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Table of Examples

1. Lighting

1.1 Overview

This chapter is a one-stop place where a builder, contractor, or lighting designer can get the information they need about residential lighting in low-rise buildings and in the dwelling units of high-rise buildings.

For residential buildings, all of the lighting requirements are mandatory measures. Therefore, lighting energy is not part of the energy budget for the whole building performance method, except as part of the standard assumption on internal heat gains that is assumed to be the same for all buildings. There are no tradeoffs between lighting and other building features.

1.1.1 Scope

A. Space Types

The design and installation of all lighting systems, lighting controls and equipment in the following space types shall comply with the applicable provisions of §150.0(k) and §150.2(b)1I.

In addition to single-family and low rise multi-family buildings, the residential lighting Standards apply to the following types of spaces:

- Dwelling units in high-rise residential buildings
- Outdoor lighting that is attached to a high-rise residential or hotel/motel building, and is separately controlled from the inside of a dwelling unit or guest room.
- Fire station dwelling accommodations.
- Hotel and motel guest rooms. Additionally, hotel and motel guest rooms shall meet the requirements of § 130.1(c)8.
- Dormitory and Senior housing dwelling accommodations.

The types of buildings having space types listed above also have space types that are required to comply with the applicable nonresidential lighting Standards. Space types required to comply with the nonresidential lighting Standards include meeting rooms, corridors, public restrooms, stairs, support areas, exercise centers, hotel function areas, lobbies, lounge areas, offices, parking garages, and all other common areas.

B. Existing Construction

“Additions” are treated the same as newly constructed buildings, so they must meet the applicable requirements of §150.0(k).

In “alterations”, existing luminaires may stay in place, but all new luminaires that are permanently installed shall meet the applicable requirements of §150.0(k).

C. Permanently Installed Lighting

The Residential Lighting Standards apply only to permanently installed luminaires, i.e., luminaires that are attached to the house, as opposed to portable luminaires such as torchieres or tablelamps. Permanently installed luminaires include ceiling luminaires, chandeliers, vanity lamps, wall sconces, under-cabinet luminaires, and any other type of luminaire that is attached to the house. Permanently installed luminaires may include hard wired or plug-in luminaires. See Section 8.1.8 below for additional information about permanently installed luminaires.

§ 100.1(b) of the Standards has the following definition:

- Permanently Installed lighting consists of luminaires that are affixed to land, within the meaning of Civil Code § 658 and 660, except as provided below. Permanently installed luminaires may be mounted inside or outside of a building or site. Permanently installed luminaires may have either plug-in or hardwired connections for electric power. Examples include track and flexible lighting systems; lighting attached to walls, ceilings, columns, inside or outside of permanently installed cabinets, internally illuminated cabinets, mounted on poles, in trees, or in the ground; attached to ceiling fans and integral to exhaust fans. Permanently installed lighting does not include portable lighting or lighting that is installed by the manufacturer in exhaust hoods for cooking equipment, refrigerated cases, food preparation equipment, and scientific and industrial equipment.

D. Outdoor Lighting

Outdoor residential lighting is sometimes subject to the residential requirements, and sometimes subject to the non-residential requirements.

For single-family residences, all lighting attached to the residence or to other buildings on the same lot must be high efficacy, or controlled by a motion sensor and either a photocell or an astronomical time clock. The same requirements apply to the outdoor lighting of low-rise multifamily with certain exceptions, and to the outdoor lighting of high-rise multifamily, as long as the lighting is controlled from inside the dwelling unit.

Outdoor residential lighting is sometimes subject to the residential requirements, and sometimes subject to the non-residential requirements. **Error! Not a valid bookmark self-reference.** shows which requirements apply to various types of outdoor lighting for each building type.

Figure 5 in Section 8.3.10 shows which requirements apply to various types of outdoor lighting for each building type.

E. Signs

Internally illuminated address signs shall consume no more than 5 watts of power (watts shall be determined according to §130.0(c)), or shall comply with the applicable nonresidential sign lighting requirements in §140.8 of the Standards

1.1.2 Summary of Requirements by Space Type

For each room or area, the requirements may be summarized as follows:

- **Kitchens.** At least half the installed wattage of luminaires in kitchens shall be high efficacy. However, some lighting installed inside a cabinet is not required to be included in the wattage calculation that determines half of the installed wattage is high efficacy. See Section 8.3 for information about residential kitchen lighting requirements.
- **Bathrooms.**At least one luminaire in each bathroom must be high efficacy. All other luminaires in a bathroom must be either high efficacy, or controlled by vacancy sensors. See Section 8.3.2 for information about residential lighting requirements in bathrooms.
- **Garages, Laundry Rooms, and Utility Rooms.** All luminaires must be high efficacy, andmust be controlled by a vacancy sensor. See Section 8.3.3 for information about residential lighting requirements in these rooms.
- **Other Rooms.** This applies only to rooms that are not kitchens, bathrooms, garages, laundry rooms, closets, or utility rooms. All installed luminaires shall either be high efficacy or shall be controlled by a vacancy sensor or dimmer.Closets that are less than 70 ft² are exempt from this requirement. See Section 8.3.8 for information about residential lighting requirements in these rooms.
- **Outdoor Lighting.** In single-family residences, all luminaires mounted to the building (or to other buildings on the same lot) shall be high efficacy luminaires or shall be controlled by a motion sensor in combination with a photocontrol, astronomical time clock, or energy management control system (EMCS). Outdoor lighting for multifamily buildings is sometimes subject to the non-residential outdoor lighting requirements; see Sections 1.1.1D and 8.3.10 for.
- **Interior Common Areas of Multifamily Buildings.** For high-rise multifamily buildings, the lighting of common areas shall comply with the non-residential lighting requirements.

  For low-rise multifamily buildings, if the total interior common area of the building equals 20 percent or less of the floor area, common area lighting shall be high efficacy or controlled by an occupant sensor. If the total interior common area of the building equals more than 20

percent of the floor area, common area lighting shall meet the non-residential lighting requirements.

See Section 8.3.12 for information about residential lighting requirements for interior common areas of multifamily buildings.

- **Parking Lots.** An additional set of requirements apply to residential parking lots or garages with space for eight or more cars, which are typically for multifamily buildings. The Nonresidential Lighting Standards for parking lots and/or garages apply in these cases (§130.2, §140.7). See Section 8.3.11 for additional information about Residential Lighting Standards for parking lots or garages with space for eight or more cars.

The Residential Lighting Standards also have requirements for electronic ballasts (Section 8.1.7), permanently installed night lights (Section 8.1.9), lighting integral to exhaust fans (Section 8.1.10), and lighting switching requirements (Section 8.1.12).

Luminaires that are recessed into insulated ceilings are required to be rated for insulation contact ("IC-rated") so that insulation can be placed over them. The housing of the luminaire shall be airtight to prevent conditioned air escaping into the ceiling cavity or attic, or unconditioned air infiltrating from the ceiling or attic into the conditioned space. See Section 8.1.12 below for additional information on luminaires recessed into insulated ceilings.

1.1.3 Related Documents

There are a number of publications and documents available from the California Energy Commission and others that provide additional information about residential lighting. A summary of these is listed below:

1. The Nonresidential Compliance Manual should be consulted for more details on the requirements for parking lots and parking garages.
2. The Residential Lighting Design Guide, (Best practices and lighting designs to help buildings comply with California's Title 24 energy code) is available from the California Lighting Technology Center (www.CLTC.ucdavis.edu).
3. The Advanced Lighting Guidelines, available from the New Buildings Institute (/www.newbuildings.org) is an informative resource for energy efficient lighting design, luminaires, and controls. While the document is mostly oriented for nonresidential lighting applications, it has generic information about lamps, ballasts, luminaires, and controls that is applicable to low-rise residential buildings.
4. Professionally qualified lighting designers can be quickly located via the websites of the International Association of Lighting Designers (www.iald.org/index), or the National Council on Qualifications for the Lighting Professions (NCQLP): www.ncqlp.org). Many designers are ready to offer informal advice as well as undertake commissioned work.
5. Many books on residential lighting design are available. The best books explain the principles of good lighting design as well as showing

examples of luminaires. The fast pace of lamp development makes recently written books much more useful.

6. Guidance on the selection and use of lighting technologies is available from the Lighting Research Center's National Lighting Product Information Program, at www.lrc.rpi.edu/programs/nlpip. Additional resources for energy efficient lighting and other building systems are available from the California Building Industry Institute at www.thebii.org.

1.2 Requirements for Luminaires

A luminaire is the lighting industry's term for light fixture. A luminaire consists of the housing, power supply (for instance a ballast,transformer, or driver), lamp, and optical components such as reflectors or lenses.. A lamp is the lighting industry's term for a light bulb.

Portable table and floor lamps are classified as luminaires, but they are not covered by the title 24 residential lighting Standards. However, they are required to comply with the California Title 20 Appliance Efficiency Regulations.

Every installed luminaire shall be classified as either "high efficacy" or "low efficacy" for compliance with the residential lighting Standards, because different requirements apply to high- and low-efficacy luminaires. The rules for classifying a luminaire as high efficacy are explained further in Sections 1.2.1 and 0.

1.2.1 High Efficacy Luminaires

§150.0(k)1

A high efficacy luminaire is one that meets the criteria listed in the left-hand column of Table 150.0-A of the Standards, or (if not covered by Table 150.0-A) meets the efficacy requirements in Table 150.0-B of the Standards. These tables are shown as and in this chapter).,

To determine whether a luminaire is classified as high efficacy or low efficacy, first refer to . If the luminaire is not listed in *either* column in Table 1-1, then use Table 1-2 to determine whether it meets the requirement for high efficacy.

When required to calculate efficacy according to Table 1-2, simply divide the initial rated lumens of the lamp by the rated wattage of the lamp. Lamp lumens can typically be found on the lamp package or in a manufacturer's catalogue

LED luminaires that have not been certified to the Energy Commission are classified as low efficacy, even if they meet the efficacy requirements of Table 150.0-B.

In general, any luminaire that contains a socket that can be fitted with an incandescent lamps classified as low efficacy, even if a compact fluorescent or LED lamp is installed into that socket.

Table 1-1 – Efficacy Classification of Common Light Sources

High Efficacy Light Sources Luminaires manufactured, designed and rated for use with only lighting technologies in this column shall be classified as high efficacy:	**Low Efficacy Light Sources** Luminaires manufactured, designed or rated for use with any of the lighting technologies in this column shall be classified as low efficacy.
1. Pin-based linear or compact fluorescent lamps with electronic ballasts. Compact fluorescent lamps ≥ 13 watts shall have 4 pins for compliance with the electronic ballast requirements in §150.0(k)1D. 2. Pulse-start metal halide lamps. 3. High pressure sodium lamps. 4. GU-24 sockets rated for LED lamps. 5. GU-24 sockets rated for compact fluorescent lamps. 6. Luminaires using LED light sources which have been certified to the Commission as high efficacy in accordance with Reference Joint Appendix JA8. 7. Luminaire housings rated by the manufacturer for use with only LED light engines. 8. Induction lamps. Note: Adaptors which convert an incandescent lamp holder to a high-efficacy luminaire shall not be used to classify a luminaire as high efficacy.	1. Line-voltage lamp holders (sockets) capable of operating incandescent lamps of any type. 2. Low-voltage lamp holders capable of operating incandescent lamps of any type. 3. High efficacy lamps installed in low-efficacy luminaires, including screw base compact fluorescent and screw base LED lamps. **4.** Mercury vapor lamps. 5. Track lighting or other flexible lighting system which allows the addition or relocation of luminaires without altering the wiring of the system. 6. Luminaires using LED light sources which have not been certified to the Commission as high efficacy. 7. Lighting systems which have modular components that allow conversion between high-efficacy and low-efficacy lighting without changing the luminaires' housing or wiring. **8.** Electrical boxes finished with a blank cover or where no electrical equipment has been installed, and where the electrical box can be used for a luminaire or a surface mounted ceiling fan**.**

Table 1-2 – Efficacy Classification of Uncommon Light Sources

Use this table to determine luminaire efficacy and classification only for lighting systems not listed in TABLE 150.0-A	
Luminaire Power Rating	**Minimum Luminaire Efficacy to Qualify as High Efficacy**
5 watts or less	30 lumens per watt
over 5 watts to 15 watts	45 lumens per watt
over 15 watts to 40 watts	60 lumens per watt
over 40 watts	90 lumens per watt
Note: Determine minimum luminaire efficacy using the system initial rated lumens divided by the luminaire total rated system input power.	

8.1.2 Low Efficacy Luminaires

§150.0(k)2

A low efficacy luminaire is one that meets the criteria listed in the right-hand column of Table 1-1, or (if not covered by Table 1-1) does not meet the minimum efficacy requirements in Table 1-2 .

Typical examples of low efficacy luminaires include:

- LED lighting which has not been certified to the Energy Commission as high efficacy.
- Contains any type of line-voltage socket or lamp holder except for GU-24. These include conventional medium screw-base sockets, candelabra sockets, pin-based sockets, or any other type of line-voltage lamp holders capable of accepting an incandescent lamp or any other type of low efficacy lamp.
- Low voltage incandescent lighting.
- Track lighting of any type, or any other lighting systems which allows the addition or relocation of luminaires without altering the wiring of the system.
- Lighting systems which have modular components that allow conversion between screw-based and pin-based sockets without changing the luminaires' housing or wiring.

8.1.3 Electrical boxes that are finished with a blank cover, or electrical boxes where no electrical equipment has been installed, where the electrical box can be used for a luminaire or a surface mounted ceiling fan.LED Classifications and Certifications

Unlike CFL and GU-24 lamps and luminaires, LED lamps and luminaires must be certified to the Commission to qualify as “high efficacy”. If not certified, they are classified as being low efficacy irrespective of their actual efficacy, the only exception to this is LED lamps that have GU-24 bases—these qualify automatically.

The market for LED luminaires has given rise to new types of luminaires and new terminology within the lighting industry. This new terminology can be confusing;

Table1-3 sets out the four types of LED lighting, and shows how to determine whether each type is high efficacy or low efficacy.

Table1-3 – Classification of LED Luminaire Types

LED type	Common examples	Is this a high efficacy luminaire?	Method for calculating Installed lighting power
Integral LED luminaire	Most LED undercabinet luminaires Most LED picture lights	Yes, if it has been certified to the Energy Commission	Treat as LED luminaire (§130.0(c)9)
Luminaire with replaceable LED light engine	Recessed LED luminaires that have a replaceable proprietary light engine)	Yes, if it does not contain a screw base or other ANSI base, and the light engine has been certified to the Energy Commission	Treat as LED luminaire (§130.0(c)9)
Integrated LED lamp with GU-24 base	GU-24 LED lamps LED trims designed to fit into recessed cans not having incandescent sockets.	Yes, if the luminaire has a GU-24 socket and is rated only for use with LEDs and/or CFLs.	Treat as an LED or CFL luminaire (§130.0(c)6 or 8)
Integrated LED lamps with any type of incandescent base	Screw-based LED lamps or LED trims designed to fit into incandescent recessed cans.	Never high efficacy	Treat as a line-voltage luminaire or line-voltage track as applicable (§130.0(c)2 or 7)
Non-integrated LED lamp	MR16 or MR11 lamps with “bi-pin” (GU5.3 or GX5.3) sockets that are powered by a 12V transformer	Never high efficacy	Treat as low voltage lighting (§130.0(c)8)

Joint Appendix 8

The four types of LED lighting are defined as follows:

- **Integral LED luminaire.**

  These are luminaires in which the LEDs cannot be removed from the luminaire. The luminaire forms a single unitary device in which the lamps are not replaceable. Many picture lights and undercabinet lights are integral LED luminaires. Integral LED luminaires are always high

efficacy if they are certified to the Commission (as described in Joint Appendix 8).

- **Luminaire with replaceable LED light engine**

  These are the similar to integrated LED lamps (above), except that the socket is proprietary (not an ANSI standard socket) and is designed to connect only to one specific luminaire from a given manufacturer. Many recessed LEDs are built this way. Integral LED luminaires are always high efficacy if they are certified to the Commission (as described in Joint Appendix 8).

- **Integrated LED lamp**

  These are lamps which contain their own drivers, and can be directly connected to a line-voltage socket through an ANSI standard base. Screw-based LED A-lamps are a typical example. Integrated LED lamps are not classified as high efficacy unless they have a GU-24 base. If they do have a GU-24 base, they are automatically high efficacy and do not need to be certified to the Energy Commission.

- **Non-integrated LED lamp**

  These are the similar to integrated LED lamps, except that the replaceable part (the lamp) does not contain its own driver (the driver is located within the luminaire). Non-integrated lamps must have ANSI sockets. Most low-voltage LED track spotlights are non-integrated lamps. These lamps are never classified as high efficacy, because they could easily be replaced with incandescent lamps after occupancy.

§150.0(k)1B

Some luminaires contain both LEDs and other light sources. These are known as hybrid LED luminaires. When the LED source has been certified to the Energy Commission as high efficacy, and the other light source in the hybrid luminaire also qualifies as high efficacy according to and of this chapter, the entire luminaire may be classified as high efficacy for compliance with the Residential Lighting Standards.

However, when a certified high efficacy LED source system is combined with a low efficacy lighting system in a Hybrid LED Luminaire, the high efficacy and low efficacy lighting systems shall each separately comply with the applicable requirements of §150.0(k), which is to say that the specific requirement of each residential room type apply to the high efficacy and low efficacy parts of the luminaire respectively.

8.1.4 GU-24 **Luminaires**

Luminaires with GU-24 sockets are automatically classified as high efficacy for residential use, and are a cost-effective way of installing high efficacy lighting.

GU-24 sockets can accept only high efficacy lamps according to the Title 20 Appliance Efficiency Regulations. The shape and size of the GU-24 socket enables it to be used in any luminaire that could use an Edison Screw socket. This means that many residential luminaire manufacturers offer GU-24 sockets as an option in all their screw-based luminaires, making it possible for all these luminaires to be classified as high-efficacy without incurring additional cost.

-

8.1.5

Compact fluorescent lamps and LED lamps are available with GU-24 bases, as shown in Figure 1-1. Under the California Title 20 Appliance Efficiency Regulations, it is illegal to manufacture or sell an incandescent lamp with a GU-24 base, a luminaire with a GU-24 socket that is rated for incandescent lamps, or an adaptor that converts a GU-24 socket to an Edison socket.

Also note, the Edison-base-to-GU-24 socket adaptor shown on the right side of Figure 1-2 shall never be recognized for compliance with the Residential Lighting Standards. However, California law does not prohibit the installation of such adaptors in luminaires that are not required to comply with Title 24.

Source: http://www.northernlightsusa.com/sites/default/files/imagecache/product_full/GU24_0.jpg.

Figure 1-1 – GU-24 Lamps

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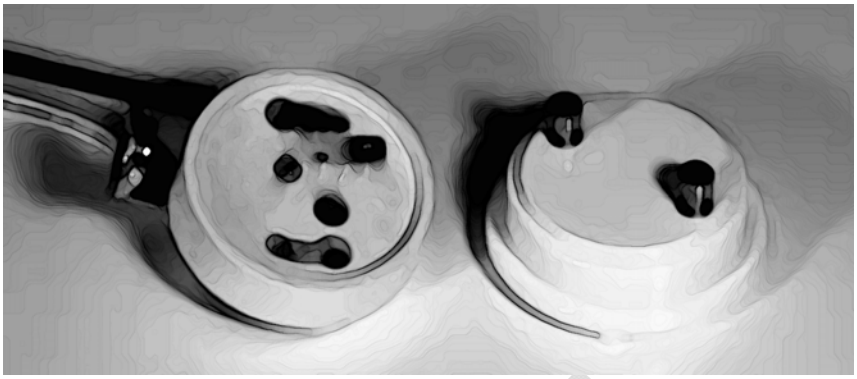


Figure 1-2 – GU-24 socket and base

8.1.6 Kitchen Luminaire Input Power

§150.0(k)3; §150.0(k)8, §130.0(c)

The Residential Lighting Standards require luminaire input power (wattage) to be determined only in kitchens. Luminaire input power shall be determined in accordance with §130.0(c) of the Standards.

Following are the requirements in §130.0(c) of the Standards, used to determine luminaire input power in residential kitchens:

A. Luminaire Labeling Requirements

The Lighting Standards generally determine installed lighting power by using the maximum relamping rated wattage of the luminaire. The Standards require that this shall be listed on a permanent, pre-printed, factory installed label, as specified by UL 1574, 1598, 2108, or 8750, as applicable. Labels must meet the following requirements:

- The factory-installed maximum relamping rated wattage label shall not consist of peel-off or peel-down layers or other methods that allow the rated wattage to be changed after the luminaire has been shipped from the manufacturer.

EXCEPTION: Peel-down labels may be used only for luminaires that are manufactured, rated, and designed to meet ALL of the following requirements:

a. The luminaire can accommodate a range of lamp wattages without changing the luminaire housing, ballast, transformer or wiring, and
b. The luminaire can operate only one lamp, and
c. The luminaire has an integrated ballast or transformer, and
d. Peel-down labels must be layered such that the rated wattage reduces as successive layers are removed and,
e. The luminaire is only one of the following three lighting technologies:

    1. High intensity discharge luminaires, having an integral electronic ballast, with a maximum relamping rated wattage of 150 watts, or

    2. Low-voltage luminaires (except low voltage track systems), ≤24 volts, with a maximum relamping rated wattage of 50 watts, or

    3. Compact fluorescent luminaires, having an integral electronic ballast, with a maximum relamping rated wattage of 42 watts.

Although the rated wattage label is generally the correct value to use for installed luminaire power, there are some exceptions and conditions for various different luminaires, as set out below, and described in §130.0(c).

B. Incandescent Luminaires

The Standards classify all luminaires with line voltage screw-base sockets as incandescent.

- For determining input power for incandescent luminaires, use the maximum relamping rated wattage of the luminaire. However, for recessed luminaires with line-voltage medium screw base sockets, the input wattage shall never be less than 50 watts per socket, even if the relamping rated wattage is less than 50 watts.
- Luminaires and luminaire housings designed to accommodate a variety of trims or modular components that allow the conversion between incandescent and any other lighting technology without changing the luminaire housing or wiring shall be classified as incandescent.
- Screw-based adaptors shall never be recognized as converting an incandescent luminaire to any type of non-incandescent technology. Screw-based adaptors, including screw-base adaptors classified as permanent by the manufacturer, shall not be recognized for compliance with Part 6.
- Luminaires and luminaire housings manufactured with incandescent screw base sockets shall be classified only as incandescent. Field modifications, including hard wiring of an LED module, shall not be

recognized as converting an incandescent luminaire or luminaire housing to a non-incandescent technology for compliance with Part 6.

C. Fluorescent and High Intensity Discharge (HID) Luminaires

The Standards classify luminaires with permanently installed or remotely installed ballasts as either fluorescent (linear fluorescent or compact fluorescent) or high intensity discharge (HID – metal halide or high pressure sodium)

- For determining input power for fluorescent and HID luminaires, the input watts shall be the rated lamp/ballast combination used in the luminaire, as published in the ballast manufacturer's catalogs based on independent testing lab reports as specified by UL 1598.
- For fluorescent luminaires, this applies to luminaires that are manufactured, rated, and designed for use only with pin-base fluorescent lamps, Screw-based compact fluorescent lamps do not qualify as fluorescent luminaires.
- For linear LED lamps, when installed in luminaires that are manufactured, rated, and designed for use with pin-base fluorescent lamps, such LED lamps shall not be recognized as converting the fluorescent luminaire to an LED luminaire.

D. Track Lighting

Track Lighting is a system that includes luminaires and a track, rails, or cables that both mount the system, and deliver electric power. There are two different type of tack lighting typically used in residential kitchens: Line-voltage and Low-voltage.

As shown in Table 1-1, track lighting is always classified as low-efficacy incandescent lighting, regardless what lighting technology is actually installed on the track.

Line-voltage track lighting

Following are options for determining the watts used by a line-voltage track lighting system in residential kitchen lighting:

- The volt-ampere rating of the branch circuit feeding the track or busway; or
- The higher the following two options:
  - The rated wattage of all of the luminaires included in the system, where wattage is determined according to §130.0(c), or
  - 45 watts per linear foot of track, or
- When using a line-voltage track lighting integral current limiter, the higher of the following two options:
  - The volt-ampere rating of an integral current limiter controlling the track or busway, or
  - 12.5 watts per linear foot of track or busway.

An Integral current limiter shall be certified to the Energy Commission in accordance with §110.9. An integral current limiter not certified to the Energy Commission shall not be recognized for compliance with the Standards.

Low-voltage track lighting

A low-voltage track lighting system is equipped with a remote transformer for use with low-voltage equipment along the entire length of track.

- The wattage of low-voltage track lighting shall be the maximum rated input wattage of the transformer.

E. Low Voltage Lighting

Low-voltage lighting includes luminaires and lighting systems with permanently installed or remotely installed transformers.

The wattage of low-voltage lighting shall be determined as follows:

- For low-voltage luminaires that do not allow the addition of lamps, lamp holders, or luminaires without rewiring, the wattage shall be the rated wattage of the lamp/transformer combination.
- For low-voltage lighting systems which allow the addition of lamps, lamp holders, or luminaires without rewiring, the wattage shall be the maximum rated input wattage of the transformer.

Line-Voltage Luminaires

F. LED Luminaires and Light Engines

§130(d)5

LEDs that are certified to the Energy Commission are recognized as being "high efficacy". LEDs that are not certified to the Energy Commission are classified as low efficacy, regardless of their actual efficacy.

For use in kitchens, their wattage must be calculated using one of the methods below.

- For standalone LED luminaires or light engines that do not allow the addition of lamps, the installed lighting power shall be the rated wattage of the system, tested in accordance with IES LM-79-08.
- For LED systems that do allow additional luminaires or light engines to be connected without rewiring, the installed lighting power shall be the maximum rated input wattage of the power supply
- For luminaires that use LED *lamps* (either integrated- or non-integrated type) installed lighting power is calculated differently than for LED luminaire or light engines. Use the calculation methods for line-voltage luminaires (incandescent), line-voltage track, or low-voltage luminaires, as applicable (see
-
-
- Table1-3.)
- Luminaires manufactured or rated for use with line-voltage or low-voltage incandescent lamps, into which LED modules or LED lamps have been installed, shall not be recognized as LED lighting systems.

G. Miscellaneous Lighting Systems

§130(d)6

This method applies only to lighting systems which have not already been addressed by another subsection of §130.0(c), and is primarily intended to address new technologies. This method shall not be applied to incandescent,

fluorescent, HID, or LED luminaires because these lighting technologies are already addressed in different subsections of §130.0(c).

The wattage of all other miscellaneous lighting equipment shall be the maximum rated wattage of the lighting equipment, or operating input wattage of the system, listed on a permanent, pre-printed, factory-installed label, or published in manufacturer's catalogs, based on independent testing lab reports as specified by UL 1574 or UL 1598.

H. Blank Electrical Boxes

In residential kitchens, the installed lighting power of electrical boxes finished with a blank cover or where no electrical equipment has been installed, and where the electrical box can be used for a luminaire or a surface mounted ceiling fan, shall be calculated as 180 watts of low efficacy lighting per electrical box.

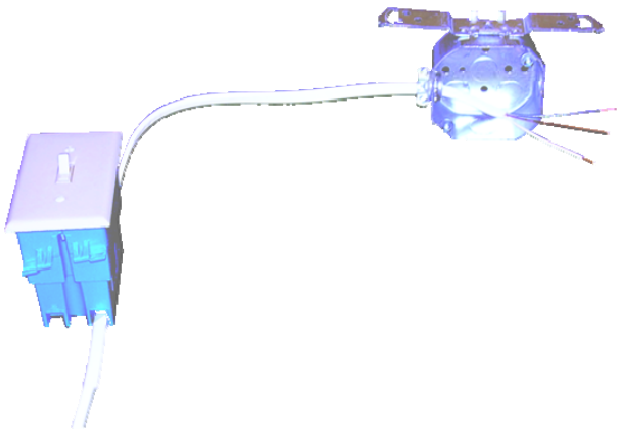


Figure 1-3 – Blank Electrical Box

I. NO "Permanent" GU-24 Adaptors

Luminaires with GU-24 sockets are recognized as high efficacy, so it may be tempting for designers or contractors to use adaptors to convert screw-base sockets to GU-24 sockets. However, the Standards do not recognize any socket adaptor as being able to permanently converting one type of luminaire to another type for compliance with the Standards. For example, there are no "permanent" adaptors for converting a luminaire with incandescent screw-base socket to a permanently installed compact fluorescent luminaire, regardless of manufacturer declarations.

Figure 1-6 – A medium screw base to GU-24 socket adaptor is not recognized as high efficacy by Title 24.

8.1.7 Electronic Ballasts

§150.0(k)4

Fluorescent lamps with a power rating of 13 W or more shall have an electronic ballast that operates the lamp at a frequency of 20 kHz or more. All commonly available electronic ballasts meet this requirement.

Luminaires with high intensity discharge (HID) lamps (like pulse-start metal halide or high-pressure sodium) may contain hardwired electromagnetic HID ballasts.

If in doubt, look at the number of pins protruding from the lamp base. Pin based compact fluorescent lamps that are operated with electronic ballasts typically have four-pin lamp holders. Pin-based compact fluorescent lamps with two-pin lamp holders typically will indicate that the ballast is magnetic. Be careful not to confuse pin-based CFL sockets with GU-24 sockets.

§110.9(n)

There are also requirements for compact fluorescent ballasts in recessed luminaires to be certified to the Energy Commission. See Section 8.1.11 for additional information.

8.1.8 Permanently Installed and Portable Luminaires

The Residential Lighting Standards require that all permanently installed luminaires be high efficacy as defined in §150.0(k)1, with some exceptions described later in this chapter. The Residential Lighting Standards do not apply to portable luminaires.

§100.1 definitions

Permanently installed luminaires include all luminaires attached to the inside or outside of a building or site. Permanently installed luminaires may have either plug-in or hardwired connections for electric power. This includes plug-in under-cabinet lighting where the luminaires are attached to the bottom of the cabinets. Permanently installed luminaires include the following:

- Lighting attached to walls, ceilings, 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 that is integral to garage door openers if it is designed to be 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.

Permanently installed lighting does not include:

- Portable lighting as defined by §100.1.
- 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 in garage door openers which consists of no more than two screw-based sockets integrated into the garage door opener 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.

The definition of permanently installed lighting in §100.1 includes outdoor lighting mounted on poles, in trees, or in the ground. However, because outdoor lighting mounted on poles, in trees, or in the ground is not regulated by the Residential Lighting Standards, this portion of the definition applies only to nonresidential outdoor lighting applications.

Portable lighting, for residential applications, is defined as lighting with plug-in connections for electric power that is table and freestanding floor lamps. However, plug-in lighting attached to the bottom of a cabinet is considered permanently installed lighting.

8.1.9 Night Lights

§150.0(k)5

Permanently installed night lights and night lights integral to an installed luminaire or exhaust fan shall be rated to consume no more than 5W of power per luminaire or exhaust fan, as determined by §130.0(c.

Night lights are not required to be controlled by vacancy sensors, irrespective of the type of room they are located in.

Note: Indicator lights that are integral to lighting controls shall comply with §110.9(b).

8.1.10 Lighting Integral to Exhaust Fans

§150.0(k)6

Lighting integral to exhaust fans shall meet the applicable requirements of §150.0(k). However, lighting which is part of a kitchen stove exhaust hood is not required to comply with §150.0(k).

This lighting integral to exhaust fans shall be controlled separately from the exhaust fan according to §150.0(k)7 and as described further in Section 8.1.12.

8.1.11 See Sections 8.1.9 and 8.1.10 for more information about lighting attached to or integral to exhaust fans. Certification to the Energy Commission

§100(k); §110; §119

Certification to the Energy Commission is completed by manufacturers of regulated devices. Certification includes a declaration of compliance, executed under penalty of perjury of the laws of California, that the regulated device meets the requirements of the Standards.

For compliance with the Title 20 Appliance Efficiency Regulations, and the Title 24 Building Energy Efficiency Standards, the Energy Commission maintains a database of appliances, controls, and other devices which have been certified to the Energy Commission.

For compliance with the Residential Lighting Standards, this database includes lighting controls, ballasts for residential recessed luminaires, and high efficacy LED lighting systems.

Lighting controls, and ballasts for residential recessed luminaires shall not be installed unless they have been certified by the manufacturer and listed on this database. LED lighting systems cannot be counted as “high efficacy” for the purposes of code compliance unless that have been certified and listed on the database. The database and certification instructions are available from the following web links:

/www.energy.ca.gov/appliances/database/index.html

www.energy.ca.gov/appliances/forms/

The certification for residential lighting applications includes the following:

A. Lighting Controls

Included in the residential lighting Standards are requirements for lighting controls. Both self contained lighting control devices, and lighting control systems shall comply with the requirements in §110.9. Additionally, lighting controls and equipment are required to be installed in accordance with the manufacturer's instructions.

- A self contained lighting control is defined as a unitary lighting control module that requires no additional components to be a fully functional lighting control. Self contained lighting control devices cannot be sold or offered for sale in California unless they have been certified to the Energy Commission according to the Title 20 Appliance Efficiency Regulations.
- A lighting control system requires two or more components to be installed in the building to provide all of the functionality required to make up a fully functional and compliant lighting control. A lighting control system must meet all applicable requirements in the Standards. Lighting control system are not required to be certified to the Energy Commission, however, they must meet the following requirements:

- An Energy Management Control System (EMCS) may be used to comply with dimmer requirements if at a minimum it provides the functionality of a dimmer, and an Installation Certificate is signed.
- An Energy Management Control System (EMCS) may be used to comply with vacancy sensor requirements if at a minimum it provides the functionality of a vacancy sensor, and an Installation Certificate is signed.
- A multi-scene programmable controller may be used to comply with dimmer requirements if at a minimum it provides the functionality of a dimmer.

B. High Efficacy LED Lighting Source Systems

For a light emitting diode (LED) lighting system to qualify as high efficacy, an LED luminaire, or LED light engine with integral heat sink shall be certified to the Energy Commission as meeting all of the following conditions:

1. Shall meet the minimum efficacy requirements in Table 150.0-B (shown as of this chapter)
2. Input power shall be determined as specified by §130.0(c)9.
3. The LED lighting system shall be tested, by an independent testing lab, according to IES LM-79-08. See Section 1.1.1 for more information about testing LED lighting.

C. Ballasts for Residential Recessed Luminaires

All ballasts for use in residential recessed luminaires shall be certified to the Energy Commission according to §110.9(n), as meeting the following conditions:

1. Be rated by the ballast manufacturer to have a minimum rated life of 30,000 hours when operated at or below a specified maximum case temperature. This maximum ballast case temperature specified by the ballast manufacturer shall not be exceeded when tested in accordance to UL 1598 Section 19.15; and
2. Have a ballast factor of not less than 0.90 for non-dimming ballasts and a ballast factor of not less than 0.85 for dimming ballasts.

8.1.12 Luminaires recessed in Ceilings

§150.0(k)12

Luminaires recessed in ceilings must meet special requirements due to the potential for thermal bridging and air paths through the ceiling insulation, and to the potential for heat build-up in the fixture to compromise the performance of the lamp. Air leaks degrade insulation performance, and can also permit condensation on the cold surface of the luminaire if exposed to moist air; for instance, in a bathroom.

Under the 2013 code, these requirements apply to all luminaires, whereas under the 2008 code they applied only to luminaires in insulated ceilings. Luminaires recessed in ceilings must meet three requirements:

1. They shall be listed, as defined in §101, for zero clearance insulation contact (IC) by Underwriters Laboratories or other nationally recognized testing/rating laboratories. This enables insulation to be packed in direct contact with the luminaire.
2. They shall have a label certifying that the luminaire has airtight construction. Airtight construction means that leakage through the luminaire will not exceed 2.0 CFM when exposed to a 75 Pascals pressure difference, when tested in accordance with ASTM E283 (An exhaust fan housing shall not be required to be certified airtight)..
3. They shall be sealed with a gasket or caulking between the luminaire housing and ceiling, and shall have all air leak paths between conditioned and unconditioned spaces sealed with a gasket or caulk, to prevent the flow of heated or cooled air out of the living areas and into the ceiling cavity.

The Residential Lighting Standards allow the use of either a gasket or caulking, and do not favor one of these methods over the other. See Section 0 for helpful information on what to look for to make sure that all air leak paths have been sealed.

The following performance requirements also apply:

- They be certified to the Commission to comply with the applicable requirements in § 110.9(n) (150.0(k)8D)
- They shall allow ballast maintenance and replacement to be readily accessible to building occupants from below the ceiling without requiring the cutting of holes in the ceiling (150.0(k)8E
- Ballasts for fluorescent lamps rated 13 watts or greater shall be electronic and shall have an output frequency no less than 20 kHz.150.0(k)1D

Example 1-1: Recessed luminaires: fire-rated housings

Question

If a factory manufactured fire rated luminaire housing is placed over a recessed luminaire in a multi-family residential dwelling unit, is the luminaire still required to comply with the IC requirements?

Answer

There are limited applications where a non-IC luminaire may be used conjunction with a manufactured fire rated luminaire housing in a multi-family residential dwelling unit. However, the luminaire shall still comply with all of the airtight requirements.

A non-IC luminaire may be used in an insulated ceiling in conjunction with a fire rated housing only if all three of the following conditions are met:

1.	The multi-family dwelling unit is an occupancy type R1 or R2; and
2.	The luminaire is recessed between different dwelling units that are regulated by California Building Code Section 712.4.1.2; and
3.	The manufactured fire rated housing is rated for a minimum of 1 hour fire in accordance with UL 263.

D. Inspection Protocol for Recessed Luminaires

§150.0(k)12

Recessed luminaires shall be IC rated and have a gasket or caulking between the housing and ceiling to prevent the flow of heated or cooled air between conditioned and unconditioned spaces. The luminaire shall include a label certifying airtight or similar designation to show air leakage less than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283. The label shall be clearly visible for the building inspector. The building inspector may verify the IC and ASTM E283 labels at a rough inspection. If verified at final inspection the building inspector may have to remove the trim kit to see the labels.

The ASTM E283 certification is a laboratory procedure intended to measure only leakage of the luminaire housing or, if applicable, of an airtight trim kit, and not the installation. Luminaire housings labeled as airtight, airtight ready or other airtight designation do not establish that the luminaire has been installed airtight. The luminaire manufacturer shall provide instructions that explain the entire assembly required to achieve an airtight installation.

The Residential Lighting Standards do not prefer the use of gaskets over caulk, or the use of caulk over gaskets for compliance with the Standards. Because a luminaire housing is not always installed perfectly parallel to the ceiling surface, both methods have their benefits as follows:

1. Caulk will generally fill in and seal wide and uneven gaps. However, after the caulk dries, it may permanently attach the luminaire housing or trim to the ceiling surface. Therefore, the caulk may need to be cut away from the ceiling surface in the event that a luminaire housing or trim needs to be moved away from the ceiling.
2. Many gaskets allow the luminaire housing or trim to be readily moved away from the ceiling surface after it has been installed. However, if the gasket is too thin, or not made out of an air stopping type of material, it may not sufficiently reduce the air flow between the conditioned and unconditioned spaces.

There are several different methods used by manufacturers to meet the airtight standards. The Residential Lighting Standards do not favor one airtight method over another.

The primary intent is to install a certified airtight luminaire so that it is sufficiently airtight to prevent the flow of heated or cooled air between conditioned and unconditioned spaces. All air leak paths through the luminaire assembly or through the ceiling opening shall be sealed. Leak paths in the installation assembly that are not part of the ASTM E283 testing shall be sealed with either a gasket or caulk. One example may apply for assemblies where a certified airtight luminaire housing is installed in an adjustable mounting frame; all air leak paths between the certified airtight luminaire

housing and the adjustable mounting frame shall be sealed, either with a gasket or caulk.

Following is the process for verifying that the requirements for an airtight installation are met.

1. Manufacturer specifications (a "cut sheet") of the certified airtight luminaire housing(s) and installation instructions shall be made available with the plans to show all components of the assembly that will be necessary to insure an airtight installation consistent with §150.0(k)5. This allows the building inspector to know what method the luminaire manufacturer specifies to achieve airtight installation, and therefore, at what phase of construction the building inspector shall inspect the luminaire for airtight compliance.
2. One of the following primary methods is specified by the luminaire manufacturer to insure an airtight seal of the certified airtight housing to the ceiling:
    a. A gasket is attached to the bottom of the certified airtight housing prior to the installation of the ceiling (i.e. drywall or other ceiling materials) to create an airtight seal. The gasket may be preinstalled at the factory, or may need to be field installed. For field installed gaskets, instructions on how the gasket is to be attached shall be provided by the manufacturer. The luminaire shall be installed so that the gasket will be sufficiently compressed by the ceiling when the ceiling is installed.
    b. A gasket is applied between the certified airtight housing and the ceiling opening after the ceiling has been installed. The gasket creates the airtight seal. The cut sheet and installation instructions for achieving the airtight conditions shall indicate how the gasket is to be attached.
    c. Caulk is applied between the certified airtight housing and the ceiling after the ceiling has been installed. The caulk creates the airtight seal. The cut sheet or installation instructions for achieving the airtight conditions shall specify the type of caulk that must be used and how the caulk shall be applied.
    d. A certified airtight trim kit is attached to the housing after the ceiling has been installed. The certified airtight trim kit in combination with the luminaire housing makes the manufactured luminaire airtight. Note that a decorative luminaire trim that is not ASTM E283 certified does not make the manufactured luminaire airtight. Most decorative luminaire trims are not designed to make a luminaire airtight. Rather, these trims are used to provide a finished look between the ceiling and luminaire housing, and may include a reflector, baffle, and/or lens. However, some trim kits are specifically designed to be a critical component used to make a luminaire installation airtight. These trim kits shall be certified airtight in accordance with ASTM E283. Certified airtight trim kits typically consist of a one-piece lamp-holder, reflector cone, and baffle.
    e. The cut sheet and installation instructions for achieving the airtight conditions shall show which certified airtight trim kits are

designed to be installed with the luminaire housing, and how the certified airtight trim kits shall be attached. A gasket must be installed between the certified airtight trim kit and the ceiling.

3. The following methods for insuring an airtight seal between the certified airtight housing or certified airtight trim and the ceiling shall be field verified at different phases during construction:
    a. Gasket attached to the bottom of the certified airtight housing shall be inspected prior to the installation of the ceiling when the rough-in electrical work is visible. The inspector shall review the cut sheet or installation instructions to make sure the housing and gasket have been installed correctly. All gaskets shall be permanently in place at the time of inspection. It is important that once the ceiling material is installed the gasket will be in continuous, compressed contact with the backside of the ceiling and that the housing is attached securely to avoid vertical movement. The housing shall be installed on a plane that is parallel to the ceiling plane to assure continuous compression of the gasket.
    b. Gasket applied between the certified airtight housing and the ceiling after the ceiling has been installed shall be inspected after the installation of the ceiling. The inspector shall review the cut sheet or installation instructions to make sure the housing and gasket have been installed correctly. The gasket shall be permanently in place at the time of inspection. It is important that the gasket is in continuous, compressed contact with the ceiling, and that the housing is attached securely to avoid vertical movement.
    c. Caulk applied between the certified airtight housing and the ceiling after the ceiling has been installed shall be inspected after the installation of the ceiling. The inspector shall review the cut sheet or installation instructions to make sure the housing has been installed correctly and the caulk has been applied correctly. It is important and that the housing is attached securely to avoid vertical movement.
    d. Certified airtight trim kit shall be inspected after the installation of the ceiling and the installation of the trim. The inspector shall review the cut sheet or installation instructions to make sure the luminaire housing and the certified airtight trim kit have been installed correctly. It is important that the housing and the certified airtight trim kit are attached securely to avoid vertical movement. The ASTM E283 certification is a laboratory procedure where the trim kit is tested on a smooth mounting surface. However, it is common for certified airtight trim kits to be installed against a textured ceiling or other irregular ceiling surface. It is important that the gasket is in continuous, compressed contact with the ceiling and the certified airtight trim kit. Therefore, it is important to visually inspect the certified airtight trim kit and gasket next to the ceiling to assure that a continuous seal has been produced.
    e. Certified airtight trim kits may be installed on luminaire housings that may or may not be certified airtight. If the trim kit

is certified airtight, it shall also have a sealed gasket between the trim kit and ceiling.

8.1.13 Ballasts for Recessed Luminaires

§119(n)

For recessed luminaires with compact fluorescent ballasts, the ballasts shall be certified to the Energy Commission. For additional information on certifying ballasts and other devices to the Energy Commission, see Section 8.1.12.

The luminaire shall be designed and installed to allow ballast maintenance and replacement to be readily accessible to building occupants from below the ceiling without requiring the cutting of holes in the ceiling.

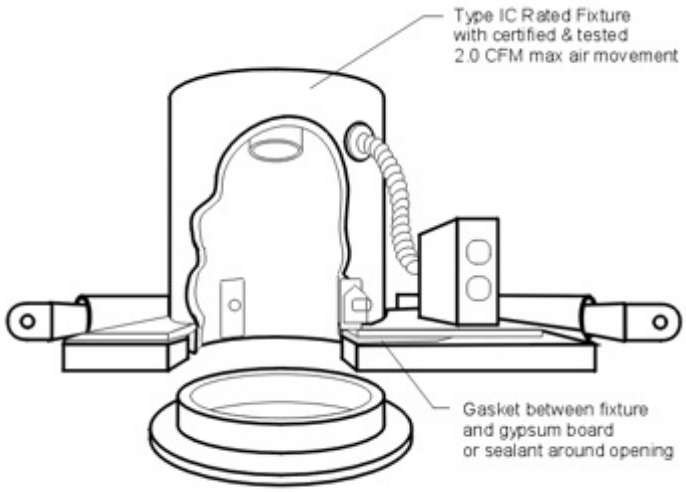


Figure 1-9 – Airtight, Type IC Luminaire

8.1.14 Recommendations for Luminaire Specifications

It is important that luminaires are described fully in the specifications and on drawings so that contractors and subcontractors provide and install residential lighting systems that comply with the Residential Lighting Standards. The specifications should be clear and complete so that contractors understand what is required to comply with the Standards.

Following are a few suggestions to help reduce the chance that there may be costly change orders required to bring a non-complying building into compliance.

1. Include all applicable residential lighting requirements in the general notes on the drawings and other bid documents.
2. Include the residential lighting requirements with each luminaire listed in the lighting schedule text and details, for example:

Table 1-6 – Recommendations for Luminaire Specifications

Luminaire Type	Recommended Type of Notes for Luminaire Schedule
Bath Bar	Bath bar, incandescent lamps, shall be controlled by a vacancy sensor per §150.0(k)
Ceiling fixture (i.e., for a bathroom application)	Fluorescent surface-mounted ceiling luminaire, with one F32-T8 fluorescent lamp and electronic ballast, meeting the requirements of §150.0(k)
Fluorescent Recessed Can (i.e., for a kitchen application)	Fluorescent recessed can, with one 26 W pin-based compact fluorescent lamp, meeting the electronic ballast, minimum efficacy, IC, and airtight requirements of §150.0(k)
Incandescent Recessed Can (i.e., for a Kitchen application)	Incandescent recessed can with a maximum relamping wattage of 75 W, meeting the labeling, IC, and Airtight requirements of §150.0(k)
Incandescent Recessed Can (i.e., for a Dining Room application)	Incandescent recessed can, meeting the IC, and Airtight requirements of §150(k), and controlled by a dimmer switch meeting the requirements of Sections 119 and 150.0(k)
Chandelier	Chandelier, controlled by a dimmer switch meeting the requirements of §150.0(k)
Vacancy Sensor (Manual-on Occupant Sensor)	Vacancy sensor meeting the requirements of Sections 119 and 150.0(k)

8.2 Requirements for Switching Devices and Controls

The use of lighting controls is an important component of the Residential Lighting Standards. This section describes lighting control requirements for the Residential Lighting Standards.

8.2.1 Certification of Residential Lighting Controls

Manual-on/automatic-off occupant sensors (also known as vacancy sensors), motion sensors, photocontrols and astronomical timeclock controls(used for outdoor lighting), track lighting integral current limiters, and dimmers installed to comply with §150.0(k)shall be certified according to the applicable requirements of the Title 20 Appliance Standards, as described in §110.9. Additional information about certifying devices to the Energy Commission is in Section 8.1.11.

8.2.2 Switching Requirements §150.0(k)7

Following are controls that are required for compliance with the Residential Lighting Standards:

A. Permanently Installed Luminaires

All permanently installed high efficacy luminaires shall be switched separately from low efficacy luminaires.

B. Exhaust Fans

There are two options for the switching of lighting associated with exhaust fans:

1. All lighting shall be switched separately from exhaust fans, or
2. For an exhaust fan with an integral lighting system, it shall be possible for the lighting system to be manually turned on and off while allowing the fan to continue to operate for an extended period of time. An exhaust fan may need to run continuously if used to comply with §150.0(o).

C. Readily Accessible Manual Controls

All permanently installed luminaires shall be switched with readily accessible controls that permit the luminaires to be manually switched on and off.

D. Manufacturer Instructions

All lighting controls and equipment shall be installed in accordance with the manufacturer's instructions.

E. Multiple Switches

This requirement applies to all 3-way, 4-way, and other lighting circuits controlled by more than one switch. A lighting circuit controlled by more than one switch where a dimmer or vacancy sensor has been installed to comply with §150.0(k) shall meet the following conditions:

1. No controls shall bypass the dimmer or vacancy sensor function, and
2. The dimmer or vacancy sensor shall be certified to the Energy Commission that it complies with the applicable requirements of §119.

8.2.3 Lighting Control Systems and Energy Management Control Systems

§110.9

Lighting control devices may be either individual devices or systems consisting of two or more components. Lighting control systems and Energy Management Control Systems (EMCS) must meet the requirements of §110.9. There is no need for the system to be certified to the Commission.

8.2.4 Vacancy Sensors

§150.0(k)10 and 110.9

The Residential Lighting Standards require the installation of high efficacy lighting, but allow vacancy sensors to be used as an alternate compliance option in many room types..

Manual-on / automatic-off occupant sensors, also known as vacancy sensors, automatically turn lights off if an occupant forgets to turn them off when a room is unoccupied. If there are rooms or areas where there are safety concerns regarding the use of vacancy sensors, then the use of “dual

technology" (infra-red plus ultrasonic) may be.desirable, or alternatively the vacancy sensor may be staged to partially shut off the lighting before switching it off completely.

Additionally, these sensors shall provide the occupant with the ability to turn the lights off manually upon leaving the room, and turn them on manually upon entering the room. The manual–off feature is critical because it provides the occupants with the flexibility to control the lighting environment to their satisfaction, and results in greater energy savings by allowing the occupants to turn off the lights when they are not needed.

§110.9

Vacancy sensors are required to be certified to the Energy Commission, as

Described in §110.9. Additionally, vacancy sensors are required to the certified by the manufacturer to the Energy Commission in accordance with the requirements in the Title 20 Appliance Efficiency Regulations before they can be sold or offered for sale in California.

Vacancy sensors commonly on the market are wired in two different ways:

- Where sensor operating current uses the load connection (two-wire connection).
- Where sensor operating current uses a neutral connection (three-wire connection).

Some vacancy sensors using the load connection for operating current have minimum load requirements. For example, a vacancy sensor may require that bulbs rated over 25W be installed before the sensor will work. However, if an occupant later installs a screw-in compact fluorescent lamp that is rated less than 25W, the sensor may no longer work. Therefore, it is critical to select a sensor that has a low enough minimum load requirement to accommodate however small a load the occupant may install into the socket. The sensors that have a minimum load requirement are typically the ones that are designed to operate without a neutral wire in the switch box which is a common wiring scheme in older residential units.

A better solution would be to install a vacancy sensor that does not have minimum load requirements.

Vacancy sensors that are designed to take advantage of the neutral wire in the switch box typically do not have a minimum load requirement and are the preferred choice to meet the requirements of the Residential Lighting Standards.

Using vacancy sensors that uses the ground wire for the operating current is not recommended. There are potential safety concerns with using the ground to carry current in residential applications.

If you are trying to control a lighting fixture from two different switches you may want to use a ceiling mounted rather than a wall switch occupant sensor, or use 3-way vacancy sensors at both switch locations.

Example 1-2: Bathroom vacancy sensors—automatic on

Question

In addition to one high-efficacy luminaire, we would like to use incandescent lighting in a bathroom, controlled by a vacancy sensor. Although the vacancy sensor has the "manual-on" capability, it also has the capability of turning the lights on automatically by flipping a switch that is located under the switch plate cover. Does this sensor meet the requirements of the Residential Lighting Standards?

Answer

No, this vacancy sensor does not meet the requirements of the Standards. §110.9 requires that the vacancy sensor shall not have an override switch that converts the sensor from a manual-on to an automatic-on system. Such vacancy sensors cannot be sold in California according to the Title 20 Appliance Efficiency Regulations.

Example 1-3: Bathroom vacancy sensors--manual off

Question

Must the vacancy sensor in the example above give the occupant the option of turning the light off manually upon leaving the bathroom?

Answer

Yes. The vacancy sensor must provide the occupant with the option to turn the lights off manually upon leaving the space. If the occupant forgets to turn the lights off when a room is left unoccupied then the vacancy sensor must turn the lights off automatically within 30 minutes. The lights must then be manually switched back on when the lights are needed again. This option provides the occupants with the flexibility to control the lighting environment to their satisfaction, and results in greater energy savings by allowing the occupants to turn off the lights when they are not needed.

Example 1-4: Can auto-on occupancy sensors be used?

Question

What are our options if we want to use an automatic-on occupant sensor in a bathroom, garage, laundry room, or utility room?

Answer

Automatic-on occupant sensors are not allowed under the Residential Lighting Standards.

8.2.5 Residential Dimmers

§150.0(k)11

Dimmers are one of the alternate options to using high efficacy lighting in any room that is not a kitchen, bathroom, garage, laundry room, closet greater than 70 ft², or utility room.

§110.9

Dimmers are required to be certified by the manufacturer to the Energy Commission as meeting all of the requirements in §110.9 and according to the Title 20 Appliance Efficiency Regulations.

Example 1-5: Using dimmers on three-way lighting circuits

Question

In stairwells and some corridors, 3-way circuits are a common way to allow control of the lighting from either end of the space. How can I use dimmers to give a similar level of control?

Answer

In this case, the Standards require that the lighting must be controlled by at least one dimmer, but they do not require that every control point must allow dimming. Therefore, one of the switches could be a dimmer and the other could be a regular toggle switch. Alternatively, more advanced controls are available that allow dimming from both ends of the circuit.

However, the toggles switch(es) must not allow the lighting to come on at a higher level than is set by the dimmer.

It is important to correctly match the dimmer with the type of lighting load that is being dimmed. Failure to correctly match the dimmer with the electrical lighting load may result in early equipment failure, including the dimmer, transformer, ballast, or lamp. This is especially important with LED lighting; a dimmer with the appropriate power range should be chosen, to match the total wattage of lighting it controls.

Dimmer manufacturers typically offer three basic types of incandescent dimmers: Line voltage (120 volt), low-voltage for use with a magnetic transformer, and low-voltage for use with an electronic transformer. Line voltage incandescent lamps, including tungsten-halogen lamps, can easily be dimmed over their full range of output with voltage control or phase control (electronic) dimmers., generally without any special considerations. When dimming a low voltage load, additional components are required in the dimmer to avoid overheating the transformer. UL has separate requirements for 120-volt and low-voltage dimmers due to the heat concern with transformers.

8.3 Requirements for Specific Space Types

8.3.1 Kitchens

§150.0(k)9.

The Residential Lighting Standards define a residential kitchen as “a room or area used for food storage and preparation and washing dishes including associated counter tops and cabinets, refrigerator, stove, oven, and floor areas.”

Kitchen lighting includes all permanently installed lighting in the kitchen, except for lighting that is internal to cabinets for the purpose of illuminating only the inside of the cabinets. Lighting in areas adjacent to the kitchen,

including but not limited to dining and nook areas, are considered kitchen lighting if they are not separately switched from kitchen lighting.

A. Determine High Efficacy and Low Efficacy Installed Wattage

§150.0(k)8

The Residential Lighting Standards require that at least half of the rated lighting wattage installed in a kitchen shall be high efficacy luminaires. For example, if 150W of high efficacy lighting is installed, no more than 150W of low efficacy lighting can be installed. See Sections 1.2.1 and 8.1.5 for descriptions of high and low efficacy luminaires.

Because high efficacy luminaires typically consume less power than other luminaires, about three-fourths of the luminaires in the kitchen are likely to be high efficacy. The Residential Lighting Installation Certificate, shall be completed to determine if kitchen lighting complies with the Standards, and shall be completed for all residential lighting installations.

There are no limits to the total number of watts that can be installed in a residential kitchen. Therefore, there are no limits to illumination levels. If higher illumination levels are needed, simply install additional wattage from high efficacy luminaires until needed illumination levels are reached.

See Section 0 of this Compliance Manual for information on determining the input power (wattage) of each installed luminaire.

Example 1-6: Kitchens: Wattage calculation

Question

I am designing a residential kitchen lighting system where I plan to install six 26W compact fluorescent recessed downlights, and four 24W linear fluorescent under cabinet luminaires. How many watts of incandescent lighting can I install?

Answer

First, determine the rated input watts of the fluorescent lighting system, including any additional wattage used by the ballasts. For this example, let's assume that the downlights with electronic ballasts are rated by the ballast manufacturer as consuming 26W, and the under cabinet luminaires with electronic ballasts are rated by the ballast manufacturer as 25W.

26 x 6 = 156W

25 x 4 = 100W

Total = 256W

Therefore, the maximum watts of incandescent lighting that can be installed is 256W.

Example 1-7: Kitchens: Rated "relamping" wattage of luminaires

Question

In the above example, if I plan to use 40W incandescent lamps (bulbs) in luminaires that have a relamping rated wattage of 90W, how many incandescent luminaires can I install?

Answer

The installed incandescent wattage is based upon the relamping rated wattage of the luminaire, and not by the wattage of the lamp. Two 90W incandescent luminaires = 180W, and three-90W incandescent luminaires = 270W. Because no more than 256W of low efficacy lighting can be installed in the above kitchen, only two-90W incandescent luminaires may be installed. The additional 76W of low efficacy lighting may be installed somewhere else in the kitchen, provided that the total installed relamping rated wattage does not exceed the 76W still available. Alternatively, four60W incandescent luminaires (240W) can be installed in the kitchen.

Example 1-8: Kitchens: Rated wattage of transformers

Question

In the above example, if I plan to use low-voltage incandescent halogen lamps with individual transformers rated at 40W each (in this example, let's assume that 40W includes the input wattage of the transformer + the lamp), how many of these low-voltage incandescent luminaires can I install?

Answer

The installed of low-voltage lighting is based upon the rating of the transformer. You are allowed up to 256W of low efficacy lighting

256 divided by 40 = 6.4 luminaires

You are allowed to install 6 low-voltage incandescent halogen luminaires with transformers rated at 40W each.

Example 1-9: Kitchens: Use of luminaires that are not certified to the Commission

Question

In the previous example, if I plan to use 15W LED luminaires which has not been certified to the Energy Commission as high efficacy, how many of these LED luminaires can I install?

Answer

LED lighting, which has not been certified by the Energy Commission as high efficacy, shall be classified as low efficacy lighting. The installed LED system wattage must include transformers, power supplies, and any other power consuming components. You are allowed up to 256W of low efficacy lighting.

In this example, let's assume a system input wattage of 15W per LED luminaire:

256 divided by 15 = 17 luminaires

You are allowed to install 17 low efficacy LED luminaires with system input wattage of 15W each.

NOTE: There would be no limit on the number of LED luminaires that could be installed, if they had been certified to the Energy Commission as high efficacy.

Example 1-10: Definition of high efficacy lighting

Question

I am using an incandescent luminaire over a sink that is rated to take a 60W lamp. The luminaire has a screw-base socket and I plan to install a 26W compact fluorescent lamp. Does this qualify as a high efficacy luminaire and what wattage should I use in determining if half the lighting power in the kitchen is high efficacy?

Answer

No, the luminaire does not count as high efficacy because it is capable of being lamped with an incandescent lamp. Use the maximum rated power (60W) for determining the percent of high efficacy lighting. If the maximum rating of the luminaire is less than 50W, it counts as a 50W luminaire for the purpose of lighting wattage calculations.

If this luminaire were manufactured with a GU-24 twist-lock socket, and no screw-base sockets, it would be classified as a high-efficacy luminaire. Note that adaptors that convert screw-base sockets to GU-24 sockets are not recognized for compliance with the lighting Standards.

Example 1-11: Kitchens: Track lighting power calculation

Question

If I use track lighting in a kitchen, how do I calculate the power?

Answer

See §130(d) or Section 8.1.6 of this Residential Compliance Manual. For line voltage track, use the maximum relamping wattage of all of the installed luminaires as listed on permanent factory-installed labels, or 45W/lf of track, whichever is larger. If a line-voltage integral current limiter is used, use 12.5W/lf of track, or the volt-ampere rating of the current limiter (if the current limiter is certified to the Commission), whichever is lower.

For low-voltage tracks, use the maximum rated input wattage of the transformer as listed on a permanent factory-installed label.

Example 1-12: Kitchens: Boundary between kitchen and other rooms

Question

Where does the kitchen lighting stop and the other lighting begin in the case of a large family room with the kitchen on just one side of an approximately 24-ft by 24-ft room. Is the kitchen nook part of the kitchen? Lighting over the eating counter? Lighting in an adjacent pantry?

Answer

Lighting over food preparation areas is kitchen lighting, including areas used for cooking, food storage and preparation and washing dishes, including associated countertops and cabinets, refrigerator, stove, oven, and floor areas. Any other lighting on the same switch is also kitchen lighting, whether or not the luminaires are in the kitchen area. Lighting for areas not specifically included in the definition of a kitchen, like the nook or the family room, is not kitchen lighting, as long as it is switched separately.

Example 1-13: Kitchens: Extraction hood lighting

Question

I am installing an extraction hood over my stove, it has lamps within it. Do these lamps have to be high efficacy?

Answer

This lighting is part of an appliance, and therefore does not have to meet the Residential Lighting Standards for permanently installed lighting. This lighting is ignored in determining if half the kitchen lighting is high efficacy.

B. Kitchen Low Efficacy Tradeoff Option

Exception to §150.0(k)8

There is a residential kitchen lighting "tradeoff" option available when additional low efficacy lighting is needed, provided that other conditions are met.

Once it has been determined that the installed low efficacy lighting wattage is no greater than the installed high efficacy wattage, a limited number of additional low efficacy lighting wattage may be installed. The additional low efficacy wattage shown below in Table 1-5 may be installed provided that all lighting in the kitchen (including the high efficacy lighting) is controlled by vacancy sensors or dimmers, or by a lighting control system that provides those functions.

See Section 8.2.1 for requirements to certify lighting controls.

Table 1-5 Additional Low Efficacy Wattage Tradeoff

Size of Individual Dwelling Unit	Additional low efficacy lighting allowed in a residential kitchen
Less than or equal to 2,500 ft²	Up to an additional 50 W
Larger than 2,500 ft²	Up to an additional 100 W

Example 1-14: Kitchens: Additional low-wattage allowances

Question

I am designing kitchen lighting for a 2,400 ft² house. My design exceeds the 50 percent low efficacy lighting ratio in my kitchen. This design includes 208W of high efficacy lighting. I plan to control the high efficacy lighting in the kitchen with a vacancy sensor, and the low efficacy lighting in the kitchen with a dimmer. How many watts of low efficacy lighting can I install in my kitchen?

Answer

You are allowed an additional 50W of low efficacy lighting in the kitchen because the house is less than 2,500 ft². You are also allowed 208W of low efficacy lighting based upon the wattage of high efficacy lighting you are installing.

50W + 208W = 258W.

You are allowed to install up to 258W of low efficacy lighting in the kitchen.

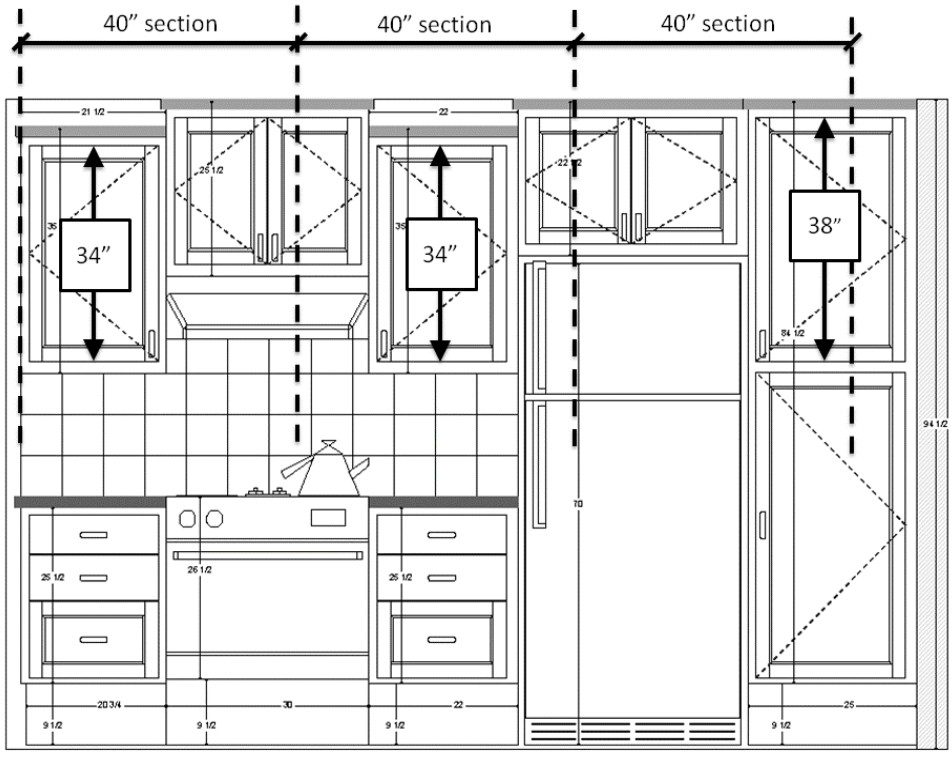
C. Lighting Internal to Cabinets

Lighting internal to cabinets is not considered when determining that at least 50 percent of the permanently installed lighting in a residential kitchen is high efficacy. Permanently installed lighting that is internal to cabinets shall use no more than 20W of power per linear foot of illuminated cabinet. This linear footage can be determined using any one of the following methods, regardless of the number of shelves or cabinet doors:

1. The total horizontal length of illuminated cabinets
2. The sum of the heights of each separate illuminated cabinet section
3. The sum of several height measurements, taken no closer than 40" from each other.

The third method is recommended when illuminating several cabinets that are of different heights. Figure 4 shows that one vertical measurement can be taken per 40" length of illuminated cabinet. If any of the cabinets are not illuminated, they do not count toward the 40" length and should be skipped.

Figure 4: Calculating the Linear Footage of Illuminated Cabinets Using Multiple Vertical Lengths



Lighting that is internal to cabinets is defined as lighting installed inside of a cabinet only for the purpose of the illuminating the inside of the cabinet. Lighting installed for the purpose of illuminating surfaces outside of kitchen cabinet is not considered lighting internal to cabinets. The following lighting systems are not considered lighting internal to cabinets:

1. Lighting recessed into a cabinet for the purpose of illuminating surfaces outside of the cabinet.
2. Lighting attached to any surface on the outside of a cabinet, including the top, bottom, or sides.

3. Lighting attached to the inside of a cabinet, such as reflector lamps, for the purpose of projecting light out of the cabinet.

Example 1-15: Kitchens: Cabinet lighting, number of shelves

Question

I have 23 lf of upper kitchen cabinets, and 32 ft of lower kitchen cabinets. I want to install lighting on the inside of three6ft sections of upper cabinet that are 30" tall, and which have glass doors. The upper cabinets have three shelves. I want to install lights under all three shelves. How many watts of lighting may I install in the cabinets?

Answer

The cabinet lighting allowance is based upon the linear footage of illuminated cabinet only, regardless of the number of shelves in each cabinet. There are three ways to calculate the allowance.

i. Horizontal length, Multiply 18 ft times 20W per foot = 360W.

ii. Number of illuminated sections. There are three separate sections of cabinet, each 30" tall. 3 times 30" = 90", times 20W per foot = 150W.

iii. Height. Height can be measured once per 40" of horizontal length. The total 18' length, divided into 40" sections, gives 5.4 sections. Assuming that the height is uniformly 30", the total height is 5.4 times 30" = 162", times 20W per foot = 270W

Using the largest of the three answers, up to 360W of internal cabinet lighting could be installed.

Example 1-16: Kitchens: Cabinet lighting, non-illuminated cabinets

Question

In the above example, if I have 18 lf of upper cabinets with glass doors, but I only want to install lighting in 10 lf of the cabinets, how many watts of lighting may I install in the cabinets?

Answer

The allowance is based upon the linear feet of cabinet that is illuminated. In this case, multiply 10 ft time 20W/ft = 200W. You are allowed to install up to 200W of internal cabinet lighting.

Example 1-17: Kitchens: Definition of cabinet lighting

Question

In the above example, I am installing puck lights under the shelves of the cabinets with glass doors. Some of the lighting will inadvertently spill through the glass. Is this still considered lighting only for the purpose of illuminating the inside of the cabinets?

Answer

Yes, this is still considered lighting for the purpose of illuminating the inside of the cabinets because the lighting system is specifically designed for illuminating the inside of the cabinets. However, if a different lighting system, such as adjustable flood lights, is designed to project lighting on to surfaces external to the cabinets, that lighting will be considered permanently installed kitchen lighting, and not internal cabinet lighting.

D. Kitchen Lighting Controls

High-efficacy luminaires and low efficacy luminaires are required to be controlled separately. See Section 8.1.12 for additional information on residential lighting controls.

All high efficacy luminaires may be controlled together, and all low efficacy luminaires may be controlled together, but to give occupants more energy-saving options, each lighting layer that serves a unique function should have the ability to operate independently. The following are some recommendations for kitchen lighting controls:

1. Recessed downlights should be controlled separately from other lighting.
2. Linear fluorescent luminaires mounted on the ceiling should be controlled separately from other lighting.
3. Under-cabinet lighting should be controlled separately from other lighting.

Under-cabinet lighting using 14W and 28W T5 linear fluorescent lamps

Source: www.gelighting.com

Figure 1-7 – Kitchen Work Surface Lighting

4. Uplights (mounted on walls or on top of cabinets) should be controlled separately from other lighting. Uplights are effective at making rooms less gloomy, so if an uplight is provided people may choose not to switch on the other lights in the room.

5. Task lighting for specific areas such as sinks or bars should be controlled separately.
6. Lighting in areas adjacent to the kitchen, such as dining and nook areas and even family rooms, is considered to be kitchen lighting if it is not separately switched from the kitchen lighting. The switches may be mounted on the same faceplate, but as long as the lights can be switched independently, these areas do not count as being in the kitchen.

Recessed cans with 18W CFLs light specific task areas

Wall-mounted uplighters using 32W CFLs increase the sense of space

Figure 1-8 – General Kitchen Lighting

E. Kitchen Alterations

The same lighting requirements apply to any kitchen lighting alterations, additions or renovations, as to newly constructed buildings.

The Standards do not recognize the conversion of incandescent luminaires to LED luminaires for newly constructed buildings or additions. However, for some residential lighting alterations, Light Emitting Diode (LED) modules may be hardwired into luminaire housings manufactured for use with incandescent lamps, provided all of the following conditions are met:

1. The luminaire has been previously used and is in its existing installation
2. The LED modules are not LED lamps, integrated or non integrated type, as defined by ANSI/IES RP-16-2010
3. The LED modules comply with all other requirements in §130.0(c)
4. The LED modules are certified as high efficacy to the Commission in accordance with §110.9
5. The LED modules are not connected using screw-based sockets or screw-base adaptors.

Note that GU-24 sockets are not covered by an ANSI standard, and therefore are not classified as either “integrated” or “non-integrated” LED lamps under ANSI/IES RP-16-2010.

Example 1-18: Kitchens: Calculating allowed wattage based on existing luminaires

Question

I am doing minor renovations to my kitchen that has six recessed incandescent cans and I am adding a new luminaire over the sink. Does this luminaire have to be a high efficacy luminaire?

Answer

Yes, all new luminaires must be high efficacy until at least 50 percent of the total lighting wattage comes from high efficacy luminaires (§150.2(b)1 and §150.2(b)2).

Example 1-19: Kitchens: Wattage calculation for a total remodel

Question

I am completely remodeling my kitchen and putting in an entirely new lighting system. How do the Residential Lighting Standards apply to this case?

Answer

All the same lighting Standards apply. This remodel is treated like newly constructed buildings.

8.3.2 Bathrooms

§100.1 definitions, §150.0(k)5

A **bathroom** is a room or area containing a sink used for personal hygiene, toilet, shower, or a tub.

If a sink used for personal hygiene is in a room other than a bathroom, such as bedroom, where no doors, walls, or other partitions separate the sink area from the rest of the room, and the lighting for the sink area is switched separately from room area lighting, only the luminaire(s) that are lighting the sink area must meet the bathroom lighting requirements; in this case, lighting of the sink area includes lighting of associated counters, cabinets, and mirrors.

Each bathroom shall have a minimum of one high efficacy luminaire. All other lighting in bathrooms shall be high efficacy or controlled by vacancy sensors.

More than one circuit of luminaires may be attached to the same vacancy sensor.

Example 1-20: What types of vacancy sensors are eligible?

Question

What types of vacancy sensors qualify for controlling low efficacy lights in bathrooms?

Answer

Eligible vacancy sensors are those which have been certified by the manufacturer to the Energy Commission according to the Title 20 Appliance Efficiency Regulations. These vacancy sensors (manual-on / automatic-off occupancy sensors) do not allow the luminaire to be turned on automatically and do not have an override that allows it to remain on.

See Section 8.2.3 for more information about vacancy sensors.

Example 1-21: Vacancy sensor safety considerations

Question

Is it good lighting practice to have all the lighting in a room controlled by a single vacancy sensor?

Answer

Vacancy sensors may fail to detect people who aren't making large movements, and their sensitivity is reduced in hot environments. Vacancy sensors may cause the lights to switch off while someone is using a hazardous device. The required high efficacy luminaire in each bathroom, and any additional high efficacy luminaires in a bathroom are not required to be controlled by a vacancy sensor.

Example 1-22: Bathrooms: Medicine cabinet lighting

Question

Is the factory installed lighting system in a bathroom mounted medicine cabinet required to be either high-efficacy or controlled by a vacancy sensor?

Answer

If the factory installed lighting in a medicine cabinet is designed to only illuminate the inside of the medicine cabinet, and the lighting is controlled only by a door activated switch where the lights turn off automatically when the cabinet door is closed, then the factory installed lighting is not regulated by the Residential Lighting Standards. However, if the factory installed lighting is connected to a manually operated switch that can be turned on regardless of the position of the cabinet door, or the lighting is designed to illuminate or display the contents of the cabinet when the door is closed, then it is considered permanently installed lighting that must comply with the Residential Lighting Standards. Also, any factory installed "bath bar" or other general lighting system integrated into the medicine cabinet is considered permanently installed lighting that must comply with the Residential Lighting Standards.

8.3.3 Garages, Laundry Rooms, and Utility Rooms

§150.0(k)6

Lighting in garages (attached and detached), laundry rooms, and utility rooms shall be high efficacy, and shall be controlled by a vacancy sensor. See Section 8.1.12 for information on residential lighting controls.

8.3.4 Garage

§101 definitions

A **garage**, for compliance with the Residential Lighting Standards, is a non-habitable building or portion of building, attached to or detached from a residential dwelling unit, in which motor vehicles are parked.

Garages present an opportunity to reduce energy use by providing task lighting. The end of the garage furthest from the door to the house is often used as a work area, and can be provided with high efficacy luminaires switched separately from the rest of the space.

Because people may be working in garages for long periods, and may be obscured by cars or other large objects, ultrasonic or dual-technology vacancy sensors may be preferred to standard passive infra-red vacancy sensors. Ultrasonic sensors can "see around corners" unlike infra-red sensors which are line-of-sight.

See Section 8.1.8 for information about when lighting integral to garage door openers does and does not have to be included as permanently installed lighting in a garage.

8.3.5 Laundry Room

§101 definitions

A **laundry room** is a non-habitable room or space which contains plumbing and electrical connections for a washing machine or clothes dryer.

8.3.6

8.3.7 Utility Room

§101 definitions

A **utility room** is a non-habitable room or building which contains only HVAC, plumbing, or electrical controls or equipment; and which is not a bathroom, closet, garage, or laundry room.

Example 1-23: Vacancy sensor safety considerations

Question

Is it good lighting practice to have all the lighting in a room controlled by a single vacancy sensor?

Answer

Vacancy sensors may fail to detect people who aren't making large movements, and the sensitivity of passive infra-red vacancy sensors is reduced in hot environments. Also, passive infra-red sensors cannot "see around corners" like ultrasonic or microwave sensors can. In spaces in which someone may be using a hazardous device (such as garages) dual-technology sensors reduce the likelihood that the lights will switch off while the room is occupied. Alternatively, sensors which dim the lights before switching them off provide an additional level of security.

Example 1-24: Laundry rooms: built-in lighting for ironing boards

Question

Is the factory installed lighting in a built-in ironing board device required to be high-efficacy and controlled by a **vacancy sensor when it is installed in a laundry room?**

Answer

Yes, if the lighting is permanently installed it must be high-efficacy and controlled by a vacancy sensor. See Section 8.1.8 for additional information about permanently installed luminaires.

8.3.8 Other Rooms

§150.0(k)7

Permanently installed lighting in other rooms has three compliance options. The lighting shall be high efficacy, controlled by a vacancy sensor, or controlled by a dimmer. See Section 8.1.12 for lighting control requirements.

"Other rooms" include any room or area that is not a kitchen, bathroom laundry, garage, or utility room. Other rooms include hallways, dining rooms, family rooms, club house, home office, bedrooms, and closets. These tend to be the rooms in which people are most aware of interior design both in terms of fashion and the usability of their living space. See Section 8.3 for a definition of a kitchen, and Section 8.3.2 for definitions of bathroom, laundry, garage, and utility room.

There are rooms in many houses for which permanently installed lighting has not been provided. Instead, these rooms are often provided with switched receptacles, sometimes called, "half-hots." Many people commonly add their own portable lighting. Unfortunately, portable lighting often means highly inefficient incandescent floor-standing luminaires that can consume 190W or more for older lamps.

Permanently installed lighting should reduce the need for such high wattage portable sources by creating variations of light throughout the room, and by reducing areas of shadow. To achieve this, use several luminaires rather than a single luminaire; wall-mounted uplights are a good choice because they are design-neutral and can be repainted. For high-end properties, linear fluorescent or LED cove lighting and other forms of concealed lighting may increase marketability.

People like to control the appearance of their rooms; providing separate switches for each luminaire will make the space more attractive to tenants and will allow them to reduce their energy use.

Although vacancy sensors can be used in living spaces, there are limitations in those living spaces where people are expected to sit still for long periods of

time and not move around enough to keep the sensor activated, resulting in lights going off prematurely.

Exception 2 to §150.0(k)7

Lighting in detached storage buildings less than 1000 ft², when those storage buildings are located on a residential site, are not required to comply with §150.0(k)11.

8.3.9 Closets

§101 definitions

A **closet** is a non-habitable room used for the storage of linens, household supplies, clothing, non-perishable food, or similar uses, and which is not a hallway or passageway.

Exception 2 to §150.0(k)10

Closets less than 70 ft² are exempt from these requirements. However, a hallway having storage shelves, such as a butler's cupboard, shall not be exempt because it is considered a hallway for compliance with the Residential Lighting Standards.

Example 1-25: Ceiling fans with integrated lighting

Question

Can a ceiling fan with integrated lighting be a high efficacy luminaire?

Answer

Yes. Ceiling fan light kits with integral CFL ballasts are available. Some LED lighting may qualify as high efficacy. LED lighting must be certified to the Energy Commission before it can be classified as high efficacy. See Section 1.1.1 for more information about requirements for residential LED lighting.

Some occupants are likely to prefer obscured lamps to visible lamps. A less efficient alternative, when the ceiling fan is installed in a room other than a kitchen, bathroom, garage, laundry room and/or utility room, is to use incandescent lamps on a dimming circuit separate to the fan circuit.

Example 1-26: Best practice for high efficacy spotlights

Question

Are high-efficacy spotlights available, to replace halogen MR16s?

Answer

Some CFLs resemble spotlights, and manufacturers may describe them as spotlights, but they produce the same diffuse light as regular CFLs. Metal halide spotlights with 35W T-6 high efficacy lamps are available, and LEDs can be used as spotlights. LED lighting must be certified to the Energy Commission before it can be classified as high efficacy. See Section 1.1.1 for more information about requirements for residential LED lighting.

8.3.10 Outdoor Lighting

§150.0(k)9

Outdoor residential lighting is sometimes subject to the residential requirements, and sometimes subject to the non-residential requirements. **Error! Not a valid bookmark self-reference.** shows which requirements apply to various types of outdoor lighting for each building type.

Figure 5: Applicability of Standards to Outdoor Lighting in Different Residential Building Types

<table>
<tr><th rowspan="2">Space type</th><th rowspan="2">Single-family</th><th colspan="2">Low-rise multifamily</th><th rowspan="2">High-rise multifamily and hotels</th></tr>
<tr><th>1-3 dwelling units</th><th>4 or more dwelling units</th></tr>
<tr><td>Private patios, entrances, balconies, porches; parking lots carports with fewer than eight vehicles per site</td><td>Residential</td><td colspan="2">Residential or non-residential</td><td rowspan="3">Residential, if the lighting is separately controlled from the inside of a dwelling unit or guest room.
Otherwise, non-residential</td></tr>
<tr><td>Residential parking garages[1], lots and carports with more than eight vehicles per site</td><td colspan="3">Non-residential</td></tr>
<tr><td>Other outdoor lighting attached to the building</td><td colspan="2">Residential</td><td>Non-residential</td></tr>
<tr><td>Outdoor lighting not attached to a building</td><td colspan="2">Not regulated</td><td colspan="2">Non-residential</td></tr>
</table>

1. Residential parking garages with seven or fewer vehicles are covered by the indoor residential lighting requirements.

"Residential" means that the lighting shall comply with §150.0(k)9A

"Non-residential" means that the lighting shall comply with Sections110.9, 130.0, 130.2, 130.4, 140.7, and 141.0

A. Single-Family Buildings

All lighting attached to the residence or to other buildings on the same lot must be high efficacy, or controlled by a motion sensor and either a photocell or an astronomical time clock.

Lighting must be controlled by a manual on/off switch that does not override any automatic sensor to the "on" mode.

Motion sensors may have a temporary override function that keeps the luminaire switched on irrespective of whether motion is detected, but the sensor must default back to automatic operation after no longer than six hours.

An Energy Management Control System (EMCS) may be used if it complies with all these requirements.

Standalone lighting control devices shall be certified to the Energy Commission in accordance with the Title 20 Appliance Standards. Lighting control systems shall meet all the applicable requirements of §110.9.

B. Low-Rise Multifamily Buildings

Low-rise multifamily buildings are subject to the same outdoor lighting requirements as single-family buildings, with the exception that outdoor lighting in the following areas is allowed to comply with *either* the single-family requirements or the nonresidential requirements:

- Private patios
- Entrances
- Balconies
- Porches
- Residential parking lots and carports with fewer than eight vehicles

Residential parking lots and carports with eight or more vehicles must meet the nonresidential outdoor lighting requirements.

C. High-Rise Multifamily buildings

Any outdoor lighting attached to the building, and that is controlled from within the dwelling unit, shall meet the residential requirements. Outdoor lighting attached to the building that is not controlled from within the dwelling unit shall meet the nonresidential requirements. For information on the nonresidential requirements, see the Nonresidential Compliance Manual.

D. Address Signs

§150.0(k)10

Internally illuminated address signs shall:

1. Comply with the nonresidential sign lighting Standards in §140.8, or
2. Consume no more than 5 watts of power as determined according to §130.0(c).

E. Other Signs

For high-rise residential buildings and hotels, signs that are not inside the dwelling units or guest rooms shall comply with the applicable nonresidential Sign Lighting requirements in §130.3 and §140.8.

F. Hot and Cold Environments

Amalgam CFLs perform better at both very high and very low temperatures than non-amalgam versions, so are appropriate for outdoor lighting, although they can take a few minutes to reach full output. CFLs and ballasts that are not labeled “instant start” are likely to be amalgam lamps. If instant start is important and temperatures may be low, specify a cold-weather-rated ballast. Alternatively, an LED luminaire may be a good choice.

G. Outdoor Lighting not Attached to a Building

§150.0(k)13

Lighting that is not permanently attached to single family and low-rise multifamily buildings with fewer than four dwelling units, such as decorative landscape lighting, is not regulated by the Residential Lighting Standards. However, when landscape lighting is attached to a building, it is regulated by the Residential Lighting Standards.

For exempt lighting, using a time clock or photocontrol on outdoor lighting not attached to buildings will help to prevent people from accidentally leaving these lights on during the day and will reduce energy use.

Example 1-27: Outdoor lighting: Glare control

Question

Are there any "cutoff" requirements for residential outdoor luminaires?

Answer

There are no "cutoff" requirements for typical residential outdoor lighting. However, residential parking lots for eight or more vehicles are required to meet the Nonresidential Standards, which do include cutoff requirements for luminaries greater than 150W. The requirement uses the Backlight, Uplight and Glare (BUG) ratings developed by the IES to define acceptable amounts of the uplight and glare (there are no limits on "backlight"). Even though not required for most residential outdoor lighting, luminaires that limit uplight are usually more efficient at providing light in the required area, so a lower wattage lamp and ballast can be used. The BUG requirements also reduce stray light and glare problems which can cause visual discomfort.

Example 1-28: Outdoor lighting: Landscape lighting

Question

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

Answer

No. The high efficacy requirement only applies to lighting mounted to the building.

Example 1-29: Outdoor lighting: Patios

Question

Does outdoor lighting on the patio of a high-rise residential building have to comply with the Residential or Nonresidential Lighting Standards?

Answer

If the patio outdoor lighting is controlled from inside of the dwelling unit, it must comply with the Residential Outdoor Lighting Standards. If the patio outdoor lighting is controlled outside of the dwelling unit, it must comply with the Nonresidential Outdoor Lighting Standards. For example, if the outdoor patio lighting is controlled by a building-wide EMCS outside of the dwelling units, it must comply with the Nonresidential Outdoor Lighting Standards.

.0150.0(k)

8.3.11 Residential Parking Lots, Carports and Parking Garages

§150.0(k)13
§130, §131, §132, §134
§146, §147
§150.0(k)15

Residential parking garages are treated as indoor spaces, whereas residential parking lots and carports are treated as outdoor space. All three types of parking facilities are required to meet either the residential or the nonresidential requirements of the Standards, depending on what type of building they are associated with, as demonstrated in Figure 6.

Figure 6: Applicability of Standards to Parking Facilities in Different Residential Building Types

<table>
<tr><th rowspan="2">Space type</th><th rowspan="2">Number of car spaces</th><th rowspan="2">Single-family</th><th colspan="2">Low-rise multifamily</th><th rowspan="2">High-rise multifamily and hotels</th></tr>
<tr><th>Common area is 20% or less of interior space</th><th>Common area is >20% of interior space</th></tr>
<tr><td rowspan="2">Parking garages</td><td><8</td><td colspan="2">Residential indoor</td><td colspan="2">Nonresidential indoor</td></tr>
<tr><td>8 or more</td><td colspan="4">Nonresidential indoor</td></tr>
<tr><td rowspan="2">Parking lots and carports</td><td><8</td><td>Residential outdoor</td><td colspan="2">Residential outdoor, or nonresidential outdoor</td><td>Nonresidential outdoor</td></tr>
<tr><td>8 or more</td><td colspan="4">Nonresidential outdoor</td></tr>
</table>

“Residential indoor” means that the lighting shall comply with §150.0(k)7 (see Section 8.3.4).

“Residential outdoor” means that the lighting shall comply with §150.0(k)9 (see Section 8.3.10).

“Non-residential” indoor means that the lighting shall comply with Sections 110.9, 130.0, 130.1, 130.4, 140.6, and 141.0

“Non-residential” outdoor means that the lighting shall comply with Sections 110.9, 130.0, 130.2, 130.4, 140.7, and 141.0

Residential parking lots should be lighted uniformly to provide a sense of safety; this means that lighting should fill in shadows and dark corners. Two or more less powerful luminaires in different places are often preferable to a single luminaire.

The Nonresidential Outdoor Lighting Standards include the following requirements for parking lots and car ports that accommodate a total of eight or more vehicles per site:

1. Incandescent luminaires rated for lamps over 100W shall be controlled by a motion sensor. Outdoor luminaires with lamps rated over 150W must comply with the Backlight, Uplight, and Glare (BUG) requirements in §130.2 as established by the IES.
2. Luminaires shall be controlled by a photocontrol, or an astronomical time switch that turns the lighting off when daylight is available.

See the following sections for a complete view of the Nonresidential Outdoor Lighting Standards: §130.0, §130.2, §130.4, and §140.7.

Example 1-30: Parking spaces

Question

I have a low-rise multi-family complex with a total of 20 parking spaces. However, the parking spaces are arranged throughout the site in groups of only 4 spaces each. Are these parking spaces required to comply with the nonresidential outdoor lighting requirements?

Answer

Yes, these spaces are required to comply with the Nonresidential Outdoor Lighting Standards. Parking lots and carports for a total of eight or more cars per site must meet the nonresidential outdoor lighting requirements.

8.3.12 Common Areas of Multi-family Buildings

§150.0(k)1612

Common areas in multi-family buildings include areas like interior hallways, lobbies, entertainment rooms, pool houses, club houses, and laundry facilities.

In low-rise multi-family buildings with four or more dwelling units where common areas are 20% or less of the building area, lighting for common areas must be high efficacy, or controlled by an occupant sensor. Occupant sensors used in common areas may have the capability of turning the lights on automatically.

In buildings where common areas are more than 20% of the building area, lighting in those common areas must comply with the nonresidential lighting requirements in Sections 110.9, 130.0, 130.1, 140.6, and 141.0. In addition, lighting in corridors and stairwells must be controlled by occupant sensors that reduce the lighting by at least 50 percent.

Buildings of three stories or fewer are classified as low-rise. For buildings higher than three stories the Nonresidential Standards apply to all of the common areas.

The quality of light provided in common areas of apartments, condominiums, and townhouses should be particularly high, because older or visually impaired residents must be able to find their way safely through spaces that may contain unexpected obstacles. Providing a sufficient level of light is essential.

The lighting of staircases and stairwells is a particular safety concern; the best way to light stairs is with directional light from above, to maximize the contrast between treads and risers. CFL luminaires with reflectors provide this type of light with great efficiency.

Example 1-31: Multifamily common areas: Low rise

Question

Does the lighting for an interior common-area hallway of a low-rise residential building with four or fewer dwelling units have to comply with the Residential or Nonresidential Lighting Standards?

Answer

No, the lighting of an interior common-area hallway of a low-rise residential building with four or less dwelling units must comply with the Residential Lighting Standards.

Example 1-32: Multifamily common areas: High rise

Question

Does the lighting for an interior common-area hallway of a high rise residential building have to comply with the Residential or Nonresidential Lighting Standards?

Answer

The lighting of an interior common-area hallway of a high rise residential building must comply with the Nonresidential Lighting Standards. All the lighting in common areas must comply with the Nonresidential Standards; lighting inside the dwelling units must comply with the Residential Lighting Standards.

Hallways and stairwells are required to have partial on/off occupancy sensors that switch off at least half the lighting load when the hallway or stairwell is unoccupied.

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Residential Alterations