

The Lighting Design Process

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SECTION 1

THE PROCESS AND WORKFLOW OF WORKING WITH A LIGHTING DESIGNER

THE BENEFITS OF WORKING WITH AN L.D.

- WORK WITH A SPECIALIST. SOMEONE WHO SPENDS THEIR LIFE DEALING WITH THE COMPLEXITIES OF THE LIGHTING INDUSTRY.
- ENJOY THE BENEFITS OF COLLABORATION, NOT ISOLATION.
- THEY DEAL WITH THE COMPLEXITIES OF MODERN LIGHTING EQUIPMENT EVERYDAY. THEY KNOW THE PITFALLS.
- THEY CAN SPECIFY OR HELP YOU TO SPECIFY THE DECORATIVE FIXTURES ALSO.
- A GOOD L.D. CAN ALSO BE AN ADVOCATE FOR BETTER LIGHTING WHEN SPEAKING WITH THE CLIENT.
- YOU WILL GET A BETTER RESULT THAN IF YOU DROP IN SOME LIGHTS AND HAVE THE E.C. GO TO THE STORE!

ESTABLISH PROJECT SCOPE AND REVIEW ALL DETAILS

- What is the overall project budget?
- Is there a budget range already allotted for Lighting and Electrical?
- Has the project already filed for permit?
- Establish all scope areas.
- Establish any other special requirements up front.
- Is the GC and / or the EC already on board?
- What software is being used on the project? L.D. will need .dwg (AutoCAD)
- What format will the drawings be in when released?
- L.D.'s typically want to control their own sheets.
- How many phases and releases in each phase do you plan to do?
 - Concept Phase
 - Schematic Phase
 - Design Development
 - Permit Phase
 - Construction Drawings

Construction Administration Phase

How many site visits will be needed? Plan them carefully.

- a. First review of design with EC and team
- b. Coordination of bids and acquisitions by EC
- c. Custom fixture coordination
- d. Adjust to any issues on site (Structural, space, change of architecture, etc.)
- e. Check as fixtures go in but no walls are closed up
- f. Review all controls locations on site
- g. Focus and adjustment
- h. Programming
- i. Final review and signoff by owner

HOW TO FIND THOSE DECORATIVE FIXTURES

- LOOK FOR ONLINE LIGHTING SHOWROOMS
- TALK WITH LOCAL SALES REPRESENTATIVES
- GO TO LOCAL SHOWROOMS
- CALL LOCAL LIGHTING DISTRIBUTORS LIKE CITY LIGHTS AND LANER ELECTRIC AND GO IN TO THEIR SHOP

www.lumens.com

www.lightology.com

www.citylightssf.com

www.visualcomfort.com

LIGHTING PLANS

LINK:

https://drive.google.com/file/d/13TKOCgur5U4GBoxbAlHLnJ9jBCrtM_ig/view?usp=sharing

LIGHTING FIXTURE SCHEDULE

LINK:

<https://drive.google.com/file/d/13o7qrxL1Ed1NGb63nVkp1w72dsEVU6z/view?usp=sharing>

LIGHTING SPECIFICATIONS PACKAGE

LINK:

https://drive.google.com/file/d/13sXFw9TCDOVIjMhXL1ta8_i_9qv8kEzl/view?usp=sharing

LIGHTING BUDGET

LINK:

https://drive.google.com/file/d/13vAWru_CqbmURaVDCXseNC1dwv5AczTR/view?usp=sharing

SECTION 2

LIGHTING TERMINOLOGY

- LED - A light emitting diode
- SSL - Solid state lighting. Light generated by a circuit board to diode, not by burning a filament.
- CRI - Color rendering index. 100 is the highest. 90+ is what you want.
- EFFICACY - Efficacy is the measurement of the amount of useful light output per unit of electricity and is measured in Lumens per Watt.
- LUMENS - A lumen is a measure of the amount of brightness of a lightbulb.
- R9 - R9 is the score that represents how accurately a light source will reproduce strong red colors
- JA8 - JA8 is the name given to the 2016 revisions of California's Title 24 regulations. It went into effect January 2017, these regulations cover indoor and outdoor lighting in new construction, renovations, and any additions to both residential and nonresidential buildings.
- TITLE 24 & TITLE 20 - Two different California energy codes that we must comply with. California's energy code is designed to reduce wasteful and unnecessary energy consumption in newly constructed and existing buildings.

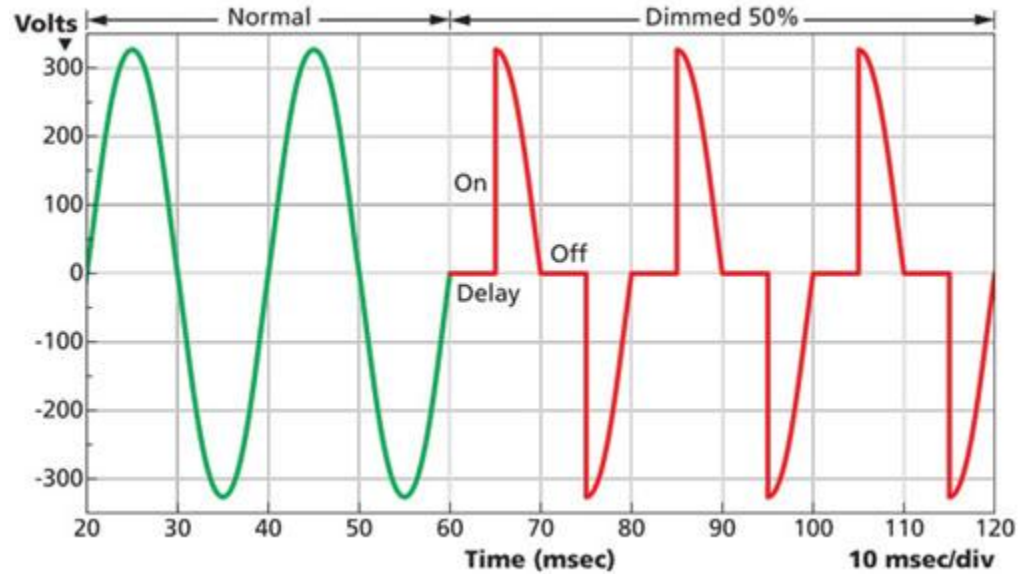
- CHEERS - CHEERS is an online verification platform where building industry professionals register projects for California energy code compliance.
- KELVIN (COLOR TEMPERATURE OR “K” - Color temperature is a way to describe the light appearance provided by a light bulb. It is measured in degrees of Kelvin (K) on a scale from 1,000 to 10,000. Typically, Kelvin temperatures for commercial and residential lighting applications fall somewhere on a scale from 2000K to 6500K.
- LUMINAIRE VS. LAMP - Luminaire is a light fixture. Lamp is a light bulb.
- FOOTCANDLES - Footcandles are the most common unit of measure used by lighting professionals to calculate light levels in businesses and outdoor spaces. A footcandle is defined as the illuminance on a one square foot surface from a uniform source of light.
- CANDLEPOWER - Another measurement system for light. It is the luminous intensity of a source of light in a given direction.
- BEAM ANGLES - The angle of the light beam projected from a light source.

DIMMING TERMINOLOGY

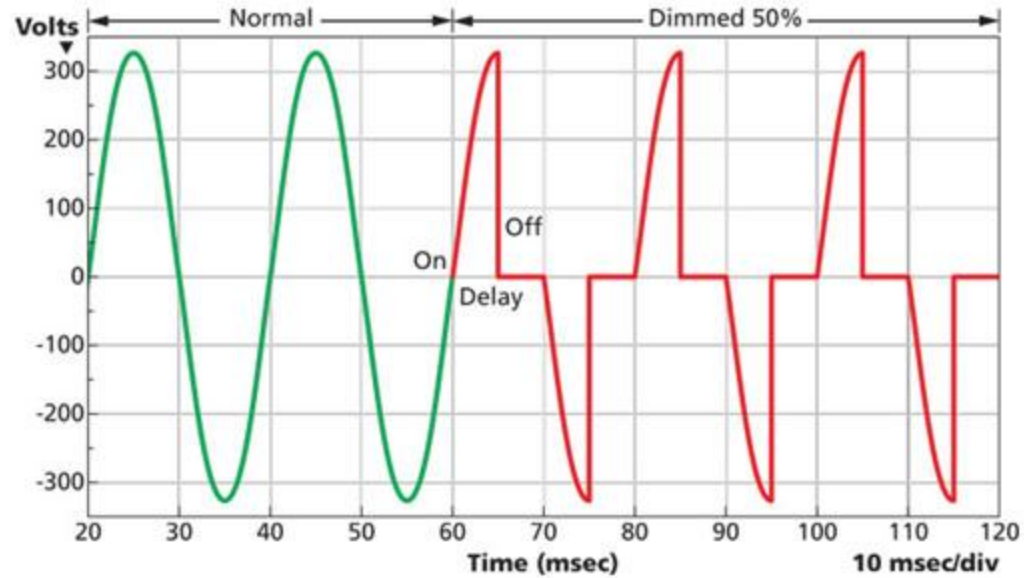
TYPES OF DIMMERS

- ELV / Trailing Edge / Reverse Phase Dimmer
- MLV / Leading Edge / Forward Phase Dimmer
- Auto Sensing
- C/L Dimmer

LEADING EDGE DIMMING



TRAILING EDGE DIMMING



SECTION 3

DESIGN PRINCIPLES AND APPROACHES FOR LIGHTING ON A RESIDENTIAL PROJECT

(Remodel, New Construction, ADU)

RESIDENTIAL REMODEL CONSTRUCTION

- Establish all scope areas
 - Interiors
 - Exteriors
 - Landscape lighting
 - Path of egress / safety lighting, etc.
- What are the ceiling conditions?
 - Drywall
 - Lath and plaster
 - Beams
 - Any old double layers, etc.?
 - Test all ceilings first for depth, layers, etc. prior to ordering of fixtures

- What is the style of the home? How much do you modernize it or should you avoid anachronistic choices?
- Think about how many different “kinds of” light you need? Task, Base, Art, etc.
- For decorative fixtures, does the owner and architect want to stick with period looking fixtures or not?
- If there are existing fixtures, change lamps to dimmable LED. It’s not hard to do.
- Do you want to use “Warm Dim” sources?
- Should you recess any lighting?
- What ceilings are insulated? Are there any scope areas where ceilings are not insulated?
- What should the dimmer and switching style be?

- Add layers of light! Most older homes often have very little lighting.
- Lighting things on the walls to provide ambiance, focus and visual interest.
- Establish a lighting controls strategy.

NEW CONSTRUCTION

- See all previous tasks!
- How many phases will the project use.
- What is the project development timeline?
- Get all contact information for all consultants!
- Will there be a project management “platform”?
- How do you release your work too?
- Who is the builder? What kind of homes are they used to creating? Is your work on this project “in their wheelhouse”? If not, discuss and be clear on design intentions.
- Make sure you negotiate for enough on-site time in CA.

ADU

- How will the unit be used?
- Will it change later? How to “future proof” it.
- Don’t get too “busy” with the lighting.
- Keep spaces clean and simple. Keep the visual noise down.
- Only light the walls that will really have art, etc. Rely on lamps for low level lighting.
- One center decorative ceiling fixture in a bedroom can go a long way.
- Do you do base light anywhere other than in the kitchen?
- Always have your under cabinet lighting!
- Establish a good lighting controls scenario.
- Do you use pendants or not? They can overwhelm a space and become distracting.

- Lead the eye to this special dwelling. It should have focus and not look like an afterthought.
- Give it some character with decorative exterior fixtures where possible.
- Always provide nice path lighting that is dimmable and controlled by time clock.

SECTION 4

CURRENT PRODUCT OFFERINGS IN FIXTURES / LUMINAIRES

RECESSED LED DOWNLIGHTING

- DMF Lighting
- TECH LIGHTING
 - Element Line
https://drive.google.com/file/d/12tooxl3-iHwqzMr3g_Yy3oghj_vuiKjl/view?usp=sharing
 -
 - Entra Line
- ACULUX (ACUITY)
- HALO
- JUNO (ACUITY)

LED Tape (Use top quality LED products only!)

CORE LIGHTING

<https://drive.google.com/file/d/1hlowLGj8GBmK-6xi2yuB6hCE0o-sl91V/view?usp=sharing>

SECTION 5

RESIDENTIAL LIGHTING CONTROLS

- LUTRON
- LEVITON

LUTRON DIMMING

- LUTRON DIVA SERIES FOR STANDARD DIMMING AND SWITCHES
- LUTRON CASETA SERIES - Entry level lighting controls with wireless technology. (75 wireless devices)
- LUTRON RADIO-RA 3 SERIES - Mid level lighting controls with wireless technology. (RA3 processors can be paired to create one system of up to 200 Sunnata RF devices and up to 200 compatible RA2, RA2 Select and Lutron smart shade devices.)
- LUTRON HOMEWORKS - High end whole home controls solution. Expensive but amazing. Fantastic finishes, lots of zones, etc.

LUTRON CUT SHEET SAMPLES

Lutron LED+ dimmers

Superior dimming of LED, incandescent and halogen bulbs

Works with:



Sunnata
LED+ dimmer



Diva
LED+ dimmer



Maestro
LED+ dimmer



Ariadni
LED+ dimmer



Skylark Contour
LED+ dimmer



Dalia
LED+ dimmer



Skylark
LED+ dimmer



Nova T+
LED+ dimmer

- **LED+ technology (formerly C.L) provides superior dimming**
 - Works with existing wiring – no neutral required
 - Easy to adjust low-end trim for maximizing bulb performance
 - Patented 2-wire technology to prevent dimmer interaction, flicker and shimmer for beautiful LED dimming
- **LED+ dimmers are tested and UL Listed to work with over 800 LED bulbs**
- **Available in a variety of styles and colors**
 - 250W models in select styles
- **PRO LED+ models deliver maximum flexibility and performance for the pro with phase selectable dimming**

For more information:
lutron.com/LEDfinder

Order now:
Contact your local electrical distributor



Save time and money: Lutron LED+ technology offers one reliable dimmer for dimmable light bulbs

Lutron LED+ technology means no callbacks

Only Lutron LED+ dimmers alleviate the challenges of controlling today's new light bulbs

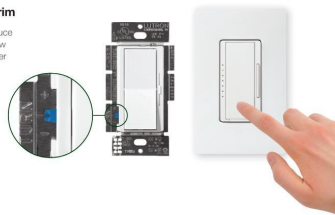
LED and CFL Dimmer Performance Comparison

	Company A	Company B	Company C	Company D	Lutron
Large list of compatible bulbs					
Large dimming range					
Minimizes flicker, shimmer, pop-on					
Ease of adjustment					
Tolerates power line noise					
Quiet – low dimmer noise					

Poor OK Excellent

Easily set the low-end trim

To improve performance and reduce flicker, optimizing the dimmer's low end is easy. Simply adjust the lever on the side or use button-press setup (for digital dimmers).



Light bulb compatibility

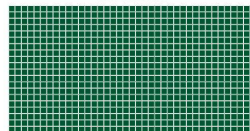
- UL Listed to control over 800 different LED bulbs. Find the right bulb for your project at lutron.com/LEDfinder.

■ = unique LED bulb model type

Other companies
100 bulbs (on average)



Lutron
over 800 bulbs



Superior performance

- Advanced microprocessor technology means compatibility with the broadest range of bulbs. See the compatible bulb list at lutron.com/LEDfinder.
- Offers superior light stability, easy low-end adjustment, and long-life performance (designed to last 10 years).
- Works with all wire temperature ratings—safe for older homes and new construction.

- 250W LED+ dimmers are designed to guarantee 1% dimming with Lutron 2-wire forward phase Hi-Lume A-Series LED drivers for LED fixtures, cove lighting, and under cabinet lighting.



Unparalleled support

- The Lutron LED Control Center of Excellence is the industry resource for LED light bulb compatibility information. 1.877.DIM.LED8 or LEDs@lutron.com
- 24/7 live technical support @ 1.800.523.9466

Lutron LED+ dimmers available in a range of styles and colors

Standalone dimmers



Sunnata
LED+ dimmer*



Diva
LED+ dimmer



Maestro
LED+ dimmer*



Ariadni
LED+ dimmer



Skylark Contour
LED+ dimmer



Dalia
LED+ dimmer



Skylark
LED+ dimmer



Nova T+
LED+ dimmer

Sensors



Maestro
LED+ dimmer
sensor

Wireless controls



Caséta Wireless
in-wall dimmer with
Pico remote



Caséta Wireless lamp
dimmer with Pico remote

*Also available in a PRO model

For more information visit lutron.com/casetawireless

Gloss Finish

	White (WH)
	Ivory (IV)
	Almond (AL)
	Light Almond (LA)
	Gray (GR)
	Brown (BR)
	Black (BL)

Satin Finish

	Brilliant White (BW)
	Glacier White (GL)
	Snow White (SW)
	Architectural White (RW)
	Lunar Gray (LG)
	Mist (MI)
	Pebble (PB)

	Cobblestone (CS)
	Slate (SL)
	Midnight (MN)
	Biscuit (BI)
	Sand (SD)
	Taupe (TP)
	Pumice (PM)

	Clay (CY)
	Sage (SA)
	Espresso (EP)
	Truffle (TF)
	Deep Sea (DE)
	Signal Red (SR)



Ariadni
in Light Almond



Sunnata
in Midnight



Diva
in Biscuit





Architectural Metals

	Satin Brass (SB)
	Bright Brass (BB)
	Bright Chrome (BC)
	Satin Chrome (SC)
	Satin Nickel (SN)
	Bright Nickel (BN)






Architectural Matte (Nova T+ only)

	White (WH)
	Beige (BE)
	Ivory (IV)
	Almond (AL)
	Light Almond (LA)
	Gray (GR)
	Taupe (TP)
	Sienna (SI)
	Brown (BR)
	Black (BL)

LED+ dimmer model information and key applications

	Traditional opening dimmers			Designer opening dimmers	
	 Dalia	 Ariadni		 Sunnata	 Maestro
Model number	RCL-153P-XX*	AYCL-153P-XX*	AYCL-253P-XX*	STCL-153M-XX*	MACL-153M-ZZ*
Amperage/wattage	150W dimmable LED 600W incandescent/halogen 250W Lutron Hi-lume A-Series LTE LED driver (max 6 drivers)	150W dimmable LED 600W incandescent/halogen 250W Lutron Hi-lume A-Series LTE LED driver (max 6 drivers)	250W dimmable LED 600W incandescent/halogen 350W Lutron Hi-lume A-Series LTE LED driver (max 8 drivers)	150W dimmable LED 600W incandescent/halogen 250W Lutron Hi-lume A-Series LTE LED driver (max 6 drivers)	150W dimmable LED 600W incandescent/halogen 250W Lutron Hi-lume A-Series LTE LED driver (max 6 drivers)
Single pole/3-way/multi-location	Single pole/ 3-way	Single pole/ 3-way	Single pole/ 3-way	Single pole/3-way/multi-location	Single pole/3-way/multi-location
Voltage	120V	120V	120V	120V	120V
Compatible with Lutron LED drivers	✓	✓	✓	✓	✓
Key applications	Spaces with a traditional aesthetic, where a locator light would be helpful (Bedrooms, living room, entry way)	Spaces with a traditional aesthetic		Spaces where the light level is frequently adjusted (dining rooms, living rooms, kitchens)	Spaces where the light needs to gradually fade off for movie watching (living room)

* XX denotes gloss color suffix, YY denotes Satin Colors® suffix, ZZ denotes gloss or Satin Colors suffix. See page 5 for details.

				Architectural dimmers	Sensor
	 Diva	 Skylark Contour	 Skylark	 Nova T†	 Maestro LED+ dimmer sensor
Model number	DVCL-153P-XX* DVSCCL-153P-YY*	DVCL-253P-XX* DVSCCL-253P-YY*	CTCL-153P-XX*	SCL-153P-XX*	NTCL-250-XX† MSCL-OP153M-ZZ*
Amperage/wattage	150W dimmable LED 600W incandescent/halogen 250W Lutron Hi-lume A-Series LTE LED driver (max 6 drivers)	250W dimmable LED 600W incandescent/halogen 350W Lutron Hi-lume A-Series LTE LED driver (max 8 drivers)	150W dimmable LED 600W incandescent/halogen 250W Lutron Hi-lume A-Series LTE LED driver (max 6 drivers)	150W dimmable LED 600W incandescent/halogen 250W Lutron Hi-lume A-Series LTE LED driver (max 6 drivers)	250W dimmable LED 1000W incandescent/halogen 3.3A (400W) Lutron Hi-lume A-Series LTE LED drivers (max 10 drivers)
Single pole/3-way	Single pole/ 3-way	Single pole/ 3-way	Single pole/ 3-way	Single pole/ 3-way	Single pole/3-way/multi-location
Voltage	120V	120V	120V	120V	120V
Compatible with Lutron LED drivers	✓	✓	✓	✓	✓
Key applications	Spaces where the light level is frequently adjusted/a favorite preset is desired (dining rooms)		Spaces where the slider needs to be easily accessible (elder care facilities)	Spaces where the light level is frequently adjusted (kitchens)	Spaces that need an intuitive control (ballrooms/offices)
	Spaces where the light level is frequently adjusted/a favorite preset is desired (dining rooms)		Spaces where the slider needs to be easily accessible (elder care facilities)	Spaces where the light level is frequently adjusted (kitchens)	Spaces where a gradual fade is desired with the added benefit of automated on and off (bathroom)

† Nova T† available in Architectural Matte

LED Center of Excellence

The LED Control Center of Excellence is designed to help you correctly specify, install, and use LEDs. Through the LED Control Center of Excellence we test LEDs on a continuing basis for compatibility with our controls and drivers, providing a level of customer guidance you won't find anywhere else.

Lutron's LED Compatibility Tool

Lutron LED+ dimmers work with a broad range of dimmable LEDs, and all incandescent and halogen bulbs. Our selection tool makes it easy to find the best LED/dimmer pair for your application.

Visit lutron.com/LEDfinder



LED Product Selection Tool

Search for tested LED solutions that will ensure compatibility between all Lutron controls and select LED products, and get detailed performance reports.

lutron.com/LEDtool



The Lutron logo, Lutron, Ariadni, Caséta, C-L, Dalia, Diva, GRAFIK T, LED+, Maestro, Nova T₂r, Satin Colors, Skylark, Skylark Contour, and Sunnata are trademarks or registered trademarks of Lutron Electronics Co., Inc., in the U.S. and/or other countries.

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Technical Support 1.800.523.9466 (Available 24/7)
Customer Service 1.888.LUTRON1 (1.888.588.7661)

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LUTRON CASETA (WIRED AND WIRELESS)

<https://drive.google.com/file/d/13l-8QjE98CrxqikjzpD1qLQAtPTRCz0Y/view?usp=sharing>

SECTION 6

CURRENT PRODUCT OFFERINGS IN “LAMPING”

TOP QUALITY LED RETROFIT LAMPS

Always test before hand if possible!

- SORAA LED - www.soraa.com
-
- GREEN CREATIVE
- PHILIPS
 - Standard color temps
 - Warm Dim options
- PHILIPS HUE (COLOR CHANGING)
- GE

LED Modules & Housings

Link:

<https://www.dmflighting.com/product/drd4/>

APPENDIX 1

THE HIGHLIGHTS OF THE NEW 2023 TITLE 24 ENERGY CODE FOR SINGLE FAMILY RESIDENTIAL

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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](https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/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).

- Luminaires containing LED light sources that are installed outdoors.
- Inseparable solid-state lighting (SSL) luminaires containing colored light sources for decorative lighting purpose.
- Pin-based linear fluorescent luminaires or compact fluorescent luminaires using electronic ballasts.
- High intensity discharge (HID) light sources, including pulse-start metal halide luminaires and high pressure sodium luminaires.
- Luminaires with induction lamp and hardwired high frequency generator.
- Ceiling fan light kits that are subject to federal appliance regulations.

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

- Integrated device lighting, including lighting integral to exhaust fans, kitchen range hoods, bath vanity mirrors, and garage door openers.
- Navigation lighting, such as night lights, step lights, and path lights less than 5 watts.
- 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
<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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](https://cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx) at <https://cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx> or an [Advanced Search](https://cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx) 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 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 \(MAEDbS\)](http://www.energy.ca.gov/appliances/) 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