

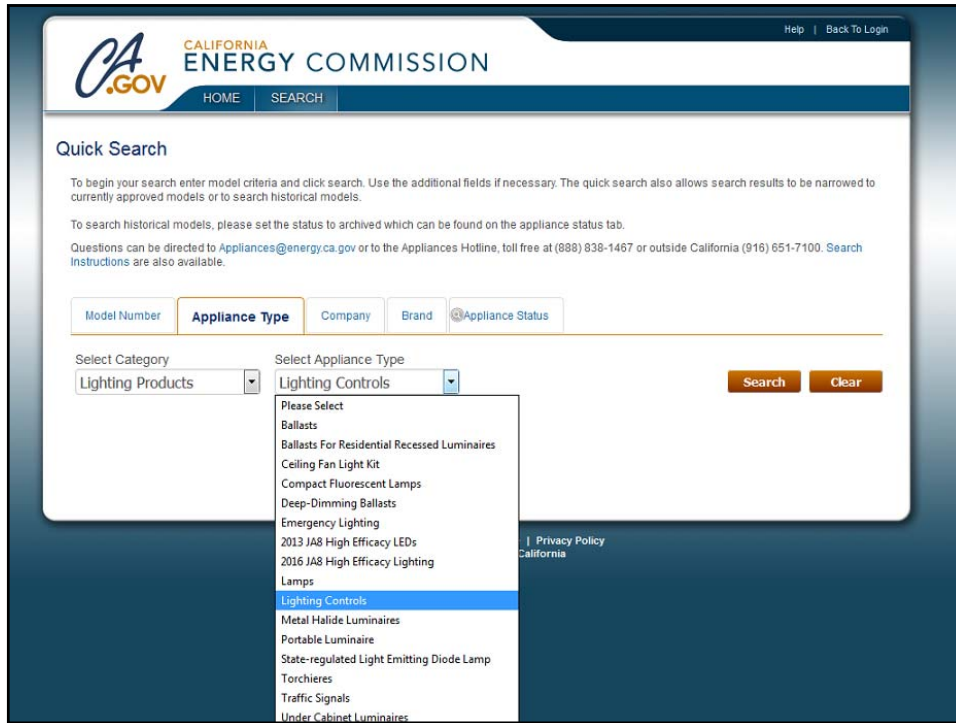
# MANDATORY MEASURES

## INDOOR LIGHTING CONTROLS

(Reference: Sub-Chapter 4, Section 130.1)

### MANDATORY LIGHTING CONTROLS

1. **130.1 (a) Area Controls:** Manual controls that control lighting in each area separately
2. **130.1 (b) Multi-level Controls:** “Dimmability.” Allow occupants to choose the appropriate light level for each area
3. **130.1 (c) Shut-off Controls:** Automatically shut off lighting or reduce light levels when illumination is not needed
4. **130.1 (d) Automatic Daylighting Controls:** Adjust electric lighting in response to the presence of daylight
5. **130.1 (e) Automated Demand Response:** Receive and *automatically* respond to demand response (DR) signals



## MANUAL ON/OFF CONTROLS

*An “area” is a space enclosed by ceiling-height partitions.*

All lighting in each **area** must be controlled separately from luminaires in other areas by manual on/off lighting controls that are:

1. Readily accessible
2. Located in the same room or area as the lighting they control and with the lighting in view
3. Able to provide any required dimming or multi-level controls steps in addition to on/off
4. General lighting is separately controlled from all other lighting systems in same area
5. Track, display, ornamental, and special effect lighting systems are controlled separately

### SEPARATELY CONTROLLED LIGHTING SYSTEMS

General lighting must be controlled separately from all other lighting systems in an area.

Display lighting must each be separately controlled on circuits of 20 amps or less. For example, window displays must be controlled separately from wall displays, which must also be controlled separately from case displays.

**When using track lighting:**

General, display, ornamental, and special effects lighting must be separately controlled.



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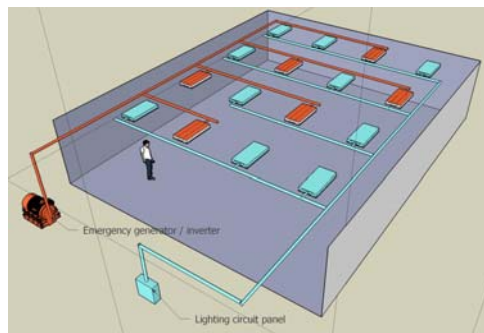
MANDATORY MEASURES

### EGRESS LIGHTING

Up to 0.2 watts per square foot of lighting may remain on **during occupied hours only** for emergency egress. This lighting must be designated for emergency egress on building plans.

Unoccupied times:

- 0.1 w/ft<sup>2</sup> lighting OFF
- 0.1 w/ft<sup>2</sup> lighting ON



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**EXCEPTIONS**

May use a manual control that is NOT accessible to general public for the following spaces:

- Public restrooms with more than 2 stalls
- Parking areas
- Stairwells and corridors

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**MULTI-LEVEL LIGHTING CONTROLS**

Title 24 sets a minimum number of control steps and illuminance uniformity requirements for most major luminaire types (see **TABLE 130.1-A**).

These requirements are required *in addition to* any mandatory manual, daylight, shut-off, or demand response controls.

Dimmable luminaires shall be controlled by a dimmer control that is capable of achieving the required multi-level steps and ON/OFF functionality.

The criteria in 130.1 (b) applies to **general lighting** for enclosed areas that:

- Are at least 100 ft<sup>2</sup> in size
- Have a connected lighting load over 0.5 W/ft<sup>2</sup>
- Have more than one luminaire or more than two lamps
- Controlled lighting in daylit zones over 0.3 W/ft<sup>2</sup>

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**TABLE 130.1-A**

**Multi-level Lighting Controls and Uniformity Requirements for General Lighting**

Luminaire Type	Minimum Required Control Steps (percent of full rated power <sup>1</sup> )	Uniform Level of Illuminance Achieved By:
Line-voltage sockets except GU-24		
Low-voltage incandescent systems		Continuous dimming 10–100 percent
LED luminaires & LED source systems		
GU-24 rated for LED		
GU-24 sockets rated for fluorescent >20 W		Continuous dimming 20–100%
Pin-based compact fluorescent >20 W <sup>2</sup>		
GU-24 sockets rated for fluorescent ≤20 W		
Pin-based compact fluorescent ≤20 W <sup>2</sup>	Minimum one step between 30–70 percent	Stepped dimming; or continuous dimming; or switching alternate lamps in a luminaire.
Linear & U-bent fluorescent ≤13 W		

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**TABLE 130.1-A, CONTINUED**

Luminaire Type	Minimum Required Control Steps (percent of full rated power <sup>1</sup> )	Uniform Level of Illuminance Achieved By:
	Minimum one step in each range	
Linear & U-bent fluorescent >13 W	20–40 percent 50–70 percent 75–85 percent 100 percent	Stepped dimming; or continuous dimming; or switching alternate lamps in each luminaire, having a minimum of four lamps per luminaire, illuminating the same area and in the same manner.
Track Lighting	Minimum one step between 30–70 percent	Stepped dimming; or continuous dimming; or separately switching circuits in a multi-circuit track with a minimum of two circuits.
HID >20 W		Stepped dimming; or continuous dimming; or switching alternate lamps in each luminaire, having a minimum of two lamps per luminaire, illuminating the same area and in the same manner.
Induction >25 W	Minimum one step between 50–70 percent	
Other light sources		

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### AUTOMATIC SHUT-OFF CONTROLS

**Automatic shut-off controls turn lights off when a space is unoccupied. All lighting must be controlled by one or more of the following:**

1. Occupant sensing control
2. Automatic time-switch
3. Building Energy Management System
4. Other control mechanism capable of automatically shutting off all lights for vacant periods

**A single control may not monitor more than 5,000 ft<sup>2</sup>**



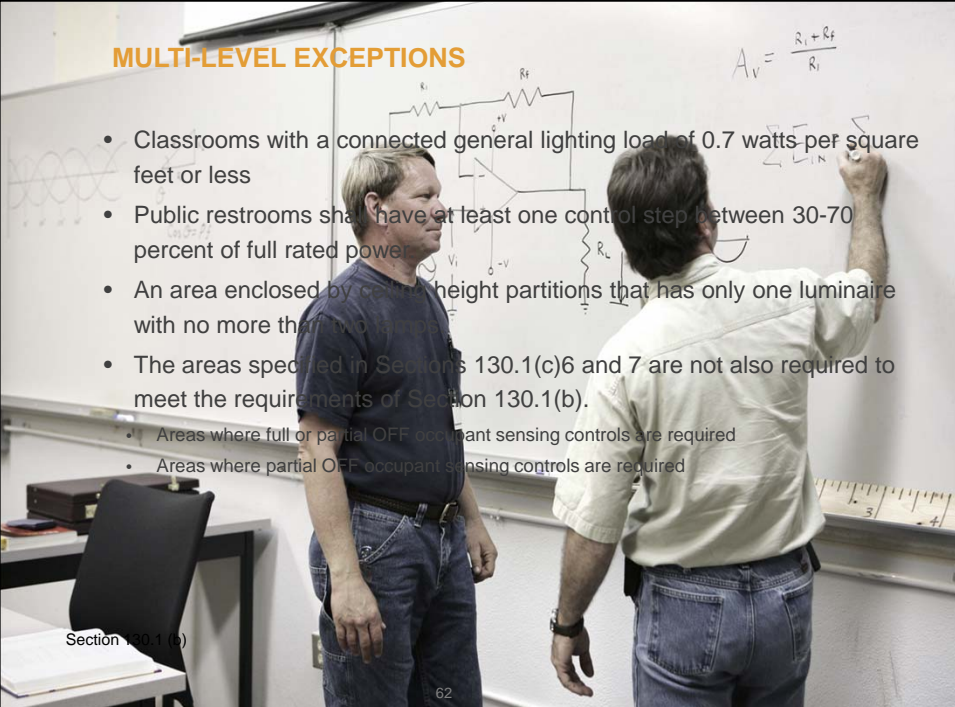



Photo: Lutron

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### MULTI-LEVEL EXCEPTIONS

- Classrooms with a connected general lighting load of 0.7 watts per square feet or less
- Public restrooms shall have at least one control step between 30-70 percent of full rated power
- An area enclosed by ceiling height partitions that has only one luminaire with no more than 100 sq ft
- The areas specified in Sections 130.1(c)6 and 7 are not also required to meet the requirements of Section 130.1(b).
  - Areas where full or partial OFF occupant sensing controls are required
  - Areas where partial OFF occupant sensing controls are required



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## SHUT-OFF CONTROLS

Automatic shut-off controls turn lights off when a space is unoccupied. All lighting must be controlled by one or more of the following:

1. Occupant sensing control
2. Automatic time-switch control
3. Building Energy Management System
4. Other control mechanism capable of automatically shutting off all lights for vacant periods



Photo: Lutron



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## SHUT-OFF CONTROLS

### Space parameters

Each room needs to be separately controlled. A single control may not monitor more than 5,000 square feet of floor area (20,000 square feet in malls and single-tenant retail spaces).

### Applications

The following types of lighting must be separately controlled:

1. General
2. Display
3. Ornamental
4. Display case

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**SHUT-OFF CONTROLS**

In the following spaces, 100% shut-off controls MUST be occupancy sensing:

1. Offices 250 ft<sup>2</sup> or smaller
2. Multipurpose rooms smaller than 1,000 ft<sup>2</sup>
3. Conference rooms of any size
4. Classrooms of any size

When multi-level controls are required:

- Partial-on occupancy or vacancy sensors shall be used

When multi-level controls *are not* required:

- Lighting is turned 100% off with occupancy controls

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**SHUT-OFF CONTROLS**

Countdown timer switches may only be used in:

1. Single-stall bathrooms smaller than 70 ft<sup>2</sup>  
(Max timeout 10 minutes)
2. Closets smaller than 70 ft<sup>2</sup>  
(Max timeout 10 minutes)
3. Aisles in server rooms smaller than 500 ft<sup>2</sup>  
(Max timeout 30 minutes)

If time-based controls are used, occupants there after hours must be able to activate lighting as needed:

- Manual switch
- Temporary override
- Occupancy-based control



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### SHUT-OFF CONTROLS

**Adaptive controls in secondary spaces**

- Stairwells/corridors,
- Aisleways and open areas in warehouses, and
- Library book stacks 10 feet or longer

Controls must be capable of:

- Partially reducing lighting power during hours of operation *by at least 50%* when vacant
- Providing 100% of light when someone is detected in the space



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### PARKING GARAGES

Parking garages are considered **interior** nonresidential spaces, except for the top level of each multi-tier garage.

- General lighting must have occupant sensing controls with at least one control step between 20% and 50% of design lighting power
- No more than 500 watts of rated lighting power may be controlled together





Photo: Lithonia Lighting

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### MIXED-USE BUILDINGS

For mixed-use buildings (e.g. high-rise residential, hotels, and motels) with a **total interior common area that is greater than 20 percent of the floor area of that building**, the common areas must comply with the **Nonresidential** Lighting Standards, while dwelling units must comply with the **Residential** Lighting Standards.



Photo: UC Davis

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### CASE STUDY: ADAPTIVE CORRIDOR LIGHTING

#### Latham Square (Oakland, CA)

- In January 2012, CLTC installed adaptive (bi-level) lighting controls on 12 floors of the Latham Square office building
- 174 Luminaires retrofitted with 64W T8 fluorescents
- **Average energy savings: 86%**



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### AUTOMATIC SHUT-OFF CONTROLS

**Spaces that are exempt from automatic shut-off controls requirements:**

1. Buildings with lighting in continuous use 24 hours/day, 365 days/year
2. Areas where partial on/off controls are required instead of shut-off controls (such as stairwells and corridors)
3. Electrical equipment rooms
4. Emergency egress lighting



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### AUTOMATIC DAYLIGHTING CONTROLS

Automatic daylight controls adjust electric lighting power when ample daylight is available. "Ample daylight" is defined by the standards as 150% of the designed light level for electric lighting.



Photo: CLTC

**Automatic daylighting controls are required for luminaires that:**

1. Provide general lighting
2. Are at least half in a skylit or sidelit area
3. Are in an area where the total installed general lighting power is at least 120 watts
4. Are located in an area which has at least 24 ft<sup>2</sup> of glazing



Photo: Lutron

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## AUTOMATIC DAYLIGHTING CONTROLS

### Automatic daylighting controls requirements:

1. Controlled lighting with an **LPD greater than 0.3 W/ft<sup>2</sup>** must have multi-level lighting in accordance with Table 130.1-A.
2. Controlled lighting + daylight **must equal or exceed** the controlled electric lighting level without daylight.
3. When there is ample daylight detected, the general lighting power in that space **must be reduced by at least 65%**.

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## DAYLIGHT CONTROLS IN PARKING GARAGES

- Parking garage areas with at least 36 ft<sup>2</sup> of glazing or opening must have automatic daylighting controls
- Controlled lighting can be multilevel, continuous dimming or ON/OFF.
- When primary sidelit zones receive illuminance levels greater than 150% of the illuminance provided by the controlled lighting when no daylight is available, lighting is off.

### Luminaires in the following areas do not need to use photocontrols:

- **Daylight transition zone:** The pathway vehicles use to enter a parking garage.
- **Dedicated ramps:** Driveways specifically meant to move vehicles between the floors of a parking garage and which have no adjacent parking.
- **Some sidelit zones:** Daylighting controls are not required if the total combined general lighting power in the primary sidelit daylight zones is less than 60 watts.

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OUTDOOR LIGHTING

### DEMAND RESPONSE

When the demand for electricity threatens to exceed supply, the power grid becomes less stable and the risk of outages increases.

Demand response (DR) programs allow end users to **temporarily** reduce their electricity use in response to a notice or automated signal sent from a utility, independent system operator (ISO) or other power provider.

This flexibility helps reduce peak demand and maintain grid stability. Currently, participating customers also receive financial incentives.

Image: Lutron

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### DEMAND RESPONSE

**Lighting is extremely well-suited to DR**

1. Peak demand periods typically overlap daylight hours
2. Research indicates illuminance levels can be reduced by as much as 20% without occupants detecting the change
3. Light levels can be immediately restored when DR events end

**Buildings larger than 10,000 ft<sup>2</sup>** must be capable of responding to a DR signal by automatically reducing lighting power **at least 15%** below the total installed lighting power while maintaining the uniformity requirements listed in Table 130.1-A.

Spaces that use less than 0.5 W/ft<sup>2</sup> are exempt and cannot be counted toward ADR compliance.

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### CHECK YOUR UNDERSTANDING: DEMAND RESPONSE

An 80,000 ft<sup>2</sup> building is being constructed. It will contain 10 tenant spaces, each 8,000 ft<sup>2</sup> in size. Do these tenant spaces need to comply with the requirements for automatic demand response?



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### SUMMARY OF MANDATORY LIGHTING CONTROLS

**DISCUSSION:** What types of controls will retail spaces typically require?

1. **Manual switches** (What needs to be switched separately?)
2. **Automatic shut-off controls** (Where are they required?)
3. **Automatic daylighting controls** (Which lighting systems must comply?)
4. **ADR** (How large does a building need to be?)



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