply to indoor and outdoor lighting for:

- Newly constructed single-family buildings.
- Additions and alterations to single-family buildings.

6.1.3 Related Resources

The California Energy Commission and others prepare educational resources with information about residential lighting. The Energy Commission's online resources can

be found at the online resource center at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center.

6.2 Luminaire Requirements

A luminaire, also known as a light fixture, is defined by §100.1 as a complete lighting unit consisting of a light source, such as a lamp or lamps, and the parts that distribute the light, position and protect the light source, and connect it to the power supply.

A lamp is a light bulb or similar separable lighting component. It is defined by §100.1 as an electrical appliance that produces optical radiation for visual illumination, with a base to provide an electrical connection between the lamp and a luminaire, and to be installed into a luminaire. The definition clarifies that a lamp is not a luminaire and is not an LED retrofit kit designed to replace components of a luminaire.

The 2022 Energy Code for residential lighting requires all permanently installed luminaires to be classified high luminous efficacy, as specified in §150.0(k). Permanently installed lighting is defined in §100.1 as luminaires that are affixed to land. Examples include:

- Lighting attached to walls, ceilings, or columns.
- Track and flexible lighting systems.
- Lighting inside permanently installed cabinets.
- Lighting attached to the top or bottom of permanently installed cabinets.
- Lighting attached to ceiling fans.
- Lighting integral to exhaust fans.
- Lighting integrated into garage door openers, if it is used as general lighting, is switched independently from the garage door opener, and does not automatically turn off after a pre-determined amount of time.

The following are examples of non-permanently installed lighting:

- Portable lighting as defined by §100.1 (including, but not limited to, table and freestanding floor lamps with plug-in connections).
- Lighting installed by the manufacturer in refrigerators, stoves, microwave ovens, exhaust hoods for cooking equipment, refrigerated cases, vending machines, food preparation equipment, and scientific and industrial equipment.
- Lighting integrated into garage door openers by the manufacturer, where the lights automatically turn on when the garage door is activated, and automatically turn off after a pre-determined amount of time.

Luminaires can be classified as high luminous efficacy by default or can be classified as high luminous efficacy if the luminaire or installed light source complies with Reference Joint Appendix JA8 requirements. Section 6.2.1 describes luminaires that are high luminous efficacy by default. Section 6.2.2 describes luminaires and light sources that must meet the requirements of Reference Joint Appendix JA8.

6.2.1 Residential Luminaires – High Luminous Efficacy by Default

Luminaires in any of the following categories are classified high luminous efficacy and do not have to comply with the requirements of Reference Joint Appendix JA8 (aka JA8 – refer to next section for details).

a. Luminaires containing LED light sources that are installed outdoors.

b. Inseparable solid-state lighting (SSL) luminaires containing colored light sources for decorative lighting purpose.

c. Pin-based linear fluorescent luminaires or compact fluorescent luminaires using electronic ballasts.

d. High intensity discharge (HID) light sources, including pulse-start metal halide luminaires and high pressure sodium luminaires.

e. Luminaires with induction lamp and hardwired high frequency generator.

f. Ceiling fan light kits that are subject to federal appliance regulations.

All other luminaire types must meet the JA8 requirements with the following exceptions:

1. Integrated device lighting, including lighting integral to exhaust fans, kitchen range hoods, bath vanity mirrors, and garage door openers.

2. Navigation lighting, such as night lights, step lights, and path lights less than 5 watts.

3. Cabinet lighting, including lighting internal to drawers, cabinetry, and linen closets with an efficacy of 45 lumens per watt or greater.

Table 6-1 summarizes the requirements for residential high luminous efficacy luminaires. There are luminaires automatically classified as high efficacy, luminaires that must use JA8-certified light sources or lamps (See Section 6.2.2), and recessed downlight luminaires in ceilings (See Section 6.2.3).

Table 6-6-1 (Based on Table 150.0-A): Summary of Compliant Luminaire Types

Automatically High Luminous Efficacy Luminaires*	Lamps and Light Sources That Must be JA8-certified	Lamps and Light Sources That Must be JA8-Certified for Elevated Temperatures
• LED light sources installed outdoors • Inseparable solid-state lighting (SSL) luminaires containing colored light sources for decorative lighting purpose • Pin-based linear fluorescent or compact fluorescent light sources using electronic ballasts • High intensity discharge (HID) light sources including pulse-start metal halide and high pressure sodium light sources • Luminaires with induction lamp and hardwired high frequency generator • Ceiling fan light kits subject to federal appliance regulations	• Light sources installed in ceiling recessed downlight luminaires. (Screw bases are not allowed in ceiling recessed downlight luminaires.) • LED luminaires with integral sources • Screw-based LED lamps (A-lamps, PAR lamps, etc.) • Pin-based LED lamps (MR-16, AR-111, etc.) • Any light source or luminaire not listed elsewhere in this table	• Lamps and separable light sources in ceiling recessed downlight luminaires. • Lamps and separable light sources in enclosed luminaires.

6.2.2 Residential Luminaires – Reference Joint Appendix JA8 Certified Light Sources

Luminaires not listed in the previous section must have an integral light source or removable lamp that meets the performance requirements of JA8. The requirements in JA8 ensure that new lighting technologies, like LEDs, provide energy-efficient light, while also maintaining performance characteristics that customers expect. In addition to setting minimum efficacy requirements, JA8 establishes performance requirements that ensure accurate color rendition, dimmability, and reduced noise and flicker during operation.

Luminaires with integral sources, such as LED luminaires, must be certified to the Energy Commission as meeting the JA8 requirements. Changeable lamps, such as those in screw-base luminaires, must also be certified to the Energy Commission.

Luminaires and lamps that have been certified to the Energy Commission must be marked with JA8-2022 or JA8-2022-E on the product. The JA8-2022-E marking indicates that the product has passed the more stringent ENERGY STAR Elevated Temperature Life test. This test ensures that the light source is appropriate for elevated temperature applications such as installation in enclosed or recessed luminaires.

Luminaires that can be classified as high luminous efficacy by meeting the requirements of JA8 include:

1. LED luminaires with integral light sources that are JA8-certified.
2. Ceiling recessed downlight luminaires with JA8-certified light sources (the luminaire must not contain screw-based lamp sockets).
3. Screw-based luminaires with JA8-certified lamps.
4. Low-voltage pin-based luminaires with JA8-certified lamps.

Almost any luminaire can be classified as high luminous efficacy if it is installed with a JA8 certified lamp or light source. The exception is recessed downlight luminaires in ceilings, which must meet additional requirements.

The Energy Commission maintains a database of certified JA8 certified luminaires, lamps, and light sources. The database can be accessed using a Quick Search Tool at https://cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx or an Advanced Search at https://cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx.

6.2.3 Recessed Downlight Luminaires in Ceilings

In addition to the high luminous efficacy requirements, there are several additional requirements for residential downlight luminaires that are recessed in ceilings.

Figure 6-1 Recessed Downlight Luminaires in Ceiling

Source: Image Courtesy of Lutron Electronics Co., Inc.

Recessed downlight luminaires are limited to specific light sources and lamp types. Recessed downlight luminaires:

1. Must contain light sources that are JA8-certified.
2. Must not contain screw-based lamps.
3. Must not contain light sources that are labeled not for use in enclosed luminaires or not for use in recessed luminaires.

All recessed downlight luminaires must contain a light source or lamp that is JA8-certified, such as an integral LED source or LED lamp. Screw-based lamps such as LED A-lamps or LED PAR lamps are not allowed. Pin-based lamps such as LED MR-16 lamps are allowed in recessed luminaires as long as they are JA8-certified.

In addition to the light source and lamp requirements listed, recessed downlight luminaires in ceilings must also meet all the following performance requirements:

1. Have a label that certifies the luminaire is airtight with air leakage less than 2.0 cubic feet per minute (cfm) at 75 Pascals when tested in accordance with ASTM E283 (exhaust fan housings with integral light are not required to be certified airtight); and
2. Be sealed with a gasket or caulk between the luminaire housing and ceiling, and have all air leak paths between conditioned and unconditioned spaces sealed with a gasket or caulk, or be installed per manufacturer's instructions to maintain airtightness between the luminaire housing and ceiling; and
3. Meet the clearance and installation requirements of California Electrical Code Section 410.116 for recessed luminaires which requires the following.
    - A recessed luminaire that is not identified for contact with insulation, non-Type IC, shall have all recessed parts spaced not less than 1/2 inch from combustible materials. The points of support and the trim finishing off the openings in the ceiling shall be permitted to be in contact with combustible materials.
    - A recessed luminaire that is identified for contact with insulation, Type IC, shall be permitted to be in contact with combustible materials at recessed parts, points of support, and portions passing through or finishing off the opening in the building structure.
    - Thermal insulation shall not be installed above a recessed luminaire or within 3 inches of the recessed luminaire's enclosure, wiring compartment, ballast, transformer, LED driver, or power supply unless the luminaire is identified as Type IC for insulation contact.

Luminaires that meet the air leakage requirement or luminaires that are Type IC rated will have this information listed on luminaire cut sheets or packaging. Installers are responsible for ensuring that luminaires are properly sealed to prevent air leakage between the luminaire housing and ceiling.

Recessed luminaires that are marked for use in fire-rated installations and recessed luminaires installed in non-insulated ceilings are exempt from the air leakage requirement and sealing requirement, however, they must meet all other requirements for recessed luminaires.

Figure 6-2 Recessed Luminaire with an IC Housing (left); Recessed Luminaire with a Non-IC Housing (right)

Source: Image Courtesy of Lutron Electronics Co., Inc.

6.2.4 Enclosed Luminaires and Recessed Luminaires other than Ceiling-Recessed Downlight Luminaires

For enclosed luminaires and recessed luminaires other than ceiling-recessed downlights, the installed light sources must be JA8-compliant and meet the elevated temperature testing requirement. The JA8-compliant lamps and light sources must be marked with “JA8-2022-E” to signify that they are suitable to be installed in an enclosed or recessed luminaire.

6.2.5 Screw-Base Luminaires

For screw-base luminaires to be installed in residential spaces, the installed lamps must be JA8 certified. Recessed downlight luminaires in ceilings cannot have screw base lamp sockets.

6.2.6 Navigation Lighting – Night Lights, Step Lights and Path Lights

Navigation lighting such as night lights, step lights, and path lights must either:

1. Be rated to consume no more than 4 watts; or
2. Comply with luminaire efficacy requirements in §150.0(k)1A and Table 150.0-A (Table 6-1).

6.2.7 Lighting internal to Drawers, Cabinets, and Linen Closets

Luminaires or light sources internal to drawers, cabinets, and linen closets must either:

1. Have an efficacy of 45 lumens per watt or greater or

2. Comply with luminaire efficacy requirements in §150.0(k)1A and Table 150.0-A (Table 6-4).

Example 6-1: Screw-based luminaires

Question

I am using a screw-based luminaire that is rated to take a 60W lamp for lighting over a sink, and I plan to install a 10W LED lamp. Does it meet the residential lighting requirement for screw-based luminaires?

Answer

If the LED lamp is JA8-certified and marked JA8-2022 or JA8-2022-E, then it meets the residential lighting requirement for screw-based luminaires in Energy Code §150.0(k)1B.

If the luminaire is a recessed luminaire in a ceiling, it would not comply since recessed luminaires cannot contain a screw base socket.

Example 6-2: Color-tunable and dim-to-warm luminaires installed in residential buildings

Question

Can color-tunable luminaires and dim-to-warm luminaires be certified to meet JA8 specifications?

Answer

JA8 includes color characteristic specifications for light sources.

The JA8 specifications require all light sources to be capable of providing color temperature (correlated color temperature, CCT) of 4000 Kelvin (K) or less.

JA8 also require light sources to provide color rendering index (CRI) of 90 or higher and R9 of 50 or higher. LED lamps regulated by the Title 20 Appliance Efficiency Regulations must have a CRI of 82 or higher.

If the color-tunable luminaire or dim-to-warm luminaire can provide a CCT of 4000k or less and provide CRI that meets these requirements, it meets the color characteristic criteria.

If all requirements of JA8 are met, including the color characteristic requirements, these light sources can be certified to meet JA8.

Example 6-3: Fade-in lighting

Question

I would like to use lighting with an aesthetic fade-in feature in my design. JA8 has a start time requirement. Are fade-in lights able to qualify as high efficacy?

Answer

Aesthetic fade-in lights are acceptable under Title 24. The test procedure for start time measures "[t]he time between the application of power to the device and the point where the light output reaches 98% of the lamp's initial plateau." The "initial plateau" is "[t]he point at which the average increase in the light output over time levels out (reduces in slope)."

For light sources with a fade-in feature, the light output intentionally follows a programmed fade-in curve to increase light output gradually. Because the light output must level out, the initial plateau for these light sources is the point in time at which there is perceived light output and the perceived light increase begins to follow the programmed fade-in curve. The programmed fade-in curve is expected to be continuously increasing as a function of time.

This allows fade-in lighting to qualify as high efficacy.

Example 6-4: Kitchen exhaust hood lighting

Question

I am installing an exhaust hood over my kitchen range that has lamps in it. Do these lamps have to be high efficacy?

Answer

This lighting is integrated into the appliance and does not have to meet the luminaire efficacy requirements for permanently installed lighting.

Example 6-5: Kitchen alterations

Question

I am designing a residential kitchen lighting system with six 12W LED recessed downlights and four 24W LED tape lights for under cabinet lighting. How many watts of incandescent or halogen luminaires can be installed?

Answer

There are no wattage limitations for residential lighting. However, all luminaires must meet the luminaire efficacy requirements in §150.0(k)1A and Table 150.0-A of the Energy Code. Incandescent and halogen light sources may not be able to meet the requirements of JA8, thus may not be able to be installed for Energy Code compliance.

Example 6-6: Night lights

Question

Where are night lights permitted to be installed in residential buildings?

Answer

There are no location restrictions in the Energy Code. Permanently installed night lights and night lights integral to installed luminaires can be installed anywhere in single family buildings, or other residential spaces.

6.2.8 Blank Electrical Boxes

The number of electrical boxes that are more than 5 feet above the finished floor and do not contain a luminaire or other device shall be no greater than the number of bedrooms. These electrical boxes must be served by a dimmer, vacancy sensor control, low voltage wiring, or fan speed control.

Example 6-7: Blank electrical boxes

Question

For a three-bedroom house, how many blank electrical boxes can be installed?

Answer

Up to three blank electrical boxes can be installed if the electrical boxes are served by a dimmer, vacancy sensor control, low voltage wiring or fan speed control. The number of electrical boxes can be less than or equal to the number of bedrooms in the dwelling.

This requirement applies to blank electrical boxes located more than 5 feet above the finished floor. It does not apply to blank electrical boxes mounted 5 feet or less above the finished floor.

6.3 Indoor Lighting Control Requirements

Lighting controls are an important part of the Energy Code because they can produce energy savings for the owners and users of the spaces. Lighting Control Requirements in Accordance with Room and Luminaire Types

All lighting controls must comply with the mandatory requirements of §110.9 (refer to Section 6.3.2 for details). Following are general control requirements that apply for the room type and for the luminaire type:

A. Readily Accessible Manual Controls

All permanently installed luminaires shall have readily accessible wall-mounted controls that permit the luminaires to be manually turned on and off. Per §100.1 Definitions, “readily accessible” means capable of being reached quickly for operation, repair, or inspection without requiring climbing or removing obstacles, or resorting to access equipment.

B. Multiple Switches

A lighting circuit can be controlled by more than one switch, such as by three-way or four-way switches. For a lighting circuit with multiple switches, where a dimmer or

vacancy sensor has been installed to comply with §150.0(k), the following requirements must be met:

1. No controls shall bypass the dimmer or vacancy sensor function.
2. The dimmer or vacancy sensor must comply with the applicable requirements of §110.9(b).

C. Energy Management Control Systems (EMCS) and Multiscene Programmable Controllers

An EMCS or a multiscene programmable controller can be installed to meet the dimming, occupancy, and lighting control requirements in § 150.0(k)2 if it provides the functionality of the specified controls in accordance with §110.9, and the physical controls specified in §150.0(k)2A.

D. Exhaust Fan Integrated Lighting

Integrated lighting in an exhaust fan must be controlled independently from the fan.

E. Lighting for Drawers and Cabinets

Undercabinet lighting, undershelf lighting, and interior lighting of display cabinets shall be controlled separately from ceiling-installed lighting such that one can be turned on without turning on the other.

Drawers and cabinetry with internal lights and opaque fronts or doors must have controls that turn the lights off when the drawer or door is closed.

F. Independent Control of Switched Outlets

Switched outlets shall be controlled separately from ceiling-installed lighting such that one can be turned on without turning on the other.

G. Ceiling Fan Lighting

Ceiling fans with integrated light sources can be controlled with a remote control for ON, OFF, and dimming control. The remote control does not need to be wall mounted.

H. Spaces Required to Have Vacancy Sensors or Occupancy Sensors

The following residential spaces are required to have at least one installed luminaire in the space be controlled by an occupancy or vacancy sensor providing automatic-off functionality:

1. Bathrooms
2. Garages
3. Laundry Rooms
4. Utility Rooms
5. Walk-in Closets

I. Luminaires Required to Have Dimming Controls

Lighting in habitable spaces such as living rooms, dining rooms, kitchens, and bedrooms must have readily accessible wall-mounted dimming controls that allow the lighting to be manually adjusted up and down.

There are three exceptions:

1. Ceiling fans may provide control of integrated lighting via a remote control.
2. Luminaires connected to a circuit with controlled lighting power less than 20 watts or controlled by an occupancy or vacancy sensor providing automatic-off functionality.
3. Navigation lighting such as night lights, step lights, and path lights less than 5 watts; and lighting with automatic off controls that is internal to drawers and cabinetry with opaque fronts or doors.

Also, lighting integral to appliances including kitchen range hoods and exhaust fans is not required to be provided with dimming controls.

Forward phase cut dimmers controlling LED light sources in these spaces shall comply with NEMA SSL 7A. The combined use of a NEMA SSL 7A-compliant dimmer with LED luminaires ensures flicker-free operation when the luminaire is dimmed. Dimmer/light source compatibility information is included on dimmer cut sheets or dimmer product packaging.

Example 6-8: Using vacancy sensors and dimmers

Question

Can I install vacancy sensors and dimmers in hallways and non-walk-in closets even though the Energy Code does not require it?

Answer

Installing controls such as vacancy sensors and dimmers in hallways and closets is allowed.

A vacancy sensor automatically turns lighting off when a space is unoccupied. This can save energy compared to a manual on-off switch where the light may be left on while the space is unoccupied.

Using vacancy sensors is recommended for any application where they can provide additional energy savings for the homeowner or occupant.

A dimmer varies the intensity of the light to suit the occasion or the time of day. When less light is needed, the homeowner can reduce the light intensity with a dimmer to save energy.

6.3.1 Lighting Control Functionality

All installed lighting control devices and systems must meet the functionality requirements in §110.9(b). In addition, all components of a lighting control system installed together shall meet all applicable requirements for the application for which they are installed as required in §150.0(k).

§110.9(b) includes requirements for specific lighting control features and functionality. Designers and installers should review features of their specified lighting control

products for meeting the requirements of §110.9(b) as part of the code compliance process.

A. Time-Switch Lighting Controls

Time-switch lighting control products shall provide the functionality listed in §110.9(b)1 of the Energy Code.

B. Dimmers

Dimmer products shall provide the functionality listed in §110.9(b)3 of the Energy Code.

Forward phase cut dimmers used with LED lighting must comply with NEMA SSL 7A.

C. Occupant Sensing Controls

Occupant sensing controls (including occupant sensors, partial-ON occupant sensors, partial-OFF occupant sensors, motion sensors, and vacancy sensors) shall provide the functionality listed in §110.9(b)4 and 110.9(b)6 of the Energy Code.

Occupant sensing controls must automatically reduce lighting or turn the lighting off within 20 minutes after the area has been vacated.

Occupant sensing control systems may consist of a combination of single- or multi-level occupant, motion, or vacancy sensor controls, if components installed for manual-on compliance don't allow occupants to change the functionality from manual-on to automatic-on.

D. Using Vacancy Sensors or Occupancy Sensors

Occupancy sensors automatically turn lighting on when a space becomes occupied, and automatically turn lighting off within 20 minutes of the space being vacated.

Vacancy sensors, also known as manual-on/automatic-off occupant sensors, require occupants to turn lights on manually, and automatically turn lights off within 20 minutes of the space being vacated.

Occupancy and vacancy sensors are required to provide the ability to manually turn lighting on and off. The manual off feature provides the flexibility to control the lighting environment by turning off lights when they are not needed.

The Energy Code allows occupancy sensors or vacancy sensors to be installed to meet the automatic-off control requirements.

Example 6-9: Bathroom vacancy sensors – manual off

Question

For a bathroom with a vacancy sensor, the lighting turns off automatically once the space is vacated. Is it necessary to provide a manual-off control?

Answer

Vacancy and occupancy sensors must provide the option to turn the lights off manually.

If an occupant forgets to turn the lights off when a room is unoccupied, the vacancy or occupancy sensor must turn the lights off automatically within 20 minutes. The occupant must also have the ability to turn the lights off upon leaving the room.

This provides flexibility to control the lighting environment and achieve greater energy savings, as lights can be turned off when not needed.

Example 6-10: Use of automatic shut-off controls

Question

What type of automatic shut-off control can be used in a bathroom, garage, laundry room, utility room, or walk-in closet?

Answer

Occupant or vacancy sensing controls that provide automatic-off functionality must be installed to meet the residential lighting control requirements for bathrooms, garages, laundry rooms, utility rooms, and walk-in closets.

Example 6-11: Using an Energy Management Control System

Question

Can an EMCS be used to control under-cabinet lighting?

Answer

An EMCS can be used to control under-cabinet lighting provided that the under-cabinet lighting is switched separately from the ceiling lighting systems as specified in §150.0(k)2G.

6.4 Residential Outdoor Lighting Requirements

All lighting permanently attached to the residence or to other buildings on the same lot are subject to the outdoor lighting requirements. This includes lighting for patios, entrances, balconies, and porches.

Lighting not permanently attached to a building on a single-family site, such as decorative landscape lighting, is not regulated by the residential lighting requirements. High luminous efficacy lighting and controls such as a time clock or photocontrol will save energy and ensure that lighting is not accidentally left on during daylight hours.

6.4.1 Outdoor Luminaires

All lighting must be high luminous efficacy. Table 150.0-A lists all qualifying high luminous efficacy luminaires and light sources. Outdoor LED luminaires and LED light sources installed outdoors are automatically classified as high luminous efficacy and are not required to comply with JA8.

6.4.2 Outdoor Lighting Controls

All lighting must be controlled by a manual ON and OFF control switch and one of the following automatic control types:

1. Photocontrol and either a motion sensor or an automatic time switch control.
2. Astronomical time clock control.

Any override that keeps the above automatic controls on must return to automatic control operations within six hours.

6.4.3 Internally Illuminated Address Signs

Internally illuminated address signs shall consume no more than 5 watts of power, or shall comply the with nonresidential sign lighting requirements in §140.8.

Example 6-12: Outdoor lighting: glare control

Question

Are there luminaire cutoff requirements for residential outdoor luminaires?

Answer

There are no luminaire cutoff requirements for residential outdoor lighting. Even though not required for most residential outdoor lighting, luminaires that limit uplight are usually more efficient at providing lighting in the required area, allowing a lower wattage luminaire to be used. Backlight, uplight, and glare requirements also reduce stray light and glare problems which can cause visual discomfort.

Example 6-13: Outdoor lighting: landscape lighting

Question

I would like to install low-voltage landscape lighting in my yard. Are these required to be controlled by a motion sensor and photocontrol?

Answer

No. The lighting requirements only apply to lighting that is attached to a building or structure. However, using photocontrols or astronomical time clock controls can save energy by ensuring that landscape lighting is not left on during daylight hours.

6.5 Residential Garages

Residential garages are treated as indoor spaces. (See Section 6.3.1.H for lighting control requirement for residential garages.)

Residential garages are required to meet either the residential or the nonresidential requirements, depending on the number of vehicles that can be stored in the garage. For residential garages with space for eight or more vehicles, the lighting must comply

with the applicable requirements for nonresidential garages in Sections 110.9, 130.0, 130.1, 130.4, 140.6, and 141.0.

6.6 Additions and Alterations

Additions are considered newly constructed buildings. Because the residential lighting requirements are mandatory, lighting in residential additions must meet all applicable requirements of §150.0(k).

For residential alterations, any new or altered lighting systems must meet all applicable requirements of §150.0(k). Existing luminaires, controls, and lighting systems that are not altered may stay as is.

6.7 Compliance Documentation

Compliance documents must be completed and submitted to the enforcement agency to demonstrate compliance with the residential lighting requirements.

All residential lighting requirements are mandatory. There are no tradeoffs between lighting and other building features. A lighting certificate of installation is required to document the project scope of work and certify that all applicable lighting requirements have been met.

6.7.1 Certificate of Installation (CF2R-LTG)

The certificate of installation for lighting is the CF2R-LTG.

A. Person Responsible to Submit the Certificate of Installation

The individual responsible for constructing and installing the residential lighting project (Title 24 California Code of Regulations, Part 1, §10-103(a)3) must submit the certificate of installation. This individual must be eligible under Division 3 of the Business and Professions Code to accept responsibility for the installed lighting system. This individual must ensure the installed lighting system complies with the applicable lighting requirements before signing the certificate.

B. Number of Certificates of Installation Required

A residential lighting project may require more than one certificate to be submitted. If one qualified person accepts responsibility for the installation of an entire lighting project, one certificate is needed. If one qualified person installs the lighting controls and another installs the luminaires, each person will need to submit a separate certificate.

A certificate must be submitted to the responsible code enforcement agency for any residential lighting project that is regulated by the Energy Code, whether that project includes installation of a single luminaire or installation of lighting for an entire building.

The responsible person or contractor installing permanently installed lighting must complete and sign the certificate. The responsible person or installer verifies whether high luminous efficacy lighting and the required controls (i.e., vacancy sensors, dimmer switches) were installed.

C. Registration

Registration is required for projects that require Home Energy Rating System (HERS) field verification (see Title 20 California Code of Regulations §1670 et seq.). When registration is required, the certificates must be submitted electronically to an approved HERS provider data registry for registration and retention.

Registration requirements are in Chapter 2 of the *2022 Residential Compliance Manual*. Lighting measures do not require HERS verification.

6.8 For Building Officials

This section provides guidance for enforcement agency personnel and those working on their behalf about what to look for on plans, what compliance documents to expect, and what to prioritize in inspections.

6.8.1 Plans

A. Confirm All Specified Luminaires Are High Luminous Efficacy

All permanently installed luminaires shown on the plans and/or specifications must be high efficacy (§150.0(k)1A). Luminaires meeting any of the following comply with §150.0(k)1A:

1. Luminaires automatically classified as high luminous efficacy.
2. Luminaires that must use JA8-certified light sources or lamps.
3. JA8-certified luminaires.

Outdoor LED luminaires, LED light sources installed outdoors, and some conventional light source types are automatically classified as high efficacy. Refer to Section 6.2 for details about high luminous efficacy luminaires and JA8-compliant luminaires. Compliant luminaire types are in Table 6-1.

Plans, lighting specifications, and/or notes should specify how luminaires will comply. JA8-certified light sources can be verified by searching for the product listing in the Energy Commission's Modernized Appliance Efficiency Database System (MAEDbS) at http://www.energy.ca.gov/appliances/. JA8-certified light sources listed in MAEDbS have been certified to the Energy Commission as meeting the high luminous efficacy requirements in JA8. The enforcing agency can also request MAEDbS product listings to be submitted with the permit application.

B. Confirm All Required Controls Are Specified

Plans and specifications should indicate vacancy or occupancy sensing controls with at least one luminaire in each of the following spaces:

1. Bathrooms
2. Laundry rooms
3. Garages
4. Utility rooms

5. Walk-in closets

Luminaires installed in habitable spaces such as living rooms, dining rooms, kitchens, and bedrooms must have readily accessible wall-mounted dimming controls. Forward phase cut dimmers controlling LED light sources must comply with NEMA SSL-7A.

Residential garages for eight or more vehicles must comply with nonresidential lighting requirements. Plans, specifications, and notes should describe any applicable nonresidential lighting requirements.

More information about indoor lighting control requirements is included in Section 6.3.

C. Confirm Any Applicable Outdoor Lighting

Outdoor lighting shall be shown on plans or described in specifications and/or notes to be high luminous efficacy and to meet the control requirements of §150.0(k)3.

6.8.2 Compliance Documentation

Confirm that all required compliance documentation is included with the plans.

A. Certificate of Installation

The certificate of installation (CF2R-LTG) is the primary compliance document for residential lighting. There will be one or more CF2R-LTG forms submitted for each project. Confirm all lighting systems and lighting controls in the project are covered by a CF2R-LTG. Confirm all CF2R-LTG forms are registered if the project requires HERS field verification and diagnostic testing. (HERS verification is not required for residential lighting, but registration is required if any project measures do require HERS verification.)

B. Lighting Schedule

Builders must submit a lighting schedule to homeowners or occupants at the time of occupancy. This schedule should describe all installed interior luminaires and lamps. A draft schedule should be included for the plan check. In addition to a list of installed lighting systems, provided documentation should include necessary system information for regular operations and maintenance.

6.9 For Manufacturers – Certification to the Energy Commission

The following are guidelines for manufacturers to ensure their lighting products meet residential lighting requirements of the Energy Standards:

Light source products (luminaires, lamps, and light sources) that are required to comply with Reference Joint Appendix JA8 shall be marked with JA8-2022 or JA8-2022-E.

For lighting control and light source products to be certified to the Energy Commission (as defined in §100.1), the manufacturer must comply with the requirements of certification. Certification can be done on the Energy Commission's Certifications Packets webpage which is https://www.energy.ca.gov/files/certification-packets-appliances. The procedures include filling out a certification packet and submitting a

declaration of compliance, executed under penalty of perjury of the laws of California, that the regulated product meets the requirements.

Building departments, builders, installers, lighting designers, and specifiers are advised to use the MAEDBS database to verify that a regulated product has been certified to the Energy Commission by the manufacturer.

Luminaires do not need to be shipped with a JA8-certified lamp by manufacturers.

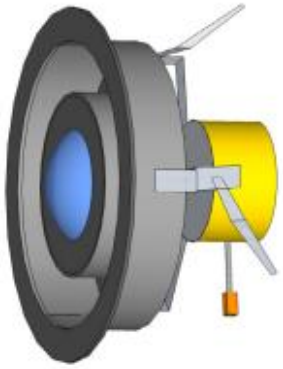
6.9.1 Luminaires, Lamps, and Other Light Sources Complying with JA8 and JA10

Joint Appendix JA8, "Qualification Requirements for High Luminous Efficacy Light Sources," is a technical specification with requirements for luminaires, lamps, and light sources. JA8 specifies the performance requirements that light sources must meet, and the testing procedures that must be used to measure the performance metrics. Table 6-3 provides an overview of performance requirements.

The elevated temperature life test requirement is optional as stated in JA8.5, and is required only for light source products intended for installation in enclosed or recessed luminaires. Light sources that have passed the elevated temperature life test specified in the ENERGY STAR Product Specification for Lamps Version 2.1, or that have passed the rated life test specified in the ENERGY STAR Product Specification for Luminaires Version 2.1, can be marked with JA8-2022-E.

LED trim kit products like the one shown in Figure 6-3 do not need to be tested for elevated temperature or marked with JA8-2022-E; however, they are still required to comply with JA8 and be marked with JA-8-2022.

Figure 6-6-3 An image of a LED Trim Kit



Source: California Energy Commission

Joint Appendix JA10, "Test Method for Measuring Flicker of Lighting Systems and Reporting Requirements," is a supplement to the reduced flicker operation requirement of JA8. JA10 describes the test method to measure the flickering of light from the lighting system. The test involves using signal processing to remove high frequency components and quantifies flicker as a percent amplitude modulation below a given cut-off frequency.

6.9.2 Marking Designation, and Product Data Required for JA8-Certified Luminaires, Lamps and Light Sources

JA8-certified products, including luminaires, lamps, and light sources, must be marked as meeting the requirement of Section JA8.5.

Table 6-2 shows different marking designations depending on the light source type.

Table 6-3 shows the required data to be submitted to the Energy Commission for JA8 certification and for meeting JA8.6.

Table 6-2: Summary of Marking Designation for Certified JA8 luminaires, Lamps and Light Sources

Light Source Type	Marking Designation	Testing Notes for Meeting the Lumen Maintenance and Rated Life Requirements
1.Ceiling recessed downlight luminaires	JA8-2022	Optional for the rated life test of ENERGY STAR® Product Spec for Luminaires Version 2.2.
2.Lamps and light sources installed in enclosed or recessed luminaires	JA8-2022-E	Light sources must pass the elevated temperature life test of ENERGY STAR® Product Spec for Lamps Version 2.1; or the rated life test of ENERGY STAR® Product Spec for Luminaires Version 2.2 to be marked with “JA8-2022-E”.
3.Light sources other than #1 and #2.	JA8-2022	Optional for the rated life test of ENERGY STAR® Product Spec for Lamps Version 2.1 or Section 10 of ENERGY STAR® Product Spec for Luminaires Version 2.2.

Table 6-3: Data to Be Submitted to the California Energy Commission to Meet JA8.6

METRIC	JA8 REQUIREMENTS
Light source type	LED, OLED, Fluorescent, HID, Incandescent, Other
Product type	Omnidirectional lamp, Directional lamp, Decorative lamp, LED light engine, Inseparable SSL luminaire, T20 lamp, Other
Lab accredited by NVLAP or accreditation body operating in accordance with ISO/IEC 17011	Yes
Initial efficacy	≥ 45 lumens/W
Power factor at full rated power	≥ 0.90
Start time	≤ 0.5 sec
Correlated color temperature (CCT)	≤ 4000 K
Color rendering index (CRI)	≥ 90 for all products other than T20 lamps ≥ 82 for T20 lamps
Color rendering R9 (red)	≥ 50 for all products other than T20 lamps
Ambient or elevated temperature	Ambient or Elevated
Minimum dimming level	≤ 10%
Dimming control compatibility	At least one type must be listed
NEMA SSL 7A compatible?	If compatible with forward phase cut dimmer control, “Yes.” If not, “NA.”
FLICKER:	--
See JA10 Table 10-1 for flicker data requirements and permissible answers	< 30% for frequencies ≤ 200 Hz at 100% light output
See JA10 Table 10-1 for flicker data requirements and permissible answers	< 30% for frequencies ≤ 200 Hz at 20% light output
AUDIBLE NOISE:	--
100% light output: Audible noise	≤ 24 Dba
20% light output: Audible noise	≤ 24 Dba
MARKING:	--
Marked in accordance with JA8.5	Yes