# Impact of New 2013 Lighting Title-24 on Architects
## AIA OC- December 10th 2013

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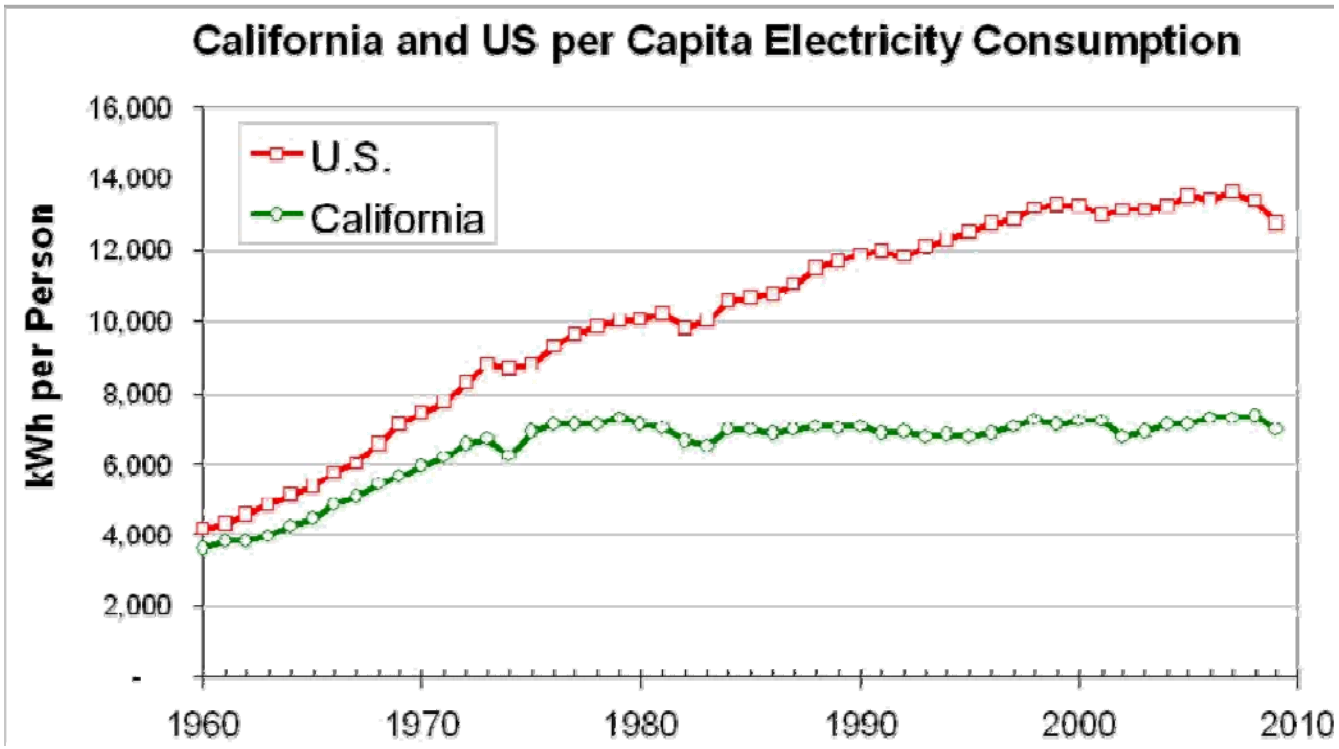
- Review the Mandatory Lighting Control requirements *(§130.0 - .5)*
- Provide an overview of changes in the Interior and Exterior Lighting Power requirements *(§140.6 - .7)*
- Review other key changes to the non-residential section of the Code
- Review Residential Lighting Requirements *(§150.0)*




- **Achieve big step towards Zero Net Energy policy goals**

  15 – 25% improvement in Standards

- **Include CEC Approved Reach Standards**

  Propose for Energy Chapter of T24, Part 11

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# Building Energy Efficiency Program

## CURRENT: 2008 Building Energy Efficiency Standards

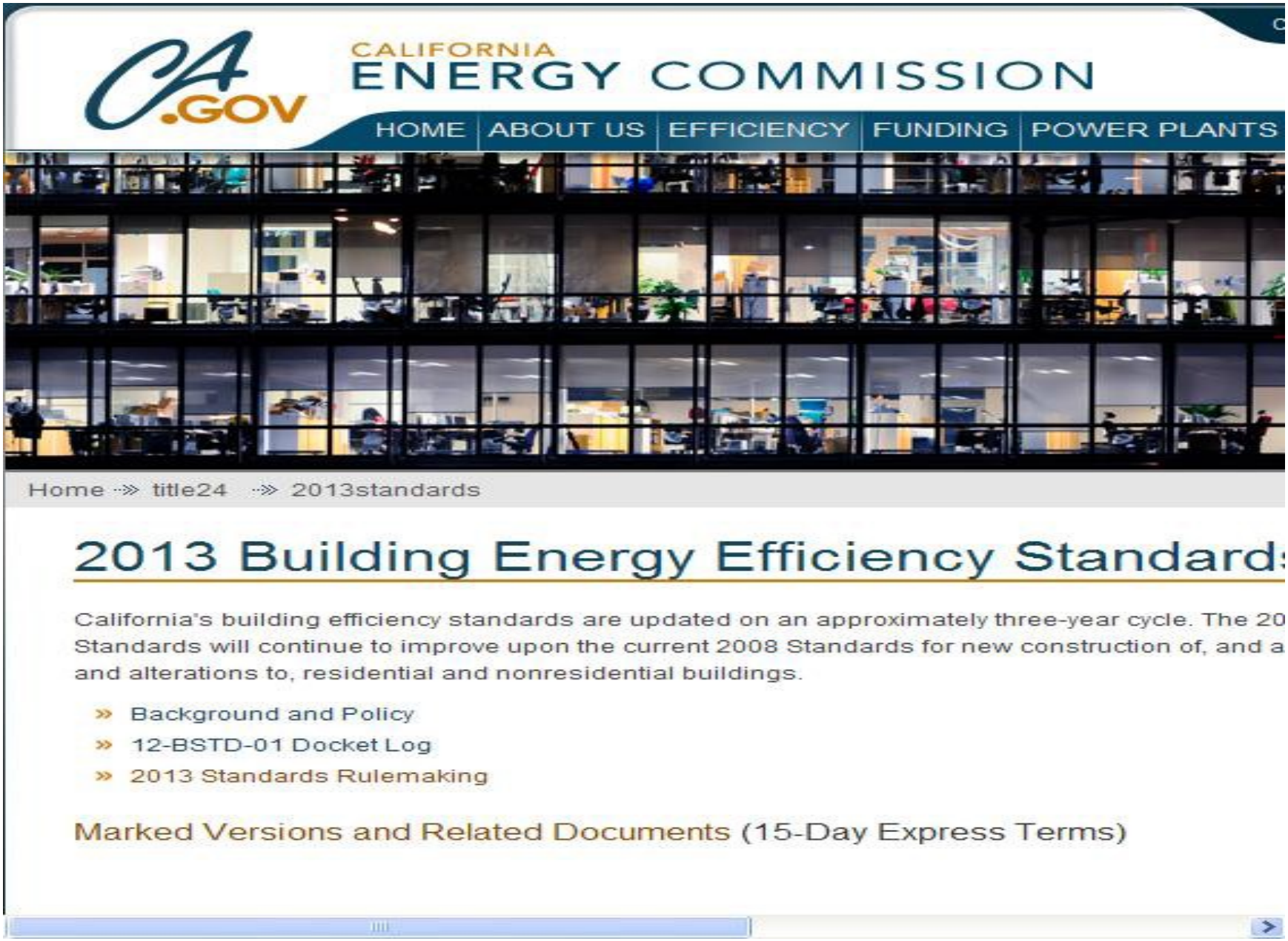
- Home Page
- Standards (PDF file)
- Residential Compliance Manual
- Nonresidential Compliance Manual
- California Climate Zone Map
- HVAC Changeout

## UPCOMING: 2013 Building Energy Efficiency Standards

- Home Page
- Rulemaking
- Pre-Rulemaking

## Go To

- Energy Efficie
- Energy Educat
- Online Learning
- Climate Zone F
- Computer Com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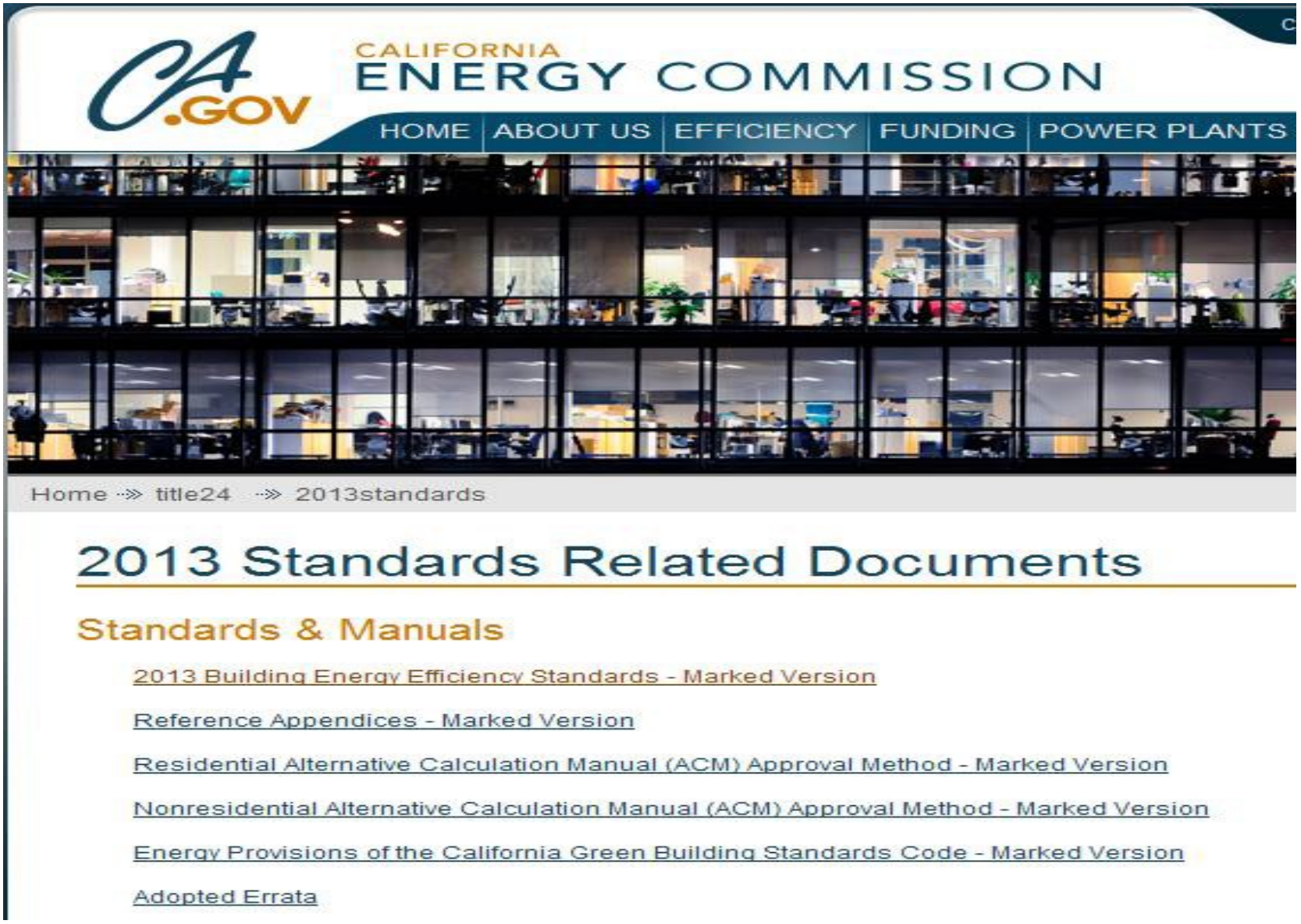
2013 Building Energy Efficiency Standard
California's building efficiency standards are updated on an approximately three-year cycle. The 20
Standards will continue to improve upon the current 2008 Standards for new construction of, and a
and alterations to, residential and nonresidential buildings.
» Background and Policy
» 12-BSTD-01 Docket Log
» 2013 Standards Rulemaking
Marked Versions and Related Documents (15-Day Express Terms)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Standards & Manuals
2013 Building Energy Efficiency Standards - Marked Version
Reference Appendices - Marked Version
Residential Alternative Calculation Manual (ACM) Approval Method - Marked Version
Nonresidential Alternative Calculation Manual (ACM) Approval Method - Marked Version
Energy Provisions of the California Green Building Standards Code - Marked Version
Adopted Errata

## Definitions: §100.1: Definitions

| | |
|---|---|
| **Shall** | *mandatory,* |
| **May** | *permissive* |
| **Lighting** | *Includes definitions for all types- Permanently Installed, Portable* |
| **Lighting Controls** | *Occupancy Sensing Controls: Motion Detectors, Partial On, Partial Off, Vacancy* |
| **Nonresidential Building Occupancy Types** | *Classroom, Office, Parking Garage Building…* |
| **Outdoor Areas** | *Canopy, Hardscape, ~~Lantern, Pendant~~…* |
| **Occupant Sensors** | *turn off lights in an indoor lighting system after an area is empty of people. When used to control outdoor lighting systems, called a* ***motion sensor****.* |
| **Vacancy Sensor** | *are OS where the lights must manually be turned on, but the sensor automatically turns the lights off soon after an area is vacated. Also called "Manual-On Occupant Sensor"* |

| | |
|---|---|
| **Manual-on or partial-on occupancy control:** | *For most spaces, occupancy sensors shall not automatically turn the lighting to full-on . This effectively requires manual-on/automatic-off controls or a 50% maximum light level for auto-on . These controls are referred to as "vacancy sensors" or "multi-level" occupancy sensors. Spaces that allow auto-on include: public corridors and stairwells, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger safety or security* |
| | |
| **Partial-On Occupant/Motion Detector- new** | *automatically or manually turn part of the lights on when an area is occupied, automatically turns lights off* |
| **Partial-Off Occupant/Motion Detector- new** | *Turns lights On automatically, and turns off part of the lighting when an area is vacated* |
| **Part Night Outdoor Lighting Control- new** | *Time or Occupancy based device that reduces or turns off power to a outdoor luminaire for a portion of the night* |

| | |
|---|---|
| **Area control** | *Each area enclosed by ceiling-height partitions must have an accessible, independent switching or control device (such as an occupancy sensor, manual switch, or dimmer) to control the general lighting.* |
| **Automatic shut-off** | *All indoor lighting systems must include a separate automatic shut-off control, such as an occupancy sensor or time switch (i .e . time clock) .* |
| **Automatic receptacle control** | *50% of power outlets in certain spaces, such as private and open offices, must be controlled with an occupancy sensor or time clock.* |
| **Daylight zone control** | *Areas in daylight zones* shall have a separate control for the general lighting** . Typically, a daylight sensor and dimming ballasts that control at least 50% of the general lighting power, meets this requirement. Switched daylight control also complies with code, but is more disruptive to occupants.* |

| | |
|---|---|
| **Daylight zones** | *are typically one window height (distance from top of window to the floor) into the space, and the width of the window, plus two feet on both sides of the window.* |
| **General lighting** | *is lighting that provides a substantially uniform level of illumination throughout an area or space. General lighting does not include decorative lighting.* |
| **Exterior lighting control** | *permanently installed outdoor lighting must be controlled by a daylight sensor or astronomical time switch that automatically turns off the lighting during daylight hours. Additionally, in 90 .1-2010, in most exterior areas, lighting has to be automatically reduced by at least 30% after business hours or when no activity is detected after 15 minutes .* |
| **Functional testing** | *prior to inspection, lighting controls must be tested to ensure that they are working properly.* |

| | |
|---|---|
| **Hotel/motel guest room lighting control (manual)** | *All guestrooms must have a control at the entry which controls all the permanently installed lighting except those in the bathroom. Bathrooms must use an automatic lighting shut-off control (i.e . occupancy sensor) to turn lights off within 60 minutes of vacancy . In California, guest rooms must meet all the Title 24 residential requirements which basically require either high-efficacy lights, dimmers, or vacancy sensors in most spaces.* |
| **Light reduction controls** | *Most spaces must allow the occupants to select a lighting level that is between 30% and 70% of full power (at least 50% or lower for IECC) in addition to OFF by either continuous dimming, stepped dimming (dimming lights to certain, pre-defined, light levels), or stepped switching (separately switching alternate lamps in a fixture or alternate luminaires in a space) while maintaining a reasonably uniform level of illuminance throughout the controlled area.* |

| | |
|---|---|
| **Occupancy sensor or timer switch controls** | *Occupancy sensors (as well as count-down timers in 90 .1-2010) that turn off lighting within 30 minutes of vacancy are required in spaces such as, but not limited to:1 . Classrooms and lecture halls; 2 . Conference, meeting, and training rooms; 3 . Employee lunch and break rooms; 4 . Storage and supply rooms* |
| **Parking garage lighting control** | *Lighting must be reduced by at Least 30% when no activity is detected for 30 minutes. Areas along the perimeter must have automatic daylight controls. And daylight transition zones (i .e . entryways) shall have automatic controls that turn lighting on during the day and off at sunset to help people adapt easier to the change in light level upon entering the garage .* |

Revised: March 6, 2013

# 2013 Residential Building Energy Efficiency Standards Measures Summary

## Prescriptive Measures:

1. High Performance Windows – Reducing the U-Factor down to 0.32 and SHGC down to 0.25. (Section 150.1(c)3A)
2. Duct Insulation – Raise minimum from R-4.2 to R-6.0 in climate zones 6, 7, and 8. **(Section 150.1(c)9)**

Night Ventilation – Whole house fan as a minimum; allows Smart Vents and Night Breeze as

Alternatives in CZs 8-14. **(Section150.1(c)12)**

Adding the Radiant Barrier requirements in CZs 3, and 5-7. **(Section 150.1(c)2)**

Increase wall insulation to R15/4 in all CZs **(Section 150.1(c)1B) Mandatory Requirements:**

iv. Duct sealing in all CZs. **(Section 150.0(m)11)**

v. Return duct design or fan power and airflow testing (Residential HVAC Quality Installation Improvements). **(Section150.0(m)13)**

Lighting – Improving and clarifying the mandatory lighting requirements for all residential buildings including kitchens, bathrooms, dining rooms, utility rooms,

garages, hall ways, bedrooms, and outdoor lighting. Require at least one high efficacy luminaire in each bathroom. **(Section150.0(k))** Updated requirements for LED luminaires for manufacturers to certify to qualify as high efficacy. **(JA-8)**

vi. Hot water pipe insulation -Requires insulation on pipes ¾ inch and larger. **(Section150.0(j)2Aii and Section 150.0(j)4)**

vii. Solar Ready Measure – 250 square feet of solar ready zone on single family roofs.

**(Section150.0(r)) Compliance Options**

B. Solar Photovoltaic can be used as a compliance option to comply under the performance path.

c. Occupant Controlled Smart Thermostat as a tradeoff against the solar ready zone. **(Section ) 110.10(b)1A EXCEPTION 6)**

## Additions and Alteration

- Simplified Compliance documentation requirements for small additions and alteration projects that do not involve a HERS measure. **(Section 150.2(a) and (b))**
- Simplified rules for both the prescriptive and performance paths for additions, alterations, and existing plus additions plus alterations. **(Section 150.2(a) and (b))**

# 2013 Nonresidential Building Energy Efficiency Standards Measures Summary

## Envelope

10

Increased low-slope cool roof requirements (increase reflectance from 0.55 to 0.63 for new construction and alterations). **(Section 140.3(a)1Aia1)**

11

Established a maximum air leakage rate (0.04 cfm/sf) except in mild climate zones. Consistent

with air leakage requirements in IECC. **(Section 140.3(a)9B)**

12

Increased fenestration requirements to reduce solar gains and increase visual light transmittance for daylighting; 0.36 U-factor, 0.25 SHGC, VT 0.42 for fixed windows; the numbers are different for operable windows and skylights. **(Section 140.3(a)5B,C & D)**

13

Added mandatory minimum wall and roof insulation requirements. **(Section 110.8(e) & (f))**

# Lighting

(b) Clarification and simplification of existing language; removing exceptions no longer relevant.

**(Section 130.0-130.5, 140.6-140.8)**

(c) Lighting control devices moving from Title 24 to Title 20; Lighting control systems shall now be acceptance tested for Title 24. **(Section 110.9(b) & Section 130.4(a))**

(d) Nonresidential indoor lighting, advanced multi-level lighting controls (controllable ballasts) increased in granularity (in addition to ON/OFF, increasing from one intermediate level to three intermediate levels for or continuous dimming), favoring dimmable ballasts for linear fluorescent lighting systems. These controls will allow

precise and non-interruptive adjustment of lighting to match the available daylighting, and provide dimming and demand response function throughout the building. **(Section 130.1(b) & Section 130.1(a) 2C)**

(e) Enhancing, modifying, and daylighting controls mandatory requirements (removed off ramps); daylighting language significantly simplified. **(Section 130.1(d)** Inserted prescriptive daylighting control requirements for secondary daylit zones **(Section 140.6(d))**

(f) Requirements for demand responsive reduction of lighting power being applied to smaller spaces. **(Section 130.1(e))**

(g) Mandatory Automated Lighting Controls and Switching Requirements in

Warehouses and Libraries - Require the installation of occupancy sensors in warehouse aisle ways and open spaces, and library stack aisles. **(Section 130.1(c)6A & B)**

Mandatory automated multi-level lighting shut-off controls and switching requirements for hotels and multifamily building corridors - require the installation of occupancy sensors in corridors and stairwells in lodging and multifamily buildings. **(Section 130.1(c)6C)**

(h) Reduction of allowed lighting power density for some nonresidential indoor and outdoor lighting applications. **(Section 140.6(c) and Section 140.7(d))**

(i) Tailored lighting revisions - Reduce the

allowed LPD for Floor Display, Wall Display, and Ornamental Lighting under the Tailored Compliance. Significant editing of Tailored Method language for clarification. **Section 140.6(c)3I, J & K)**

(j) Plug Load Circuit Controls - requiring automatic shut-off controls of electric circuits that serve plug loads, including task lightings, in office buildings. **(Section 130.5(d)1)**

(k) Hotel/Motel Guest Room Occupancy Controls for HVAC and lighting systems - would require installation of occupancy controls for HVAC equipment, and all lighting fixtures in hotel/motel guest rooms, including plug-in lighting. **(Section 120.2(e)4 & Section 130.1(c)8)**

## Mechanical

(ii) Added requirements for Fan Control and Integrated Economizers. Packaged units down to 6 tons must be VAV with the ability to modulate cooling capacity to 20% of maximum. Economizers must also be able to modulate cooling capacity to match VAV units. **(Section 140.4(c) & (e))**

(iii) Reduced ability for HVAC systems to reheat conditioned air. **(Section 140.4(d))**

(iv) Increased chiller efficiency requirements, consistent with ASHRAE 90.1-2010. **(Section 140.4(i))**

(v) Increased cooling tower energy efficiency and WATER Savings. **(Section 140.4(k)2)**

(vi) Added requirements for commercial boiler combustion controls. **(Section 140.4(k)3)**

(vii) Added acceptance tests for HVAC sensors and controls, including those for demand controlled ventilation. **(Section 120.5(a))**

(viii) A

dded efficiency requirements for small motors. **(Section 140.4(c)4)**

(ix) Added credit for evaporative systems that meet the Western Cooling Efficiency Challenge (WCEC program to acknowledge high energy and water efficiency in evaporative systems). **(Section 140.4)**

(x) Moving Fault Detection and Diagnostics (FDD) protocols for air temperature, economizers, damper modulation, and

excess outdoor air to mandatory measures from the current compliance option.
**(Section 120.2(i))**

## Process Loads

(a) Added mandatory requirements for commercial supermarket refrigeration. **(Section 120.6(b))**

(b) Increased mandatory requirements for refrigerated warehouses. **(Section 120.6(a))**

(c) Added ventilation control requirements for commercial kitchens. **(Section 140.9(b))**

(d) Added prescriptive requirements for laboratory exhaust VAV and heat recovery. **(Section 140.9(c))**

(e) Added mandatory ventilation control requirements for parking garages. **(Section 120.6(c))**

(f) Added mandatory requirements for VFDs

and system controls on compressed air systems.

**(Section 120.6(e))**

(g) Added mandatory requirements for computer data centers. **(Section 140.9(a))**

(h) Added mandatory requirements for process boilers. **(Section 120.6(d))**

## Solar Ready

(a) Added mandatory requirements for nonresidential buildings (3 stories or less) to make provisions to more easily enable the future addition of solar electric or solar water heating systems. **(Section 110.10(a)4)**

## Compliance Option

(b) Hybrid Evaporative Cooling Systems in Nonresidential Buildings.

## Residential and Nonresidential

Compliance Documents Central Repository – Create a central repository to store compliance documentation that can be used by the CEC and others to improve compliance with the standards and perform program evaluation. **(10-10**

## Summary A

**Exterior**

– Sensors on all exterior luminaires mounted under 24’

**Interior**

1. Sensors required in secondary spaces
2. Daylighting required in spaces (which spaces)
3. Dimmable ballasts required (which spaces?)

**Compliance retrofit threshold reduced**

4. 10% of all luminaires or 40 ballasts

## Summary B

•Reductions in office and retail LPDs (140.6)
•Additional 'office' Power Adjustment Factors added for local (proximity) controls (140.6)
•Mandatory multi-level control (dimmable) (130.1(b))
•Mandatory partial on/off occ sensors in corridors, stairwells, library stacks and warehouse aisles (130.1(c))
•Security and egress lighting must be switched off automatically (130.1(c))
Mandatory Controls:

- Mandatory photo controls in much smaller spaces (130.1(d))
- Mandatory demand response in all buildings >10,000 sf (130.1(e))
- Expanded code compliance for retrofit projects
- Reduced outdoor LPDs
- Mandatory UG (not BUG) for outdoor luminaires
- Mandatory photo control ***and*** time scheduling for outdoor luminaires
- Mandatory partial on/off occupancy sensing for outdoor luminaires mounted at 24' or less

## Multi-Level Control Requirements (130.1(b))

**Mandatory** for general lighting of any enclosed nonresidential area 100 square feet or larger, with a connected lighting load >0.5 W/sf (§130.1(b))

For dimming luminaires, manual dimming control must be provided that provides access to the range of light levels available(§130.1(a)2C).

Each luminaire shall be controlled by **at least of one** of the following methods:

Manual dimming meeting the applicable requirements of §130.1(a)
Lumen maintenance as defined in §100.1
Tuning as defined in §100.1
Automatic daylighting controls in accordance with §130.1(d) Demand responsive lighting controls in accordance with §130.1(e)

EXCEPTION 1 to §130.1(b): Classrooms, **with a connected general lighting load of 0.7 W/sf or less**, shall have at least **one** control step between 30-70 percent of full rated power.

# *Wallpack Incentive Changes*

| Lighting Technology | % Energy Savings over 2013 T24 | 2008 Incentive | 2013 Incentive | Incentive Lost |
|---|---|---|---|---|
| LED Parking Garage Luminaire | 0% | $82 | $0 | $82 |
| LED Parking Garage Luminaire (50% Low Mode) | 0% | $132 | $0 | $132 |
| LED Parking Garage Luminaire (20% Low Mode) | 44% | $161 | $30 | $131 |

# *Office Incentive Changes*

| Lighting Technology | % Energy Savings over 2013 T24 | 2008 Incentive | 2013 Incentive | Incentive Lost |
|---|---|---|---|---|
| Ambient Troffer with Occupancy | 0% | $15 | $0 | $15 |
| Ambient Troffer with Occupancy and Daylighting | 14% | $20 | $5 | $15 |
| LED Ambient Troffer with Occupancy and Daylighting | 78% | $41 | $27 | $15 |

# *Corridor Incentive Changes*

| Lighting Technology | % Energy Savings over 2013 T24 | 2008 Incentive | 2013 Incentive | Incentive Lost |
|---|---|---|---|---|
| Ambient Troffer with Occupancy (50% Low) | 0% | $47 | $0 | $47 |
| Ambient Troffer with Occupancy (20% Low) | 40% | $75 | $28 | $47 |
| Ambient Troffer with Networked Controls (20% Low) | 40% | $75 | $28 | $47 |
| LED Ambient Troffer with Networked Controls (20% Low) | 71% | $97 | $50 | $47 |

**Definitions:** *§100.1: Definitions*

| | |
|---|---|
| **Shall** | *mandatory,* |
| **May** | *permissive* |
| **Lighting** | *Includes definitions for all types- Permanently Installed, Portable* |
| **Lighting Controls** | *Occupancy Sensing Controls: Motion Detectors, Partial On, Partial Off, Vacancy* |
| **Nonresidential Building Occupancy Types** | *Classroom, Office, Parking Garage Building…* |
| **Outdoor Areas** | *Canopy, Hardscape, ~~Lantern, Pendant~~…* |
| **Occupant Sensors** | *turn off lights in an indoor lighting system after an area is empty of people. When used to control outdoor lighting systems, called a* ***motion sensor****.* |
| **Vacancy Sensor** | *are OS where the lights must manually be turned on, but the sensor automatically turns the lights off soon after an area is vacated. Also called "Manual-On Occupant Sensor"* |

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| **Manual-on or partial-on occupancy control:** | *For most spaces, occupancy sensors shall not automatically turn the lighting to full-on . This effectively requires manual-on/automatic-off controls or a 50% maximum light level for auto-on . These controls are referred to as "vacancy sensors" or "multi-level" occupancy sensors. Spaces that allow auto-on include: public corridors and stairwells, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger safety or security* |
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| **Partial-On Occupant/Motion Detector- new** | *automatically or manually turn part of the lights on when an area is occupied, automatically turns lights off* |
| **Partial-Off Occupant/Motion Detector- new** | *Turns lights On automatically, and turns off part of the lighting when an area is vacated* |
| **Part Night Outdoor Lighting Control- new** | *Time or Occupancy based device that reduces or turns off power to a outdoor luminaire for a portion of the night* |

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| **Area control** | *Each area enclosed by ceiling-height partitions must have an accessible, independent switching or control device (such as an occupancy sensor, manual switch, or dimmer) to control the general lighting.* |
| **Automatic shut-off** | *All indoor lighting systems must include a separate automatic shut-off control, such as an occupancy sensor or time switch (i .e . time clock) .* |
| **Automatic receptacle control** | *50% of power outlets in certain spaces, such as private and open offices, must be controlled with an occupancy sensor or time clock.* |
| **Daylight zone control** | *Areas in daylight zones* shall have a separate control for the general lighting** . Typically, a daylight sensor and dimming ballasts that control at least 50% of the general lighting power, meets this requirement. Switched daylight control also complies with code, but is more disruptive to occupants.* |

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| **Daylight zones** | *are typically one window height (distance from top of window to the floor) into the space, and the width of the window, plus two feet on both sides of the window.* |
| **General lighting** | *is lighting that provides a substantially uniform level of illumination throughout an area or space. General lighting does not include decorative lighting.* |
| **Exterior lighting control** | *permanently installed outdoor lighting must be controlled by a daylight sensor or astronomical time switch that automatically turns off the lighting during daylight hours. Additionally, in 90 .1-2010, in most exterior areas, lighting has to be automatically reduced by at least 30% after business hours or when no activity is detected after 15 minutes .* |
| **Functional testing** | *prior to inspection, lighting controls must be tested to ensure that they are working properly.* |

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| **Hotel/motel guest room lighting control (manual)** | *All guestrooms must have a control at the entry which controls all the permanently installed lighting except those in the bathroom. Bathrooms must use an automatic lighting shut-off control (i.e . occupancy sensor) to turn lights off within 60 minutes of vacancy . In California, guest rooms must meet all the Title 24 residential requirements which basically require either high-efficacy lights, dimmers, or vacancy sensors in most spaces.* |
| **Light reduction controls** | *Most spaces must allow the occupants to select a lighting level that is between 30% and 70% of full power (at least 50% or lower for IECC) in addition to OFF by either continuous dimming, stepped dimming (dimming lights to certain, pre-defined, light levels), or stepped switching (separately switching alternate lamps in a fixture or alternate luminaires in a space) while maintaining a reasonably uniform level of illuminance throughout the controlled area.* |

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| **Occupancy sensor or timer switch controls** | *Occupancy sensors (as well as count-down timers in 90 .1-2010) that turn off lighting within 30 minutes of vacancy are required in spaces such as, but not limited to:1 . Classrooms and lecture halls; 2 . Conference, meeting, and training rooms; 3 . Employee lunch and break rooms; 4 . Storage and supply rooms* |
| **Parking garage lighting control** | *Lighting must be reduced by at Least 30% when no activity is detected for 30 minutes. Areas along the perimeter must have automatic daylight controls. And daylight transition zones (i .e . entryways) shall have automatic controls that turn lighting on during the day and off at sunset to help people adapt easier to the change in light level upon entering the garage .* |

(b) **Documentation.** The following documentation is required to demonstrate compliance with Part 6. This documentation shall meet the requirements of Section 10-103(a) or alternatives approved by the Executive Director.

1. **Certificate of Compliance.** For all buildings, the Certificate of Compliance described in Section 10-103 shall be signed by the person in charge of the building design, who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design (*responsible person*); and submitted in accordance with Sections 10-103(a)1 and 10-103(a)2 to certify conformance with Part 6. If more than one person has responsibility for the building design, each person shall sign the Certificate of Compliance document(s) applicable to that portion of the design for which the person is responsible. Alternatively, the person with chief responsibility for the building design shall prepare and sign the Certificate of Compliance document(s) for the entire building design. Subject to the requirements of Sections 10-103(a)1 and 10-103(a)2, persons who prepare Certificate of Compliance documents (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. In accordance with applicable requirements of 10-103(a)1, the signatures provided by *responsible persons* and *documentation authors* shall be original signatures on paper documents or electronic signatures on electronic documents conforming to the electronic signature specifications in Reference Joint Appendix JA7.

   For all Nonresidential buildings, the Design Review Kickoff Certificate(s) of Compliance, and Construction Document Design Review Checklist Certificate(s) of Compliance shall be completed and signed by a licensed professional engineer. For buildings less than 10,000 square feet, the licensed professional engineer may be the engineer of record. For buildings greater than 10,000 square feet but less than 50,000 square feet, the licensed professional engineer shall be a qualified in-house engineer with no other project involvement or a third party engineer. Contractors accepting the responsibilities of the engineer under the provision of the Business and Professions Code may also complete and sign these certificates. For buildings greater than 50,000 square feet and all buildings with complex mechanical systems serving more than 10,000 square feet, the licensed professional engineer shall be a third party.

   A. All Certificate of Compliance documentation shall conform to a format and informational order and content approved by the Energy Commission.

      These documents shall:

      i. Identify the energy features, performance specifications, materials, components, and manufactured devices required for compliance with Part 6.

      ii. Identify the building project name and location. The building project name and location identification on the Certificate of Compliance shall be consistent with the building project name and location identification given on the other applicable building design plans and specifications submitted to the enforcement agency for approval with the building permit application.

      iii. Display the unique registration number assigned by the data registry if Section 10-103(a)1 requires the document to be registered.

      iv. Include a declaration statement to the effect that the building energy features, performance specifications, materials, components, and manufactured devices for the building design identified on the Certificate of Compliance indicate the building is in compliance with the requirements of Title 24, Parts 1 and 6, and the building design features identified on the Certificate of Compliance are consistent with the building design features identified on the other applicable compliance documents, worksheets, calculations, plans, and specifications submitted to the enforcement agency for approval with the building permit application.

v. Be signed by the *documentation author* to certify the documentation is accurate and complete.
When document registration is required by Section 10-103(a)1, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

vi. Be signed by the *responsible person* eligible under Division 3 of the Business and Professions Code to accept responsibility for the design to certify conformance with Part 6. When document registration is required by Section 10-103(a)1, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

B. For all low-rise residential buildings for which compliance requires HERS field verification, the person(s) responsible for the Certificate(s) of Compliance shall submit the Certificate(s) for registration and retention to a HERS provider data registry. The submittals to the HERS provider data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Compliance documents that are registered and retained by a HERS provider data registry shall also be automatically transmitted by the data registry, to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

C. For alterations to existing residential buildings for which HERS field verification is not required such as water heater and window replacements, and for additions to existing residential buildings that are less than 300 square feet for which HERS field verification is not required, the enforcement agencies may at their discretion not require any Certificate of Compliance documentation, or may develop simplified Certificate of Compliance documentation for demonstrating compliance with the Standards.

Exemptions from submitting compliance documentation shall not be deemed to grant authorization for any work to be done in any manner in violation of this code or other provisions of law.

D. Beginning on January 1, 2015, contingent upon approval of data registry(s) by the Commission, all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person(s) responsible for the Certificate(s) of Compliance shall submit the Certificate(s) for registration and retention to a data registry approved by the Commission. The submittals to the approved data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Compliance documents that are registered and retained by an approved data registry shall also be automatically transmitted by the data registry to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

2. **Application for a building permit.** Each application for a building permit subject to Part 6 shall contain at least one copy of the documents specified in Sections 10-103(a)2A, 10-103(a)2B, and 10-103(a)2C.

A. For all newly constructed buildings, additions, alterations, or repairs regulated by Part 6 the applicant shall submit the applicable Certificate(s) of Compliance to the enforcement agency for approval. The certificate(s) shall conform to the requirements of Section 10-103(a)1, and shall be approved by the local enforcement agency, in accordance with all applicable requirements of Section 10-103(d), by stamp or authorized signature prior to issuance of a building permit. A copy of the Certificate(s) of Compliance shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).

For alterations to existing residential buildings for which HERS field verification is required, and when the enforcement agency does not require building design plans to be submitted with the application for a building permit, the applicable Certificate of Compliance documentation specified in 10-103(a)1 is not required to be approved by the enforcement agency prior to issuance of a building permit, but shall be approved by the enforcement

agency prior to final inspection of the dwelling unit, and shall be made available to the enforcement agency for all applicable inspections.

When the enforcement agency requires building design plans to be submitted with the application for a building permit, the applicable Certificate of Compliance documents shall be incorporated into the building design plans. When Section 10-103(a)1 requires document registration, the certificate(s) that are incorporated into the building design plans shall be copies of the registered Certificate of Compliance documents from a HERS provider data registry, or a data registry approved by the Commission.

B. When the enforcement agency requires building design plans and specifications to be submitted with the application for a building permit, the plans shall conform to the specifications for the features, materials, components, and manufactured devices identified on the Certificate(s) of Compliance, and shall conform to all other applicable requirements of Part 6. Plans and specifications shall be submitted to the enforcement agency for any other feature, material, component, or manufactured device that Part 6 requires be indicated on the building design plans and specifications. Plans and specifications submitted with each application for a building permit for Nonresidential buildings, High-rise Residential buildings and Hotels and Motels shall provide acceptance requirements for code compliance of each feature, material, component or manufactured device when acceptance requirements are required under Part 6. Plans and specifications for Nonresidential buildings, High-rise Residential buildings and Hotels and Motels shall require, and indicate with a prominent note on the plans, that within 90 days after the Enforcement Agency issues a permanent final occupancy permit, record drawings be provided to the building owner.

   For all buildings, if the specification for a building design feature, material, component, or manufactured device is changed before final construction or installation, such that the building may no longer comply with Part 6 the building must be brought back into compliance, and so indicated on amended plans, specifications, and Certificate(s) of Compliance that shall be submitted to the enforcement agency for approval. Such characteristics shall include the efficiency (or other characteristic regulated by Part 6) of each building design feature, material, component, or device.

C. The enforcement agency shall have the authority to require submittal of any supportive documentation that was used to generate the Certificate(s) of Compliance, including but not limited to the electronic input file for the compliance software tool that was used to generate performance method Certificate(s) of Compliance; or any other supportive documentation that is necessary to demonstrate that the building design conforms to the requirements of Part 6.

3. **Certificate of Installation.** For all buildings, the person in charge of the construction or installation, who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices regulated by Part 6 or the Appliance Efficiency Regulations (*responsible person*) shall sign and submit Certificate of Installation documentation as specified in Section 10-103(a)3 to certify conformance with Part 6. If more than one person has responsibility for the construction or installation, each person shall sign and submit the Certificate of Installation documentation applicable to the portion of the construction or installation for which they are responsible; alternatively, the person with chief responsibility for the construction or installation shall sign and submit the Certificate of Installation documentation for the entire construction or installation scope of work for the project. Subject to the requirements of Section 10-103(a)3, persons who prepare Certificate of Installation documentation (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. In accordance with applicable requirements of 10-103(a)3, the signatures provided by *responsible persons* and *documentation authors* shall be original signatures on paper documents or electronic signatures on electronic documents conforming to the electronic signature specifications in Reference Joint Appendix JA7.

   A. All Certificate of Installation documentation shall conform to a format and informational order and content approved by the Energy Commission.

      These documents shall:

      i. Identify the features, materials, components, manufactured devices, and system performance diagnostic results required to demonstrate compliance with Part 6 and the Appliance Efficiency Regulations.

ii. State the number of the building permit under which the construction or installation was performed.

iii Display the unique registration number assigned by the data registry if Section 10-103(a)3 requires the document to be registered.

viii. Include a declaration statement indicating that the constructed or installed features, materials, components or manufactured devices (the installation) identified on the Certificate of Installation conforms to all applicable codes and regulations, and the installation conforms to the requirements given on the plans and specifications approved by the enforcement agency.

ix. Be signed by the *documentation author* to certify the documentation is accurate and complete.
When document registration is required by Section 10-103(a)3, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

x. Be signed by the r*esponsible person* eligible under Division 3 of the Business and Professions Code to accept responsibility for construction or installation in the applicable classification for the scope of work specified on the Certificate of Installation document(s), or shall be signed by their authorized representative. When document registration is required by Section 10-103(a)3, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

B. For all low-rise residential buildings for which compliance requires HERS field verification, the person(s) responsible for the Certificate(s) of Installation , or their authorized representative(s), shall submit all Certificate of Installation documentation that is applicable to the building to a HERS provider data registry for registration and retention in accordance with procedures specified in Reference Residential Appendix RA2. The submittals to the HERS provider data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Installation documents that are registered and retained by a HERS provider data registry shall also be automatically transmitted by the data registry to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

C. For alterations to existing residential buildings for which HERS field verification is not required such as water heater and window replacements, and for additions to existing residential buildings that are less than 300 square feet for which HERS field verification is not required, the enforcement agencies may at their discretion not require any Certificate of Installation documentation, or may develop simplified Certificate of Installation documentation for demonstrating compliance with the Standards.

Exemptions from submitting compliance documentation shall not be deemed to grant authorization for any work to be done in any manner in violation of this code or other provisions of law.

D. Beginning on January 1, 2015, contingent upon approval of data registry(s) by the Commission, all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person(s) responsible for the Certificate(s) of Installation shall submit the Certificate(s) for registration and retention to a data registry approved by the Commission. The submittals to the approved data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Installation documents that are registered and retained by an approved data registry shall also be automatically transmitted by the data registry to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

E. For all buildings, a copy of the Certificate(s) of Installation shall be posted, or made available with the building permit(s) issued for the building, and shall be made available to the enforcement agency for all applicable inspections. When document registration is required by Section 10-103(a)3, registered copies of the Certificate(s) of Installation from a HERS provider data registry or a data registry approved by the Commission shall be posted

or made available with the building permit(s) issued for the building, and shall be made available to the enforcement agency for all applicable inspections. If construction on any portion of the building subject to Part 6 will be impossible to inspect because of subsequent construction, the enforcement agency may require the Certificate(s) of Installation to be posted upon completion of that portion. A copy of the Certificate(s) of Installation shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).

4. **Certificate of Acceptance.** For all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person in charge of the acceptance testing, who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the applicable scope of system design, or construction, or installation of features, materials, components, or manufactured devices regulated by Part 6 or the Appliance Efficiency Regulations (*responsible person*), shall sign and submit all applicable Certificate of Acceptance documentation in accordance with Section 10-103(a)4 and Nonresidential Appendix NA7 to certify conformance with Part 6. If more than one person has responsibility for the acceptance testing, each person shall sign and submit the Certificate of Acceptance documentation applicable to the portion of the construction or installation, for which they are responsible; alternatively, the person with chief responsibility for the system design, construction or installation, shall sign and submit the Certificate of Acceptance documentation for the entire construction or installation scope of work for the project. Subject to the requirements of Section 10-103(a)4, persons who prepare Certificate of Acceptance documentation (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. Persons who perform acceptance test procedures in accordance with the specifications in Reference Joint Appendix NA7, and report the results of the acceptance tests on the Certificate of Acceptance (*field technicians*) shall sign a declaration statement on the documents they submit to certify the information provided on the documentation is true and correct. In accordance with applicable requirements of 10-103(a)4, the signatures provided by *responsible persons*, *field technicians*, and *documentation authors* shall be original signatures on paper documents or electronic signatures on electronic documents conforming to the electronic signature specifications in Reference Joint Appendix JA7.

   A. All Certificate of Acceptance documentation shall conform to a format and informational order and content approved by the Energy Commission.

      These documents shall:

      i. Identify the features, materials, components, manufactured devices, and system performance diagnostic results required to demonstrate compliance with the acceptance requirements to which the applicant must conform as indicated in the plans and specifications submitted under Section 10-103(a)2, and as specified in Reference Nonresidential Appendix NA7.

      ii. State the number of the building permit under which the construction or installation was performed.

      iii. Display the unique registration number assigned by the data registry if Section 10-103(a)4 requires the document to be registered.

      iv. Include a declaration statement indicating that the features, materials, components or manufactured devices identified on the Certificate of Acceptance conform to the applicable acceptance requirements as indicated in the plans and specifications submitted under Section 10-103(a), and with applicable acceptance requirements and procedures specified in the Reference Nonresidential Appendix NA7, and confirms that Certificate(s) of Installation described in Section 10-103(a)3 has been completed and is posted or made available with the building permit(s) issued for the building.

      v. Be signed by the *documentation author* to certify the documentation is accurate and complete.
      When document registration is required by Section 10-103(a)4, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

      vi. Be signed by the *field technician* who performed the acceptance test procedures and reported the results on the Certificate of Acceptance. When document registration is required by Section 10- 103(a)4, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

vii. Be signed by the *responsible person* in charge of the acceptance testing who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the system design, construction or installation in the applicable classification for the scope of work identified on the Certificate of Acceptance, or shall be signed by their authorized representative. When document registration is required by Section 10-103(a)4, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

B. Beginning on January 1, 2015, contingent upon approval of data registry(s) by the Commission, for all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person(s) responsible for the Certificate(s) of Acceptance shall submit the Certificate(s) for registration and retention to a data registry approved by the Commission. The submittals to the approved data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Acceptance documents that are registered and retained by an approved data registry shall also be automatically transmitted by the data registry, to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

C. A copy of the registered Certificate(s) of Acceptance shall be posted, or made available with the building permit(s) issued for the building, and shall be made available to the enforcement agency for all applicable inspections. If construction on any portion of the building subject to Part 6 will be impossible to inspect because of subsequent construction, the enforcement agency may require the Certificate(s) of Acceptance to be posted upon completion of that portion. A copy of the Certificate(s) of Acceptance shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).

5. **Certificate of Field Verification and Diagnostic Testing (Certificate of Verification).** For all buildings for which compliance requires HERS field verification, a certified HERS Rater shall conduct all required HERS field verification and diagnostic testing in accordance with applicable procedures specified in Reference Appendices RA2, RA3, NA1, and NA2. All applicable Certificate of Verification documentation shall be completed, signed, and submitted by the certified HERS Rater who performed the field verification and diagnostic testing services (*responsible person*) in accordance with the requirements of Section 10- 103(a)5, and Reference Appendices RA2, and NA1, to certify conformance with Part 6. If more than one rater has responsibility for the HERS verification for the building, each rater shall sign and submit the Certificate of Verification documentation applicable to the portion of the building for which they are responsible. Subject to the requirements of Section 10-103(a)5, persons who prepare Certificate of Verification documentation (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. The signatures provided by *responsible persons* and *documentation authors* shall be electronic signatures on electronic documents.

A All Certificate of Verification documentation shall conform to a format and informational order and content approved by the Energy Commission.

These documents shall:

i. Identify the installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification for compliance with Part 6 as specified on the Certificate(s) of Compliance for the building.

ii. State the number of the building permit under which the construction or installation was performed,

iii. Display the unique registration number assigned by the HERS provider data registry, and provide any additional information required by Reference Appendices RA2, RA3, NA1, and NA2.

iv. Include a declaration statement indicating that the installed features, materials, components or manufactured devices requiring HERS verification conform to the applicable requirements in Reference Appendices RA2, RA3, NA1, NA2, and the requirements specified on the Certificate(s)

of Compliance approved by the local enforcement agency, and confirms the same features, materials, components or manufactured devices are identified on the applicable Certificate(s) of Installation signed and submitted by the person(s) responsible for the construction or installation as described in Section 10-103(a)3.

v. Be signed by the *documentation author* to certify the documentation is accurate and complete. The signatures shall be electronic signatures on electronic documents in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

vi. Be signed by the HERS Rater who performed the field verification and diagnostic testing services (*responsible person).* The signatures shall be electronic signatures on electronic documents in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

D. For all buildings for which compliance requires HERS field verification, the certified HERS Rater responsible for the Certificate(s) of Verification shall submit the Certificates for registration and retention to a HERS provider data registry in accordance with the applicable procedures in Reference Appendices RA2 and NA1. The submittals to the HERS provider data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Verification documents that are registered and retained by a HERS provider data registry shall also be automatically transmitted by the data registry, to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

E. For all buildings, a copy of the registered Certificate(s) of Verification shall be posted, or made available with the building permit(s) issued for the building, and shall be made available to the enforcement agency for all applicable inspections. If construction on any portion of the building subject to Part 6 will be impossible to inspect because of subsequent construction, the enforcement agency may require the Certificate(s) of Verification to be posted upon completion of that portion. A copy of the registered Certificate(s) of Verification shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).

**EXCEPTION to Section 10-103(a)**: Enforcing agencies may exempt nonresidential buildings that have no more than 1,000 square feet of conditioned floor area in the entire building and an occupant load of 49 persons or less from the documentation requirements of Section 10-103(a), provided a statement of compliance with Part 6 is submitted and signed by a licensed engineer or the licensed architect with chief responsibility for the design.

(c) **Compliance, Operating, Maintenance, and Ventilation Information to be provided by Builder.**

1. **Compliance information.**

A. For low-rise residential buildings, at final inspection, the enforcement agency shall require the builder to leave in the building, copies of the completed, signed, and submitted compliance documents for the building owner at occupancy. For low-rise residential buildings, such information shall, at a minimum, include copies of all Certificate of Compliance, Certificate of Installation, and Certificate of Verification documentation submitted. These documents shall be in paper or electronic format and shall conform to the applicable requirements of Section 10-103(a).

B. For nonresidential buildings, high-rise residential buildings and hotels and motels, at final inspection, the enforcement agency shall require the builder to leave in the building, copies of the completed, signed, and submitted compliance documents for the building owner at occupancy. For nonresidential buildings, high-rise residential buildings and hotels and motels, such information shall include copies of all Certificate of Compliance, Certificate of Installation, Certificate of Acceptance and Certificate of Verification documentation submitted. These documents shall be in paper or electronic format and shall conform to the applicable requirements of Section 10-103(a).

2. **Operating information.** At final inspection, the enforcement agency shall require the builder to leave in the building, for the building owner at occupancy, operating information for all applicable features, materials, components, and mechanical devices installed in the building. Operating information shall include instructions on how to operate the features, materials, components, and mechanical devices correctly and efficiently. The instructions shall be consistent with specifications set forth by the Executive Director. For low-rise residential buildings, such information shall be contained in a folder or manual which provides all information specified in Section 10-103(b). This operating information shall be in paper or electronic format.

   For dwelling units, buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for operating the feature, material, component or mechanical device installed in the building. This operating information shall be in paper or electronic format.

3. **Maintenance information.** At final inspection, the enforcement agency shall require the builder to leave in the building, for the building owner at occupancy, maintenance information for all features, materials, components, and manufactured devices that require routine maintenance for efficient operation. Required routine maintenance actions shall be clearly stated and incorporated on a readily accessible label. The label may be limited to identifying, by title and/or publication number, the operation and maintenance manual for that particular model and type of feature, material, component or manufactured device.

   For dwelling units, buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for maintaining the feature, material, component or mechanical device installed in the building. This information shall be in paper or electronic format.

4. **Ventilation information.** For low-rise residential buildings, the enforcement agency shall require the builder to leave in the building, for the building owner at occupancy, a description of the quantities of outdoor air that the ventilation system(s) are designed to provide to the building's conditioned space, and instructions for proper operation and maintenance of the ventilation system. For buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for operating and maintaining the feature, material, component or mechanical ventilation device installed in the building. This information shall be in paper or electronic format.

   For nonresidential buildings, high-rise residential buildings and hotels and motels, the enforcement agency shall require the builder to provide the building owner at occupancy a description of the quantities of outdoor and recirculated air that the ventilation systems are designed to provide to each area. For buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for operating and maintaining the feature, material, component or mechanical device installed in the building. This information shall be in paper or electronic format.

(d) **Equipment Information to be Provided by Manufacturer or Supplier.** The manufacturer or supplier of any manufactured device shall, upon request, provide to building designers and installers information about the device. The information shall include the efficiency (and other characteristics regulated by Part 6). This information shall be in paper or electronic format.

(e) **Enforcement Agency Requirements.**

1. **Permits.** An enforcement agency shall not issue a building permit for any construction unless the enforcement agency determines in writing that the construction is designed to comply with the requirements of Part 6 that are in effect on the date the building permit was applied for. The enforcement agency determination shall confirm that the documentation requirements of Sections 10-103(a)1 and 10-103(a)2 have been met.

If a building permit has been previously issued, there has been no construction under the permit, and the permit has expired, the enforcement agency shall not issue a new permit unless the enforcement agency determines in writing that the construction is designed to comply with the requirements of Part 6 in effect on the date the new permit is applied for. The enforcement agency determination shall confirm that the documentation requirements of Sections 10-103(a)1 and 10-103(a)2 have been met.

"Determines in writing" includes, but is not limited to, approval of a building permit with a stamp normally used by the enforcement agency.

2. **Inspection.** The enforcement agency shall inspect newly constructed buildings and additions, and alterations to existing buildings to determine whether the construction or installation is consistent with the agency's approved plans and specifications, and complies with Part 6. Final certificate of occupancy shall not be issued until such consistency and compliance is verified. For Occupancy Group R-3, final inspection shall not be complete until such consistency and compliance is verified.

   Such verification shall include determination that:

   A. All installed features, materials, components or manufactured devices, regulated by the Appliance Efficiency Regulations or Part 6 are indicated, when applicable, on the Certificate(s) of Installation, Certificate(s) of Acceptance and Certificate(s) of Verification, and are consistent with such features, materials, components or manufactured devices given in the plans and specifications and the Certificate(s) of Compliance approved by the local enforcement agency.

   B. All required Certificates of Installation are posted, or made available with the building permit(s) issued for the building, and are made available to the enforcement agency for all applicable inspections, and that all required Certificates of Installation conform to the specifications of Section 10-103(a)3.

   C. All required Certificates of Acceptance are posted, or made available with the building permit(s) issued for the building, and are made available to the enforcement agency for all applicable inspections, and that all required Certificates of Acceptance conform to the specifications of Section 10-103(a)4.

   D. All required Certificates of Verification are posted, or made available with the building permit(s) issued for the building, and are made available to the enforcement agency for all applicable inspections, and that all required Certificates of Verification conform to the specifications of Section 10-103(a)5.

**EXCEPTION to Section 10-103(d):** For newly constructed buildings that meet the requirements of the New Solar Homes Partnership (NSHP) as specified in the NSHP Guidebook, the enforcement agency may waive the plan check and inspection of all measures other than the mandatory measures in the building.

**NOTE:** Authority: Section 25402, Public Resources Code. Reference: Section 25402, Public Resources Code.

# 13-103-A – NONRESIDENTIAL LIGHTING CONTROLS ACCEPTANCE TEST TRAINING AND CERTIFICATION

(a) **Scope.** The requirements of this section apply to nonresidential lighting control Acceptance Test Technicians and Employers, and the Certification Providers that train and certify them.

(l) **Industry Certification Threshold.** Lighting Controls Acceptance Test Technician and Employer certification requirements shall take effect when the Energy Commission finds that each of the following conditions are met. Until such time that Section 10-103-A(b)1 and 10-103-A(b)2 are met, Field Technicians are allowed to complete the acceptance test requirements in Section 130.4 without completing the Acceptance Test Technician certification requirements.

1. **Number of Certified Acceptance Test Technicians.** There shall be no less than 300 Lighting Controls Acceptance Test Technicians certified to perform the acceptance tests in Building Energy Efficiency Standards, Section 130.4. The number of certified Acceptance Test Technicians shall be demonstrated by Certification Provider-prepared reports submitted to the Energy Commission.

2. **Industry Coverage by Certification Provider(s).** The Certification Provider(s) approved by the Energy Commission, in their entirety, shall provide reasonable access to certification for technicians representing the majority of the following industry groups: electrical contractors, certified general electricians, professional engineers, controls installation and startup contractors and certified commissioning professionals who have verifiable training, experience and expertise in lighting controls and electrical systems. The Energy Commission will determine whether in their entirety reasonable access to certification is provided by considering factors such as certification costs commensurate with the complexity of the training being provided, certification marketing materials, prequalification criteria, class availability, and curriculum.

(m) **Qualifications and Approval of Certification Providers.** The Acceptance Test Technician Certification Providers (ATTCPs) shall submit a written application to the Energy Commission with a summary and the related background documents to explain how the following criteria and procedures have been met:

1. **Requirements for Applicant ATTCPs to Document Organizational Structure.** ATTCPs shall provide written explanations of the organization type, by-laws, and ownership structure. ATTCPs shall explain in writing how their certification program meets the qualification requirements of Title 24, Part 1, Section 10-103-A(c). ATTCPs shall explain in their application to the Energy Commission how their organizational structure and procedures include independent oversight, quality assurance, supervision and support of the acceptance test training and certification processes.

2. **Requirements for Certification of Employers.** The ATTCPs shall provide written explanations of how their program includes certification and oversight of Acceptance Test Employers to ensure quality control and appropriate supervision and support for Acceptance Test Technicians.

3. **Requirements for Applicant ATTCPs to Document Training and Certification Procedures.**
ATTCPs shall provide a complete copy of all training and testing procedures, manuals, handbooks and materials. ATTCPs shall explain in writing how their training and certification procedures include, but are not limited to, the following:

**A. Training Scope.** Both hands-on experience and theoretical training such that Acceptance Test Technicians demonstrate their ability to apply the Building Energy Efficiency Standards acceptance testing and documentation requirements to a comprehensive variety of lighting control systems and networks that are reflective of the range of systems currently encountered in the field. The objective of the hands-on training is to practice and certify

competency in the technologies and skills necessary to perform the acceptance tests.

**B. Lighting Controls Acceptance Test Technician Training.**

(i) **Curricula.** Acceptance Test Technician Certification Provider training curricula for Lighting Control Acceptance Test Technicians shall include, but not be limited to, the analysis, theory, and practical application of the following:

a) Lamp and ballast systems;

b) Line voltage switching controls;

c) Low voltage switching controls;

d) Dimming controls;

e) Occupancy sensors;

f) Photosensors;

g) Demand responsive signal inputs to lighting control systems;

h) Building Energy Efficiency Standards required lighting control systems;

i) Building Energy Efficiency Standards required lighting control system- specific analytical/problem solving skills;

j) Integration of mechanical and electrical systems for Building Energy Efficiency Standards required lighting control installation and commissioning;

k) Safety procedures for low-voltage retrofits (<50 volts) to control line voltage systems (120 to 480 volts);

l) Accurate and effective tuning, calibration, and programming of Building Energy Efficiency Standards required lighting control systems;

m) Measurement of illuminance according to the Illuminating Engineering Society's measurement procedures as provided in the IESNA Lighting Handbook, $10^{th}$ Edition, 2011, which are incorporated by reference;

n) Building Energy Efficiency Standards lighting controls acceptance testing procedures; and

o) Building Energy Efficiency Standard**s** acceptance testing compliance documentation for lighting controls.

**(xi) Hands-on training.** The ATTCP shall describe in their application the design and technical specifications of the laboratory boards, equipment and other elements that will be used to meet the hands-on requirements of the training and certification.

**(xii) Prequalification.** Participation in the technician certification program shall be limited to persons who have at least three years of verifiable professional experience and expertise in lighting controls and electrical systems as determined by the Lighting Controls **ATTCPs,** to demonstrate their ability to understand and apply the Lighting Controls Acceptance Test Technician certification training. The criteria and review processes used by the ATTCP to determine the relevance of technician professional experience shall be described in the ATTCP application to the Energy Commission.

**(xiii) Instructor to Trainee Ratio. A** sufficient ratio of instructors to participants in classroom and laboratory work to ensure integrity and efficacy of the curriculum and program. The ATTCP shall document in its application to the Energy Commission why its instructor to trainee ratio is sufficient based on industry standards and other relevant information.

**(xiv) ests.** A written and practical test that demonstrates each certification applicant's competence in all specified subjects. The ATTCPs shall retain all results of these tests for five years from the date of the test.

**(xv) Recertification.** Requirements and Procedures for recertification of Acceptance Test Technicians each time the Building Energy Efficiency Standards is updated with new and/or modified acceptance test requirements.

**C. Lighting Controls Acceptance Test Employer Training.** Training for Lighting Controls Acceptance Test Employers shall consist of a single class or webinar consisting of at least four

hours of instruction that covers the scope and process of the acceptance tests in Building Energy Efficiency Standards, Section 130.4.

**D. Complaint Procedures.** The ATTCPs shall describe in their applications to the Energy Commission **p**rocedures for accepting and addressing complaints regarding the performance of any certified acceptance test technician or employer, and explain how building departments and the public will be notified of these procedures.

**E. Certification Revocation Procedures.** The ATTCPs shall describe in their applications to the Energy Commission procedures for revoking the certification of Acceptance Test **Technicians and Employers** based upon poor quality or ineffective work, failure to perform acceptance tests, falsification of documents, failure to comply with the documentation requirements of these regulations or other specified actions that justify decertification.

**F. Quality Assurance and Accountability.** The ATTCP shall describe in their application to the Energy Commission how their certification business practices include quality assurance, independent oversight and accountability measures, such as, independent oversight of the certification processes and procedures, visits to building sites where certified technicians are completing acceptance tests, certification process evaluations, building department surveys to determine acceptance testing effectiveness, and expert review of the training curricula developed for Building Energy Efficiency Standards, Section 130.4. Independent oversight may be demonstrated by accreditation under the ISO/IEC 17024 standard.

**G. Certification Identification Number and Verification of ATT Certification Status.** Upon certification of an ATT, the ATTCP shall issue a unique certification identification number to the ATT. The ATTCP shall maintain an accurate record of the certification status for all ATTs that the ATTCP has certified. The ATTCP shall provide verification of current ATT certification status upon request to authorized document Registration Provider personnel or enforcement agency personnel to determine the ATT's eligibility to sign Certificate of Acceptance documentation according to all applicable requirements in Sections 10-103-A, 10-102, 10-103(a)4, and the Reference Joint Appendix JA7.

**(d) Requirements for ATTCPs to Provide Annual Reports. T**he ATTCP shall provide an annual report to the Energy Commission summarizing the certification services provided over the reporting period, including the total number of Acceptance Test Technicians and Employers certified by the ATTCP (a) during the reporting period and (b) to date. The ATTCP shall report to the Energy Commission what adjustments have been made to the training curricula, if any, to address changes to the Building Energy Efficiency Standards Acceptance Testing requirements, adopted updates to the Building Energy Efficiency Standards or to ensure training is reflective of the variety of lighting controls that are currently encountered in the field, no less than six months prior to the effective date of any newly adopted, or amendment to existing, Building Energy Efficiency Standards. All required reports shall contain a signed certification that the ATTCP has met all requirements for this program.

**(e) Interim Approval of Lighting Controls Acceptance Test Technician Certification Provider.** The California Advanced Lighting Controls Training

Program (CALCTP) shall be approved as an authorized Lighting Controls Acceptance Test Technician Certification Provider subject to the following conditions:

- Interim approval shall be conditioned upon submittal of an application that contains the information required by subdivision (c)(1)-(3), including documentation demonstrating that the certification includes training and testing on the Building Energy Efficiency Standards lighting control acceptance testing procedures and the Building Energy Efficiency Standards acceptance testing compliance documentation for lighting control systems.
- Technicians who have been certified by CALCTP prior to the inclusion of training on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation shall qualify as Lighting Control Acceptance Test Technicians upon successful completion of a class or webinar consisting of at least four hours of instruction on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation.
- Employers who have been certified by CALCTP prior to the inclusion of training on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation shall qualify as a Lighting Control Acceptance Test Employer upon successful completion of a class or

  webinar consisting of at least four hours of instruction on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation.
- Interim approval for all ATTCPs shall end on the later date of, July 1, 2014 or six months after the effective date of the 2013 California Building Energy Efficiency Standards. The Energy Commission may extend the interim approval period for up to six additional months total, if it determines the threshold requirements in Section 10-103-A(b) have not been met for the certification requirements to take effect. If the Energy Commission determines that an extension is necessary, its determination shall be approved at a publicly-noticed meeting.
- During the interim approval period, including any possible extensions to this interim period, the Energy Commission may approve additional ATTCP providers meeting the requirements of 10-103-A(c). -

(f) **Application Review and Determination.** The Energy Commission shall review Acceptance Test Technician Certification Provider applications according to the criteria and procedures in Section 10-103-A(c) to determine if such providers are approved to provide acceptance testing certification services.

1. Energy Commission staff will review and validate all information received on Acceptance Test Technician Certification Provider applications, and determine that the application is complete and contains sufficient information to be approved.
2. The Executive Director may require that the applicant provide additional information as required by staff to fully evaluate the Provider application. The Executive Director shall provide a copy of its evaluation to interested persons and provide a reasonable opportunity for public comment.
3. The Executive Director shall issue a written recommendation that the Energy Commission designate the applicant as an authorized Acceptance Test Technician Certification Provider or deny the Provider application.
4. The Energy Commission shall make a final decision on the application at a publicly noticed hearing.

(g) **Review by the Energy Commission.**

If the Energy Commission determines there is a violation of these regulations or that an Acceptance Test Technician Certification Provider is no longer providing adequate certification services, the Energy Commission may revoke the authorization of the Acceptance Test Technician Certification Provider pursuant to Section 1230 et. seq. of Title 20 of the California Code of Regulations.

**NOTE:** Authority: Sections 25402, 25402.1, 25213, Public Resources Code. Reference: Sections 25007, 25402(a)-(b), 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code.

**Solar Ready Requirements** *§110.10 (e): Mandatory Requirements for Solar Ready Buildings*

Mandates a “Solar Zone” for:

- Single Family
- Low-rise Multi-family
- Hotel/Motel Occupancies & High Rise Multi Family
- All other Nonresidential Buildings 3 stories or less

Includes Interconnection Pathways, Documentation, and Main Service Panel requirements

# SUBCHAPTER 4 NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—MANDATORY REQUIREMENTS FOR LIGHTING SYSTEMS AND EQUIPMENT, AND ELECTRICAL POWER DISTRIBUTION SYSTEMS

## SECTION 130.0 – LIGHTING CONTROLS AND EQUIPMENT— GENERAL

(c) Except as provided in Subsection (b), the design and installation of all lighting systems and equipment in nonresidential, high-rise residential, hotel/motel buildings, outdoor lighting, and electrical power distribution systems subject to Part 6 shall comply with the applicable provisions of Sections 130.0 through 130.5.

(d) **Functional areas where compliance with the residential lighting Standards is required.** The design and installation of all lighting systems, lighting controls, and equipment in the following functional areas shall comply with the applicable provisions of Section 150.0(k). In buildings containing these functional areas, all other functional areas, such as common areas, shall comply with the applicable nonresidential lighting Standards.

1. High-rise residential dwelling units.
2. 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.
3. Fire station dwelling accommodations.
4. Hotel and motel guest rooms. Additionally, hotel and motel guest rooms shall meet the requirements of Section 130.1(c)8.
5. Dormitory and Senior housing dwelling accommodations.

(e) **Luminaire classification and power.** Luminaires shall be classified and wattage determined as follows:

1. **Luminaire labeling.** Luminaire wattage shall be labeled as follows:

   A. The maximum relamping rated wattage of a luminaire shall be listed on a permanent, preprinted, factory-installed label, as specified by UL 1574, 1598, 2108, or 8750, as applicable; and

   B, 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 to Section 130.0(c)1B:** Peel-down labels may be used only for the following luminaires when they can accommodate a range of lamp wattages without changing the luminaire housing, ballast, transformer or wiring. Qualifying luminaires shall have a single lamp, and shall have integrated

ballasts or transformers. Peel-down labels must be layered such that the rated wattage reduces as successive layers are removed.

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

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

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

2. For luminaires with line voltage lamp holders not containing permanently installed ballasts or transformers; the wattage of such luminaires shall be determined as follows:

   A. The maximum relamping rated wattage of the luminaire; and

   B. For recessed luminaires with line-voltage medium screw base sockets, wattage shall not be less than 50 watts per socket.

3. 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.

4. Screw based adaptors shall not be used to convert an incandescent luminaire to any type of no incandescent technology. Screw-based adaptors, including screw-base adaptors classified as permanent by the manufacturer, shall not be recognized for compliance with Part 6.

5. 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 no incandescent technology for compliance with Part 6.

6. Luminaires with permanently installed or remotely installed ballasts. The wattage of such luminaries shall be determined as follows:

   A. Wattage shall be the operating input wattage of the rated lamp/ballast combination published in ballast manufacturer's catalogs based on independent testing lab reports as specified by UL 1598.

   B. Replacement of lamps in a luminaire manufactured or rated for use with linear fluorescent lamps, with linear lamps of a different technology such as linear LED lamps, shall not be recognized as converting the fluorescent luminaire to a different technology for compliance with Part 6.

7. Line-voltage lighting track and plug-in busway that allows the addition or relocation of luminaires without altering the wiring of the system. The wattage of such luminaires shall be determined by one of the following methods:

   A. The wattage of line voltage busway and track rated for more than 20 amperes shall be the total volt- ampere rating of the branch circuit feeding the busway and track.

   B. The wattage of line voltage busway and track rated for 20 amperes or less shall be determined by one of the following methods:

      i. The volt-ampere rating of the branch circuit feeding the track or busway; or

      ii. The higher of the rated wattage of all of the luminaires included in the system, where luminaire classification and wattage is determined according to the applicable provisions in Section 130.0(c), or 45 watts per linear foot; or

      iii. When using a line-voltage track lighting integral current limiter, the higher of 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 Section 110.9, and shall comply with the Lighting Control Installation Requirements in accordance with Section 130.4, to qualify to use Subsection

Biii to determine luminaire power; or

iv. When using a dedicated track lighting supplementary overcurrent protection panel, the sum of the ampere (A) rating of all of the overcurrent protection devices times the branch circuit voltages. Track lighting supplementary overcurrent protection panels shall comply with the applicable requirements in Section 110.9, and shall comply with the Lighting Control Installation Requirements in accordance with Section 130.4, to qualify to use Subsection Biv to determine luminaire power.

8. Luminaires and lighting systems with permanently installed or remotely installed transformers. The wattage of such luminaires shall be determined as follows:

   A. 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.

   B. For low-voltage lighting systems, including low voltage tracks and other low-voltage lighting systems that allow the addition of lamps, lamp holders, or luminaires without rewiring, the wattage shall be the maximum rated input wattage of the transformer, labeled in accordance with Item 1, or the maximum rated wattage published in transformer manufacturer's catalogs, as specified by UL 2108.

9. Light emitting diode (LED) Luminaires, and LED Light Engine.

   A. The wattage of such luminaires shall be the maximum rated input wattage of the system when tested in accordance with IES LM-79-08.

   B. The maximum rated input wattage shall be labeled in accordance with Section 130.0(c)1.

   C. An LED lamp, integrated or nonintegrated type in accordance with the definition in ANSI/IES RP-16- 2010, shall not be classified as a LED lighting system for compliance with Part 6. LED modules having screwbases including screw based pig-tails, screw-based sockets, or screw-based adaptors shall not be recognized as a LED lighting system for compliance with Part 6.

   D. Luminaires and luminaire housings equipped with screw-base sockets shall not be classified as a LED lighting system for compliance with Part 6.

   E. Luminaires manufactured or rated for use with low-voltage incandescent lamps, into which have been installed LED modules or LED lamps, shall not be recognized as a LED lighting system for compliance with Part 6.

   F. For LED lighting systems that allow the addition of luminaires or light engines without rewiring, the wattage of such luminaires shall be the maximum rated input wattage of the power supply, labeled in accordance with Section 130.0(c)1 or published in the power supply manufacturer's catalog.

10. 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, labeled in accordance with Section 130.0(c)1, or published in manufacturer's catalogs, based on independent testing lab reports as specified by UL 1574 or UL 1598. Lighting technologies listed in Subsections 2 through 9 shall be determined in accordance with the applicable requirements in Subsections 1 through 9.

(f) **Lighting Controls**. All lighting controls and equipment shall comply with the applicable requirements in Section 110.9, and shall be installed in accordance with the manufacturer's instructions.

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# SECTION 130.1 – INDOOR LIGHTING CONTROLS THAT SHALL BE INSTALLED

(a) Area Controls.

1. All luminaires shall be functionally controlled with manually switched ON and OFF lighting controls. Each area enclosed by ceiling-height partitions shall be independently controlled.

   **EXCEPTION to Section 130.1(a)1:** Up to 0.2 watts per square foot of lighting in any area within a building may be continuously illuminated during occupied times to allow for emergency egress, if:

   A. The area is designated an emergency egress area on the plans and specifications submitted to the enforcement agency under Section 10-103(a)2 of Part 1; and

   B. The control switches for the egress lighting are not accessible to unauthorized personnel.

2. The lighting controls shall meet the following requirements:

   A. Be readily accessible; and

   B. Be operated with a manual switch that is located in the same room or area with the lighting that is controlled by that lighting control; and

   C. If controlling dimmable luminaires, be a dimmer switch that allows manual ON and OFF functionality, and is capable of manually controlling lighting through all lighting control steps that are required in Section 130.1(b).

   **EXCEPTION 1 to Section 130.1(a)2:** In malls, auditoriums, retail and wholesale sales floors, industrial facilities, convention centers, and arenas, the lighting control shall be located so that a person using the lighting control can see the lights or area controlled by that lighting control, or so that the area being lit is annunciated.

   **EXCEPTION 2 to Section 130.1(a)2:** Public restrooms having two or more stalls may use a manual switch not accessible to unauthorized personnel.

3. **Other Lighting Controls.**

   A. Other lighting controls may be installed in addition to the manual lighting controls provided they do not override the functionality of controls installed in accordance with Section 130.1(a)1, 2, or 4.

4. **Separately Controlled Lighting Systems.** In addition to the requirements in Section 130.1(a)1, 2, and 3:

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

   B. Floor and wall display, window display, case display, ornamental, and special effects lighting shall each be separately controlled on circuits that are 20 amps or less.

   C. When track lighting is used, general, display, ornamental, and special effects lighting shall each be separately controlled.

(b) **Multi-Level Lighting Controls.** The general lighting of any enclosed area 100 square feet or larger, with a connected lighting load that exceeds 0.5 watts per

square foot shall meet the following requirements:

1. Lighting shall have the required number of control steps and meet the uniformity requirements in accordance with TABLE 130.1-A; and
2. Multi-level lighting controls shall not override the functionally of other lighting controls required for compliance with Sections 130.1(a), and (c) through (e); and
3. Each luminaire shall be controlled by at least of one of the following methods:
   A. Manual dimming meeting the applicable requirements of Section 130.1(a)
   B. Lumen maintenance as defined in Section 100.1
   C. Tuning as defined in Section 100.1
   D. Automatic daylighting controls in accordance with Section 130.1(d)
   E. Demand responsive lighting controls in accordance with Section 130.1(e)

**EXCEPTION 1 to Section 130.1(b):** Classrooms, with a connected general lighting load of 0.7 watts per square feet and less, shall have at least one control step between 30-70 percent of full rated power.

**EXCEPTION 2 to Section 130.1(b):** An area enclosed by ceiling height partitions that has only one luminaire with no more than two lamps.

(c) **Shut-OFF Controls**

1. In addition to lighting controls installed to comply with Sections 130.1(a) and (b), all installed indoor lighting shall be equipped with controls that meet the following requirements:
   A. Shall be controlled with an occupant sensing control, automatic time-switch control, signal from another building system, or other control capable of automatically shutting OFF all of the lighting when the space is typically unoccupied; and
   B. Separate controls for the lighting on each floor; and
   C. Separate controls for a space enclosed by ceiling height partitions not exceeding 5,000 square feet; and

      **EXCEPTION to Section 130.1(c)1C:** In the following function areas the area controlled may not exceed 20,000 square feet: Malls, auditoriums, single tenant retail, industrial, convention centers, and arenas,
   D. Separate controls for general, display, ornamental, and display case lighting.

   **EXCEPTION 1 to Section 130.1(c)1:** Where the lighting is serving an area that is in continuous use, 24 hours per day/365 days per year.

   **EXCEPTION 2 to Section 130.1(c)1**: Lighting complying with Section 130.1(c)5, or 7.

   **EXCEPTION 3 to Section 130.1(c)1:** In office buildings, up to 0.05 watts per square foot of lighting in any area within a building may be continuously illuminated, provided that the area is designated an emergency egress area on the plans and specifications submitted to the enforcement agency under Section 10-103(a)2 of Part 1.

   **EXCEPTION 4 to Section 130.1(c)1**: Electrical equipment rooms subject to Article 110.26(D) of the California Electrical Code.

2. Countdown timer switches shall not be used to comply with the automatic shut-OFF control requirements in Section 130.1(c)1.

   **EXCEPTION 1 to Section 130.1(c)2:** Single-stall bathrooms less than 70 square feet, and closets less than 70 square feet may use countdown timer switches with a maximum setting capability of ten minutes to comply with the automatic shut-Off requirements.

   **EXCEPTION 2 to Section 130.1(c)2:** Lighting in a Server Aisle in a Server Room, as defined in Section 100.1, may use countdown timer switches with a maximum setting capability of 30 minutes to comply with the automatic shut-OFF requirements.

3. If an automatic time-switch control, other than an occupant sensing control, is installed to comply with Section 130.1(c)1, it shall incorporate an override lighting control that:

   A. Complies with Section 130.1(a); and

   B. Allows the lighting to remain ON for no more than 2 hours when an override is initiated.

   **EXCEPTION to Section 130.1(c)3B:** In the following function areas, the override time may exceed 2 hours: Malls, auditoriums, single tenant retail, industrial, and arenas where captive-key override is utilized.

4. If an automatic time-switch control, other than an occupant sensing control, is installed to comply with Section 130.1(c)1, it shall incorporate an automatic holiday "shut-OFF" feature that turns OFF all loads for at least 24 hours, and then resumes the normally scheduled operation.

   **EXCEPTION to Section 130.1(c)4:** In retail stores and associated malls, restaurants, grocery stores, churches, and theaters, the automatic time-switch control is not required to incorporate an automatic holiday shut-OFF feature.

5. **Areas where Occupant Sensing Controls are required to shut OFF All Lighting**. In offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms of any size, and conference rooms of any size, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting when the room is unoccupied. In addition, controls shall be provided that allow the lights to be manually shut-OFF in accordance with Section 130.1(a) regardless of the sensor status.

6. **Areas where partial ON/OFF occupant sensing controls are required** in addition to complying with Section 130.1(c)1.

   A. In aisle ways and open areas in warehouses, lighting shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls shall independently control lighting in each aisle way, and shall not control lighting beyond the aisle way being controlled by the sensor.

      **EXCEPTION 1 to Section 130.1(c)6A:** In aisle ways and open areas in warehouses in which the installed lighting power is 80 percent or less of the value allowed under the Area Category Method, occupant sensing controls shall reduce lighting power by at least 40 percent.

      **EXCEPTION 2 to Section 130.1(c)6A:** When metal halide lighting or high pressure sodium lighting is installed in warehouses, occupant sensing controls shall reduce lighting power by at least 40 percent.

   B. In library book stack aisles 10 feet or longer that are accessible from only one end, and library book stack aisles 20 feet or longer that are accessible from both ends, lighting shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls shall independently control lighting in each aisle way, and shall not control lighting beyond the aisle way being controlled by the sensor.

C. Lighting installed in corridors and stairwells shall be controlled by occupant sensing controls that separately reduce the lighting power in each space by at least 50 percent when the space is unoccupied. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress.

7. **Areas where partial ON/OFF occupant sensing controls are required** instead of complying with Section 130.1(c)1.

A. Lighting in stairwells and common area corridors that provide access to guestrooms and dwelling units of high-rise residential buildings and hotel/motels shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress.

**EXCEPTION to Section 130.1(c)7A:** In corridors and stairwells in which the installed lighting power is 80 percent or less of the value allowed under the Area Category Method, occupant sensing controls shall reduce power by at least 40 percent.

B. In parking garages, parking areas and loading and unloading areas, general lighting shall be controlled by occupant sensing controls having at least one control step between 20 percent and 50 percent of design lighting power. No more than 500 watts of rated lighting power shall be controlled together as a single zone. A reasonably uniform level of illuminance shall be achieved in accordance with the applicable requirements in TABLE 130.1-A. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress.

Interior areas of parking garages are classified as indoor lighting for compliance with Section 130.1(c)7B. Parking areas on the roof of a parking structure are classified as outdoor hardscape and shall comply with the applicable provisions in Section 130.2.

**EXCEPTION to Section 130.1(c)7B:** Metal halide luminaires with a lamp plus ballast mean system efficacy of greater than 75 lumens per watt, used for general lighting in parking garages, parking areas and loading and unloading areas, shall be controlled by occupant sensing controls having at least one control step between 20 percent and 60 percent of design lighting power.

8. Hotel motel guest rooms shall have captive card key controls, occupancy sensing controls, or automatic controls such that, no longer than 30 minutes after the guest room has been vacated, lighting power is switched off.
**EXCEPTION to Section 130.1(c)8**: One high efficacy luminaire as defined in TABLE 150.0-A or 150.0-B that is switched separately and where the switch is located within 6 feet of the entry door.

(d) **Automatic Daylighting Controls.**

1. Daylit Zones shall be defined as follows:

A. **SKYLIT DAYLIT ZONE** is the rough area in plan view under each skylight, plus 0.7 times the average ceiling height in each direction from the edge of the rough opening of the skylight, minus any area on a plan beyond a permanent obstruction that is taller than the following: A permanent obstruction that is taller than one-half the distance from the floor to the bottom of the skylight. The bottom of the skylight is measured from the bottom of the skylight well for skylights having wells, or the bottom of the skylight if no skylight well exists.

For the purpose of determining the skylit daylit zone, the geometric shape of the skylit daylit zone shall be identical to the plan view geometric shape of the rough opening of the skylight; for example, for a rectangular skylight the skylit daylit zone plan area shall be rectangular, and for a circular skylight the skylit daylit zone plan area shall be circular.

B. **PRIMARY SIDELIT DAYLIT ZONE** is the area on a plan directly adjacent to each vertical glazing, one window head height deep into the area, and

window width plus 0.5 times window head height wide on each side of the rough opening of the window, minus any area on a plan beyond a permanent obstruction that is 6 feet or taller as measured from the floor.

C. **SECONDARY SIDELIT DAYLIT ZONE** is the area on a plan directly adjacent to each vertical glazing, two window head heights deep into the area, and window width plus 0.5 times window head height wide on each side of the rough opening of the window, minus any area on a plan beyond a permanent obstruction that is 6 feet or taller as measured from the floor.

**Note**: Modular furniture walls shall not be considered a permanent obstruction.

2. Luminaires providing general lighting that are in or are partially in the Skylit Daylit Zones or the Primary Sidelit Daylit Zones shall be controlled independently by fully functional automatic daylighting controls that meet the applicable requirements of Section 110.9, and the applicable requirements below:

   A. All Skylit Daylit Zones and Primary Sidelit Daylit Zones shall be shown on the plans.

   B. Luminaires in the Skylit Daylit Zone shall be controlled separately from those in the Primary Sidelit Daylit Zones.

   C. Luminaires that fall in both a Skylit and Primary Sidelit Daylit Zone shall be controlled as part of the Skylit Daylit Zone.

   D. **Automatic Daylighting Control Installation and Operation**. For luminaires in daylight zones, automatic daylighting controls shall be installed and configured to operate according to all of the following requirements:

      i. Photosensors shall be located so that they are not readily accessible to unauthorized personnel, and the location where calibration adjustments are made to automatic daylighting controls shall not be readily accessible to unauthorized personnel.

      ii. Automatic daylighting controls shall provide functional multilevel lighting having at least the number of control steps specified in TABLE 130.1-A.

      **EXCEPTION 1 to Section 130.1(d)2Dii:** Controlled lighting having a lighting power density less than 0.3 $W/ft^2$ is not required to provide multilevel lighting controls.

      **EXCEPTION 2 to Section 130.1(d)2Dii:** When skylights are replaced or added to an existing building where there is an existing general lighting system that is not being altered, multilevel lighting controls are not required.

      iii. For each space, the combined illuminance from the controlled lighting and daylight shall not be less than the illuminance from controlled lighting when no daylight is available.

      iv. In areas served by lighting that is daylight controlled, when the illuminance received from the daylight is greater than 150 percent of the design illuminance received from the general lighting system at full power, the general lighting power in that daylight zone shall be reduced by a minimum of 65 percent.

   **EXCEPTION 1 to Section 130.1(d)2:** Rooms in which the combined total installed general lighting power in the Skylit Daylit Zone and Primary Sidelit Daylit Zone is less than 120 Watts.

   **EXCEPTION 2 to Section 130.1(d)2:** Rooms that have a total glazing area of less than 24 square feet.

   **EXCEPTION 3 to Section 130.1(d)2:** Parking garages complying with Section 130.1(d)3.

3. **Parking Garage Daylighting Requirements**. In a parking garage area with a combined total of 36 square feet or more of glazing or opening, luminaires

providing general lighting that are in the combined primary and secondary sidelit daylit zones shall be controlled independently by automatic daylighting controls, and shall meet the following requirements as applicable:

A. All primary and secondary sidelit daylit zones shall be shown on the plans.

B. Automatic Daylighting Control Installation and Operation. Automatic daylighting control shall be installed and configured to operate according to all of the following requirements:

   i. Automatic daylighting controls shall have photosensors that are located so that they are not readily accessible to unauthorized personnel, and the location where calibration adjustments are made to the automatic daylighting controls shall not be readily accessible to unauthorized personnel.

   ii. Automatic daylighting controls shall be multilevel, continuous dimming or ON/OFF.

   iii. The combined illuminance from the controlled lighting and daylight shall not be less than the illuminance from controlled lighting when no daylight is available.

   iv. When primary sidelit zones receive illuminance levels greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power consumption shall be zero.

**EXCEPTION 1 to Section 130.1(d)3:** Luminaires located in the daylight transition zone and luminaires for only dedicated ramps. Daylight transition zone and dedicated ramps are defined in Section 100.1.

**EXCEPTION 2 to Section 130.1(d)3:** The total combined general lighting power in the primary sidelit daylight zones is less than 60 watts.

(e) **Demand Responsive Controls.**

Lighting power in buildings larger than 10,000 square feet shall be capable of being automatically reduced in response to a Demand Response Signal; so that the building's total lighting power can be lowered by a minimum of 15 percent below the total installed lighting power. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in TABLE 130.1-A.

Spaces that are non-habitable shall not be used to comply with this requirement, and spaces with a lighting power density of less than 0.5 watts per square foot shall not be counted toward the building's total lighting power.

TABLE 130.1-A MULTI-LEVEL LIGHTING CONTROLS AND UNIFORMITY REQUIREMENTS

| **Luminaire Type** | **Minimum Required Control Steps ( percent of full rated power[1] )** | | | | **Uniform level of illuminance shall be achieved by:** |
|---|---|---|---|---|---|
| Line-voltage sockets except GU-24 | Continuous dimming 10-100 percent | | | | |
| Low-voltage incandescent systems | | | | | |
| LED luminaires and LED source systems | | | | | |
| GU-24 rated for LED | | | | | |
| GU-24 sockets rated for fluorescent > 20 watts | Continuous dimming 20-100 percent | | | | |
| Pin-based compact fluorescent > 20 watts[2] | | | | | |
| GU-24 sockets rated for fluorescent ≤ 20 watts | Minimum one step between 30-70 percent | | | | Stepped dimming; or<br>Continuous dimming; or<br>Switching alternate lamps in a luminaire |
| Pin-based compact fluorescent ≤ 20 watts[2] | | | | | |
| Linear fluorescent and U-bent fluorescent ≤ 13 watts | | | | | |
| Linear fluorescent and U-bent fluorescent > 13 watts | Minimum one step in each range: | | | | Stepped dimming; or<br>Continuous dimming; or<br>switching alternate lamps in each luminaire, having a minimum of 4 lamps per luminaire, illuminating the same area and in the same manner |
| | 20-40 % | 50-70 % | 80-85 % | 100 % | |
| Track Lighting | Minimum one step between 30 – 70 percent | | | | Step dimming; or<br>Continuous dimming; or<br>Separately switching circuits in multi-circuit track with a minimum of two circuits. |
| HID > 20 watts | | | | | |

| | | |
|---|---|---|
| Induction > 25 watts | Minimum one step between 50 - 70 percent | Stepped dimming; or<br>Continuous dimming; or<br>Switching alternate lamps in each luminaire, having a minimum of 2 lamps per luminaire, illuminating the same area and in the same |
| Other light sources | | |
| 1. Full rated input power of ballast and lamp, corresponding to maximum ballast factor<br>2. Includes only pin based lamps: twin tube, multiple twin tube, and spiral lamps | | |

# SECTION 130.2 – OUTDOOR LIGHTING CONTROLS AND EQUIPMENT

(a) **Outdoor Incandescent Lighting.** All outdoor incandescent luminaires rated over 100 watts, determined in accordance with Section 130.0(c)2, shall be controlled by a motion sensor.

(b) **Luminaire Cutoff Requirements.** All outdoor luminaires rated for use with lamps greater than 150 lamp watts, determined in accordance with Section 130.0(c), shall comply with Backlight, Uplight, and Glare (collectively referred to as "BUG" in accordance with IES TM-15-11, Addendum A) requirements as follows:

1. There are no Backlight requirements in Section 130.2 of Part 6; and
2. Maximum zonal lumens for Uplight shall be in accordance with TABLE 130.2-A; and
3. Maximum zonal lumens for Glare shall be in accordance with TABLE 130.2-B.

**EXCEPTION 1 to Section 130.2(b):** Signs.

**EXCEPTION 2 to Section 130.2(b):** Lighting for building facades, public monuments, statues, and vertical surfaces of bridges.

**EXCEPTION 3 to Section 130.2(b):** Lighting not permitted by a health or life safety statute, ordinance, or regulation to be a cutoff luminaire.

**EXCEPTION 4 to Section 130.2(b):** Temporary outdoor lighting**.**

**EXCEPTION 5 to Section 130.2(b):** Replacement of existing pole mounted luminaires in hardscape areas meeting all of the following conditions:

A. Where the existing luminaire does not meet the luminaire BUG requirements in Section 130.2(b); and
B. Spacing between existing poles is greater than six times the mounting height of the existing luminaires; and
C. Where no additional poles are being added to the site; and
D. Where new wiring to the luminaires is not being installed; and
E. Provided that the connected lighting power wattage is not increased.

**EXCEPTION 6 to Section 130.2(b):** Luminaires that illuminate the public right of way on publicly maintained roadways, sidewalks, and bikeways.

(c) **Controls for Outdoor Lighting.** Outdoor lighting controls shall be installed that meet the following requirements as applicable:

**EXCEPTION 1 to Section 130.2(c):** Outdoor lighting not permitted by a health or life safety statute, ordinance, or regulation to be turned OFF.

**EXCEPTION 2 to Section 130.2(c):** Lighting in tunnels required to be illuminated 24 hours per day and 365 days per year.

1. All installed outdoor lighting shall be controlled by a photocontrol or outdoor astronomical time-switch control that automatically turns OFF the outdoor lighting when daylight is available.
2. All installed outdoor lighting shall be circuited and independently controlled from other electrical loads by an automatic scheduling control.

3. All installed outdoor lighting, where the bottom of the luminaire is mounted 24 feet or less above the ground, shall be controlled with automatic lighting controls that meet all of the following requirements:

   A. Shall be motion sensors or other lighting control systems that automatically controls lighting in accordance with Item B in response to the area being vacated of occupants; and

   B. Shall be capable of automatically reducing the lighting power of each luminaire by at least 40 percent but not exceeding 80 percent, or provide continuous dimming through a range that includes 40 percent through 80 percent, and

   C. Shall employ auto-ON functionality when the area becomes occupied; and

   D. No more than 1,500 watts of lighting power shall be controlled together.

   **EXCEPTION 1 to Section 130.2(c)3:** Lighting for Outdoor Sales Frontage, Outdoor Sales Lots, and Outdoor Sales Canopies complying with Section 130.2(c)4.

   **EXCEPTION 2 to Section 130.2(c)3:** Lighting for Building Facades, Ornamental Hardscape and Outdoor Dining complying with Section 130.2(c)5.

   **EXCEPTION 3to Section 130.2(c)3**:, Outdoor lighting, where luminaire rated wattage is determined in accordance with Section 130.0(c), and which meet one of the following conditions:

      A. Pole-mounted luminaires each with a maximum rated wattage of 75 watts; or

      B. Non-pole mounted luminaires with a maximum rated wattage of 30 watts each; or

      C. Linear lighting with a maximum wattage of 4 watts per linear foot of luminaire.

   **EXCEPTION 4 to Section 130.2(c)3:** Applications listed as Exceptions to Section 140.7(a) shall not be required to meet the requirements of Section 130.2(c)3.

4. For Outdoor Sales Frontage, Outdoor Sales Lots, and Outdoor Sales Canopies lighting, an automatic lighting control shall be installed that meets the following requirements:

   A. A part-night outdoor lighting control as defined in Section 100.1; or

   B. Motion sensors capable of automatically reducing lighting power by at least 40 percent but not exceeding 80 percent, and which have auto-ON functionality.

5. For Building Facade, Ornamental Hardscape and Outdoor Dining lighting, an automatic lighting control shall be installed that meets one or more of the following requirements:

   A. A part-night outdoor lighting control as defined in Section 100.1; or

   B. Motion sensors capable of automatically reducing lighting power by at least 40 percent but not exceeding 80 percent, and which have auto-ON functionality; or

   C. A centralized time-based zone lighting control capable of automatically reducing lighting power by at least 50 percent.

   D. Outdoor wall mounted luminaires having a bilaterally symmetric distribution as described in the IES Handbook (typically referred to as "wall packs") where the bottom of the luminaire is mounted 24 feet or less above the ground shall comply with the applicable requirements in Section 130.2(c)3.

*TABLE 130.2-A Uplight Ratings (Maximum Zonal Lumens)*

| **Secondary Solid Angle** | **Maximum Zonal Lumens per Outdoor Lighting Zone** | | | |
|---|---|---|---|---|
| | OLZ 1 | OLZ 2 | OLZ 3 | OLZ 4 |
| Uplight High (UH)<br>100 to 180 degrees | 10 | 50 | 500 | 1,000 |
| Uplight Low (UL)<br>90 to <100 degrees | 10 | 50 | 500 | 1,000 |

*TABLE 130.2-B Glare Ratings (Maximum Zonal Lumens)*

| **Glare Rating for Asymmetrical Luminaire Types (Type 1, Type II, Type III, Type IV)** | | | | |
|---|---|---|---|---|
| **Secondary Solid Angle** | **Maximum Zonal Lumens per Outdoor Lighting Zone** | | | |
| | OLZ 1 | OLZ 2 | OLZ 3 | OLZ 4 |
| Forward Very High (FVH)<br>80 to 90 degrees | 100 | 225 | 500 | 750 |
| Backlight Very High (BVH)<br>80 to 90 degrees | 100 | 225 | 500 | 750 |
| Forward High (FH)<br>60 to <80 degrees | 1,800 | 5,000 | 7,500 | 12,000 |
| Backlight High (BH)<br>60 to <80 degrees | 500 | 1,000 | 2,500 | 5,000 |
| | | | | |
| **Glare Rating for Quadrilateral Symmetrical Luminaire Types (Type V, Type V Square)** | | | | |
| **Secondary Solid Angle** | **Maximum Zonal Lumens per Outdoor Lighting Zone** | | | |
| | **OLZ 1** | **OLZ 2** | **OLZ 3** | **OLZ 4** |
| Forward Very High (FVH)<br>80 to 90 degrees | 100 | 225 | 500 | 750 |
| Backlight Very High (BVH)<br>80 to 90 degrees | 100 | 225 | 500 | 750 |
| Forward High (FH)<br>60 to <80 degrees | 1,800 | 5,000 | 7,500 | 12,000 |
| Backlight High (BH)<br>60 to <80 degrees | 1,800 | 5,000 | 7,500 | 12,000 |

# SECTION 130.3 – SIGN LIGHTING CONTROLS

(a) **Controls for Sign Lighting.** All sign lighting shall meet the requirements below as applicable:

1. **Indoor Signs.** All indoor sign lighting shall be controlled with an automatic time-switch control or astronomical time-switch control.
2. **Outdoor Signs.** Outdoor sign lighting shall meet the following requirements as applicable:
   A. All outdoor sign lighting shall be controlled with a photocontrol in addition to an automatic time-switch control, or an astronomical time-switch control.

      **EXCEPTION to Section 130.3(a)2A:** Outdoor signs in tunnels, and signs in large permanently covered outdoor areas that are intended to be continuously lit, 24 hours per day and 365 days per year.

   B. All outdoor sign lighting that is ON both day and night shall be controlled with a dimmer that provides the ability to automatically reduce sign lighting power by a minimum of 65 percent during nighttime hours. Signs that are illuminated at night and for more than 1 hour during daylight hours shall be considered ON both day and night.

      **EXCEPTION to Section 130.3(a)2B:** Outdoor signs in tunnels and large covered areas that are intended to be illuminated both day and night.
3. **Demand Responsive Electronic Message Center Control.** An Electronic Message Center (EMC) having a new connected lighting power load greater than 15 kW shall have a control installed that is capable of reducing the lighting power by a minimum of 30 percent when receiving a demand response signal.

   **EXCEPTION to Section 130.3(a)3:** Lighting for EMCs that is not permitted by a health or life safety statute, ordinance, or regulation to be reduced by 30 percent.

# SECTION 130.4 –LIGHTING CONTROL ACCEPTANCE AND INSTALLATION CERTIFICATE REQUIREMENTS

(a) **Lighting Control Acceptance Requirements.** Before an occupancy permit is granted for a newly constructed building or area, or a new lighting system serving a building, area, or site is operated for normal use, all indoor and outdoor lighting controls serving the building, area, or site shall be certified as meeting the Acceptance Requirements for Code Compliance in accordance with Section 130.4. A Certificate of Acceptance shall be submitted to the enforcement agency under Section 10-103(a) of Part 1, that:

1. Certifies plans, specifications, installation certificates, and operating and maintenance information meet the requirements of Part 6.
2. Completes the applicable procedures in Reference Nonresidential Appendix NA7.6, NA7.7, NA7.8, and NA7.9; and submits all applicable compliance forms.
3. Certifies that automatic daylight controls comply with Section 130.1(d) and Reference Nonresidential Appendix NA7.6.1
4. Certifies that lighting shut-OFF controls comply with Section 130.1(c) and Reference Nonresidential Appendix NA7.6.2
5. Certifies that demand responsive controls comply with Section 130.1(e) and Reference Nonresidential Appendix NA7.6.3
6. Certifies that outdoor lighting controls comply with the applicable requirements of Section 130.2(c) and Reference Nonresidential Appendix NA7.8.

(b) **Lighting Control Installation Certificate Requirements.** To be recognized for compliance with Part 6 an Installation Certificate shall be submitted in accordance with Section 10-103(a) for any lighting control system, Energy Management Control System, track lighting integral current limiter, track lighting supplementary overcurrent protection panel, interlocked lighting system, lighting Power Adjustment Factor, or additional wattage available for a videoconference studio, in accordance with the following requirements, as applicable:

1. Certification that when a lighting control system is installed to comply with lighting control requirements in Part 6 it complies with the applicable requirements of Section 110.9; and complies with Reference Nonresidential Appendix NA7.7.1.
2. Certification that when an Energy Management Control System is installed to function as a lighting control required by Part 6 it functionally meets all applicable requirements for each application for which it is installed, in accordance with Sections 110.9, 130.0 through 130.5, 140.6 through 150.0, and 150.2; and complies with Reference Nonresidential Appendix NA7.7.2.
3. Certification that line-voltage track lighting integral current limiters comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.3.
4. Certification that line-voltage track lighting supplementary overcurrent protection panels comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.4.
5. Certification that interlocked lighting systems used to serve an approved area comply with Section 140.6(a)1; and comply with Reference Nonresidential Appendix NA7.7.5.
6. Certification that lighting controls installed to earn a lighting Power Adjustment Factor (PAF) comply with Section 140.6(a)2; and comply with Reference Nonresidential Appendix NA7.7.6.
7. Certification that additional lighting wattage installed for a videoconference studio complies with Section 140.6(c)2Gvii; and complies with Reference Nonresidential Appendix NA7.7.7.

(c) When certification is required by Title 24, Part 1, Section 10-103-A, the acceptance testing specified by Section 130.4 shall be performed by a Certified Lighting Controls Acceptance Test Technician (CLCATT). If the CLCATT is operating as an employee, the CLCATT shall be employed by a Certified Lighting Controls Acceptance Test Employer. The CLCATT shall disclose on the Certificate of Acceptance a valid CLCATT certification identification number issued by an approved Acceptance Test Technician Certification Provider. The CLCATT shall complete all Certificate of Acceptance documentation in accordance with the applicable requirements in Section 10-103(a)4.

**NOTE:** Authority: Sections 25402, 25402.1, 25213, Public Resources Code. Reference: Sections 25007, 25402(a)-(b), 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code.

## SECTION 130.5 –ELECTRICAL POWER DISTRIBUTION SYSTEMS

(a) **Service Metering.** Each electrical service shall have permanently installed user-accessible metering of total electrical energy use per TABLE 130.5-A.

**EXCEPTION to Section 130.5(a)** Buildings for which the utility company provides a meter for occupant or user use that indicates instantaneous kW demand and kWh for a user-resettable period.

(b) **Disaggregation of Electrical Circuits**. Electrical power distribution systems shall be designed to permit the disaggregated measurement of electrical load energy uses downstream from the service meter according to TABLE 130.5-B. Additive and subtractive methods may be used to determine aggregate and disaggregated energy use. This may be accomplished by any of the following methods:

1. Separate switchboards, motor control centers, or panelboards to which are connected only the required load or group of loads; or
2. Subpanels of the above to which are connected only the required load or group of loads and for which the subpanel load can be independently measured in aggregate; or
3. Branch circuits, taps or disconnects requiring overcurrent protection devices rated 60 amperes or greater.

**EXCEPTION 1 to Section 130.5(b)** Buildings for which a complete metering and measurement system is provided that at a minimum measures and reports the loads called for in TABLE 130.5-B.

**EXCEPTION 2 to Section 130.5(b)** Alterations where all of the following conditions exist are not required to comply with this section:

A. The following existing equipment remains in place:
   i. Service distribution switchboards or panelboards; and
   ii. Feeders; and
   iii. Motor control centers or panelboards.

B. Existing equipment included in Item A (above) remains unaltered except for:
   i. Changes to load circuit connections; or
   ii. Changes to the quantity of outgoing overcurrent protection devices; or

iii. Changes to the ampacity of outgoing overcurrent protection devices.

(c) **Voltage Drop**

1. **Feeders.** Feeder conductors shall be sized for a maximum voltage drop of 2 percent at design load.
2. **Branch Circuits.** Branch circuit conductors shall be sized for a maximum voltage drop of 3 percent at design load.

**EXCEPTION to Section 130.5(c):** Feeder conductors and branch circuits that are dedicated to emergency services.

(d) **Circuit Controls for 120-Volt Receptacles**. In all buildings, both controlled and uncontrolled 120 volt receptacles shall be provided in each private office, open office area, reception lobby, conference room, kitchenette in office spaces, and copy room. Additionally, hotel/motel guest rooms shall comply with Item 5. Controlled receptacles shall meet the following requirements, as applicable:

1. Electric circuits serving controlled receptacles shall be equipped with automatic shut-OFF controls following the requirements prescribed in Section 130.1(c)(1 through 5); and
2. At least one controlled receptacle shall be installed within 6 feet from each uncontrolled receptacle or a splitwired duplex receptacle with one controlled and one uncontrolled receptacle shall be installed; and
3. Controlled receptacles shall have a permanent marking to differentiate them from uncontrolled receptacles; and
4. For open office areas, controlled circuits shall be provided and marked to support installation and configuration of office furniture with receptacles that comply with Section 130.5(d) 1, 2, and 3; and
5. For hotel and motel guest rooms at least one-half of the 120-volt receptacles in each guest room shall be controlled receptacles that comply with Section 130.5(d)1, 2, and 3. Electric circuits serving controlled receptacles shall have captive card key controls, occupancy sensing controls, or automatic controls such that, no longer than 30 minutes after the guest room has been vacated, power is switched off.
6. Plug-in strips and other plug-in devices that incorporate an occupant sensor shall not be used to comply with this requirement.

**EXCEPTION 1 to Section 130.5(d):** In open office areas, controlled circuit receptacles are not required if, at time of final permit, workstations are installed, and each workstation is equipped with an occupant sensing control that is permanently mounted in each workstation, and which controls a hardwired, nonresidential-rated power strip. Plug-in strips and other plug-in devices that incorporate an occupant sensor shall not be used for this exception.

**EXCEPTION 2 to Section 130.5(d):** Receptacles that are only for the following purposes:

i. Receptacles specifically for refrigerators and water dispensers in kitchenettes.

ii. Receptacles located a minimum of six feet above the floor that are specifically for clocks.

iii. Receptacles for network copiers, fax machines, A/V and data equipment other than personal computers in copy rooms.

iv. Receptacles on circuits rated more than 20 amperes.

(e) **Demand responsive controls and equipment.** Demand responsive controls and equipment shall be capable of receiving and automatically responding to at least one standards based messaging protocol which enables demand response after receiving a demand response signal.

(f) **Energy Management Control System (EMCS)**.

1. An EMCS may be installed to comply with the requirements of one or more lighting controls if it meets the following minimum requirements:
   A. Provides all applicable functionality for each specific lighting control or system for which it is installed in accordance with Section 110.9; and
   B. Complies with all applicable Lighting Control Installation Requirements in accordance with Section 130.4 for each specific lighting control or system for which it is installed; and
   C. Complies with all applicable application requirements for each specific lighting control or system for which it is installed, in accordance with Part 6.
2. An EMCS may be installed to comply with the requirements of a thermostat if it complies with all applicable application requirements for each thermostat in accordance with Part 6.

*TABLE 130.5-A MINIMUM REQUIREMENTS FOR METERING OF ELECTRICAL LOAD*

| **Meter Type** | **Services rated 50 kVA or less** | **Services rated more than 50kVA and less than or equal to 250 kVA** | **Services rated more than 250 kVA and less than or equal to 1000kVA** | **Services rated more than 1000kVA** |
|---|---|---|---|---|
| Instantaneous (at the time) kW demand | Required | Required | Required | Required |
| Historical peak demand (kW) | Not required | Not required | Required | Required |
| Resettable kWh | Required | Required | Required | Required |
| kWh per rate period | Not required | Not required | Not required | Required |

*TABLE 130.5-B MINIMUM REQUIREMENTS FOR SEPARATION OF ELECTRICAL LOAD*

| Load Type | Services rated 50 kVA or less | Services rated more than 50kVA and less than or equal to 250 kVA | Services rated more than 250 kVA and less than or equal to 1000kVA | Services rated more than 1000kVA |
|---|---|---|---|---|
| Lighting including exit and egress lighting and exterior lighting | Not required | All lighting in aggregate | All lighting disaggregated by floor, type or area | All lighting disaggregated by floor, type or area |
| HVAC systems and components including chillers, fans, heaters, furnaces, package units, cooling towers, and circulation pumps associated with HVAC | Not required | All HVAC in aggregate | All HVAC in aggregate and each HVAC load rated at least 50 kVA | All HVAC in aggregate and each HVAC load rated at least 50kVA |
| Domestic and service water system pumps and related systems and components | Not required | All loads in aggregate | All loads in aggregate | All loads in aggregate |
| Plug load including appliances rated less than 25 kVA | Not required | All plug load in aggregate<br>Groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf | All plug load separated by floor, type or area<br>Groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf | All plug load separated by floor, type or area<br>All groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf |
| Elevators, escalators, moving walks, and transit systems | Not required | All loads in aggregate | All loads in aggregate | All loads in aggregate |
| Other individual non-HVAC loads or appliances rated 25kVA or greater | Not required | All | Each | Each |
| Industrial and commercial load centers 25 kVA or greater including theatrical lighting installations and commercial kitchens | Not required | All | Each | Each |
| Renewable power source (net or total) | Each group | Each group | Each group | Each group |
| Loads associated with renewable power source | Not required | All loads in aggregate | All loads in aggregate | All loads in aggregate |
| Charging stations for electric vehicles | All loads in aggregate | All loads in aggregate | All loads in aggregate | All loads in aggregate |

## SECTION 140.5 – PRESCRIPTIVE REQUIREMENTS FOR SERVICE WATER HEATING SYSTEMS

(a) **Nonresidential Occupancies.** A service water heating system installed in a nonresidential building complies with this section if it complies with the applicable requirements of Sections 110.1, 110.3 and 120.3.

(b) **High-Rise Residential and Hotel/Motel Occupancies.** A service water heating system installed in a high-rise residential or hotel/motel building complies with this section if it meets the requirements of Section 150.1(c)8.

## SECTION 140.6 – PRESCRIPTIVE REQUIREMENTS FOR INDOOR LIGHTING

A building complies with this section if:

i. The Calculation of Actual Indoor Lighting Power Density of all proposed building areas combined, calculated under Subsection (a) is no greater than the Density Calculation of Allowed Indoor Lighting Power Density, Specific Methodologies calculated under Subsection (c); and

ii. The Calculation of Allowed Indoor Lighting Power Density, General Rules comply with Subsection (b); and

iii. General lighting complies with the Automatic Daylighting Controls in Secondary Daylit Zone requirements in Subsection (d).

(a) **Calculation of Actual Indoor Lighting Power Density.** The actual indoor Lighting Power Density of all proposed building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building; subject to the applicable adjustments under Subdivisions 1 through 3 of this subsection and the requirements of Subdivision 4 of this subsection.

**EXCEPTION to Section 140.6(a):** Up to 0.3 watts per square foot of portable lighting for office areas shall not be required to be included in the calculation of actual indoor Lighting Power Density.

1. **Two interlocked lighting systems**: No more than two lighting systems may be used for an area, and if there are two they must be interlocked. Where there are two interlocked lighting systems, the watts of the lower wattage system may be excluded from the actual indoor Lighting Power Density if:

   A. An Installation Certificate detailing compliance with Section 140.6(a)1 is submitted in accordance with Section 10-103 and Section 130.4; and

   B. The area or areas served by the interlocking systems is an auditorium, a convention center, a conference room, a multipurpose room, or a theater; and

   C. The two lighting systems are interlocked with a Nonprogrammable Double-Throw Switch to prevent simultaneous operation of both systems.

      For compliance with Part 6 a Nonprogrammable Double-Throw Switch is an electrical switch commonly called a "single pole double throw" or "three-way" switch that is wired as a selector switch allowing one of two loads to be enabled. It can be a line voltage switch or a low voltage switch selecting between two relays. It cannot be overridden or changed in any manner that would permit both loads to operate simultaneously.

2. **Reduction of wattage through controls.** In calculating actual indoor Lighting Power Density, the installed watts of a luminaire providing general lighting in an area listed in TABLE 140.6-A may be reduced by the product of (i) the number of watts controlled as described in TABLE 140.6-A, times (ii) the applicable Power Adjustment Factor (PAF), if all of the following conditions are met:

   A. An Installation Certificate is submitted in accordance with Section 130.4(b); and

B. Luminaires and controls meet the applicable requirements of Section 110.9, and Sections 130.0 through 130.5; and

C. The controlled lighting is permanently installed general lighting systems and the controls are permanently installed nonresidential-rated lighting controls. (Thus, for example, portable lighting, portable lighting controls, and residential rated lighting controls shall not qualify for PAFs.)

When used for determining PAFs for general lighting in offices, furniture mounted luminaires that comply with all of the following conditions shall qualify as permanently installed general lighting systems:

i. The furniture mounted luminaires shall be permanently installed no later than the time of building permit inspection; and

ii. The furniture mounted luminaires shall be permanently hardwired; and

iii. The furniture mounted lighting system shall be designed to provide indirect general lighting; and

iv. Before multiplying the installed watts of the furniture mounted luminaire by the applicable PAF, 0.3 watts per square foot of the area illuminated by the furniture mounted luminaires shall be subtracted from installed watts of the furniture mounted luminaires; and

v. The lighting control for the furniture mounted luminaire complies with all other applicable requirements in Section 140.6(a)2.

D. At least 50 percent of the light output of the controlled luminaire is within the applicable area listed in TABLE 140.6-A. Luminaires on lighting tracks shall be within the applicable area in order to qualify for a PAF.

E. Only one PAF from TABLE 140.6-A may be used for each qualifying luminaire. PAFs shall not be added together unless allowed in TABLE 140.6-A.

F. Only lighting wattage directly controlled in accordance with Section 140.6(a)2 shall be used to reduce the calculated actual indoor Lighting Power Densities as allowed by Section 140.6(a)2. If only a portion of the wattage in a luminaire is controlled in accordance to Section 140.6(a)2, then only that portion of controlled wattage may be reduced in calculating actual indoor Lighting Power Density.

G. Lighting controls used to qualify for a PAF shall be designed and installed in addition to manual, multilevel, and automatic lighting controls required in Section 130.1, and in addition to any other lighting controls required by any provision of Part 6. PAFs shall not be available for lighting controls required by Part 6.

**EXCEPTION to Section 140.6(a)2G:** Lighting controls designed and installed for the sole purpose of compliance with Section 130.1(b)3 may be used to qualify for a PAF, provided the lighting controls are designed and installed in addition to all manual, and automatic lighting controls otherwise required in Section 130.1.

H. To qualify for the PAF for a Partial-ON Occupant Sensing Control in TABLE 140.6-A, a Partial-On Occupant Sensing Control shall meet all of the following requirements:

i. The control shall automatically deactivate all of the lighting power in the area within 30 minutes after the room has been vacated; and

ii. The first stage shall automatically activate between 30-70 percent of the lighting power in the area and may be a switching or dimming system; and

iii. The second stage shall require manual activation of the alternate set of lights, and this manual-ON requirements shall not be capable of conversion from manual-ON to automatic-ON functionality via manual switches or dip switches; and

iv. Switches shall be located in accordance with Section 130.1(a) and shall allow occupants to manually do all of the following regardless of the sensor status: activate the alternate set of lights in accordance with Item (iii); activate 100 percent of the lighting power; and deactivate all of the lights.

I. To qualify for the PAF for an occupant sensing control controlling the general lighting in large open plan office areas above workstations, in accordance with TABLE 140.6-A, the following requirements shall be met:

i. The open plan office area shall be greater than 250 square feet; and

ii. This PAF shall be available only in office areas which contain workstations; and

iii. Controlled luminaires shall only be those that provide general lighting directly above the controlled area, or furniture mounted luminaires that comply with Section 140.6(a)2 and provide general lighting directly above the controlled area; and

iv. Qualifying luminaires shall be controlled by occupant sensing controls that meet all of the following requirements, as applicable:

a. Infrared sensors shall be equipped by the manufacturer, of fitted in the field by the installer, with lenses or shrouds to prevent them from being triggered by movement outside of the controlled area.

b. Ultrasonic sensors shall be tuned to reduce their sensitivity to prevent them from being triggered by movements outside of the controlled area.

c. All other sensors shall be installed and adjusted as necessary to prevent them from being triggered by movements outside of the controlled area.

J. To qualify for the PAF for a Manual Dimming System PAF or a Multiscene Programmable Dimming System PAF in TABLE 140.6-A, the lighting shall be controlled with a control that can be manually operated by the user.

K. To qualify for the PAF for a Demand Responsive Control in TABLE 140.6-A, a Demand Responsive Control shall meet all of the following requirements:

i. The building shall be 10,000 square feet or smaller; and

ii. The controlled lighting shall be capable of being automatically reduced in response to a demand response signal; and

iii. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in TABLE 130.1-A; and

iv. Spaces that are non-habitable shall not be used to comply with this requirement, and spaces with a lighting power density of less than 0.5 watts per square foot shall not be counted toward the building's total lighting power.

L. To qualify for the PAF for Combined Manual Dimming plus Partial-ON Occupant Sensing Control in TABLE 140.6-A, (i) the lighting controls shall comply with the applicable requirements in Section 140.6(a)2J; and (ii) the lighting shall be controlled with a dimmer control that can be manually operated, or with a multi-scene programmable control that can be manually operated.

3. **Lighting wattage excluded.** The watts of the following indoor lighting applications may be excluded from actual indoor Lighting Power Density. (Indoor lighting not listed below shall comply with all applicable nonresidential indoor lighting requirements in Part 6.):

A. In theme parks: Lighting for themes and special effects.

B. Studio lighting for film or photography provided that these lighting systems are in addition to and separately switched from a general lighting system.

C. Lighting for dance floors, lighting for theatrical and other live performances, and theatrical lighting used for religious worship, provided that these lighting systems are additions to a general lighting system and are separately controlled by a multiscene or theatrical cross-fade control station accessible only to authorized operators.

D. In civic facilities, transportation facilities, convention centers, and hotel function areas: Lighting for temporary exhibits, if the lighting is in addition to a

general lighting system and is separately controlled from a panel accessible only to authorized operators.

E. Lighting installed by the manufacturer in walk-in freezers, vending machines, food preparation equipment, and scientific and industrial equipment.

F. In medical and clinical buildings: Examination and surgical lights, low-ambient night-lights, and lighting integral to medical equipment, provided that these lighting systems are additions to and separately switched from a general lighting system.

G. Lighting for plant growth or maintenance, if it is controlled by a multi-level astronomical time-switch control that complies with the applicable provisions of Section 110.9.

H. Lighting equipment that is for sale.

I. Lighting demonstration equipment in lighting education facilities.

J. Lighting that is required for exit signs subject to the CBC. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.

K. Exitway or egress illumination that is normally off and that is subject to the CBC.

L. In hotel/motel buildings: Lighting in guestrooms (lighting in hotel/motel guestrooms shall comply with Section 130.0(b). (Indoor lighting not in guestrooms shall comply with all applicable nonresidential lighting requirements in Part 6.)

M. In high-rise residential buildings: Lighting in dwelling units (Lighting in high-rise residential dwelling units shall comply with Section 130.0(b).) (Indoor lighting not in dwelling units shall comply with all applicable nonresidential lighting requirements in Part 6.)

N. Temporary lighting systems. (As defined in Section 100.1.)

O. Lighting in occupancy group U buildings less than 1,000 square feet.

P. Lighting in unconditioned agricultural buildings less than 2,500 square feet.

Q. Lighting systems in qualified historic buildings, as defined in the California Historical Building Code (Title 24, Part 8), are exempt from the Lighting Power Density allowances, if they consist solely of historic lighting components or replicas of historic lighting components. If lighting systems in qualified buildings contain some historic lighting components or replicas of historic components, combined with other lighting components, only those historic or historic replica components are exempt. All other lighting systems in qualified historic buildings shall comply with the Lighting Power Density allowances.

R. Lighting in nonresidential parking garages for seven or less vehicles: Lighting in nonresidential parking garages for seven or less vehicles shall comply with the applicable residential parking garage provisions of Section 150.0(k).

S. Lighting for signs: Lighting for signs shall comply with Section 140.8.

T. Lighting for automatic teller machines that are located inside parking garages.

U. Lighting in refrigerated cases less than 3,000 square feet. (Lighting in refrigerated cases less than 3,000 square feet shall comply with the Title 20 Appliance Efficiency Regulations).

V. Lighting in elevators where the lighting meets the requirements of ASHRAE/IESNA Standard 90.1, 2010.

4. **Luminaire Classification and Power.** Luminaire Classification and Power shall be determined in accordance with Section 130.0(c).

(b) **Calculation of Allowed Indoor Lighting Power Density: General Rules**

1. The allowed Indoor Lighting Power Density allotment for conditioned areas shall be calculated separately from the allowed Lighting Power Density allotment for unconditioned areas. Each allotment is applicable solely to the area to which it applies, and there shall be no trade-offs between conditioned and

unconditioned area allotments.

2. Allowed Indoor Lighting Power Density allotment shall be calculated separately from the allowed Outdoor Lighting Power Density allotment. Each allotment is applicable solely to the area to which it applies, and there shall be no trade-offs between the separate Indoor and Outdoor allotments.

3. The Allowed Indoor Lighting Power Density allotment for general lighting shall be calculated as follows:

   A. The Complete Building Method, as described in Section 140.6(c)1, shall be used only for an entire building, except as permitted by Section 140.6(c)1. As described more fully in Section 140.6(c)1, and subject to the adjustments listed there, the Allowed Indoor Lighting Power Density allotment for general lighting for the entire building shall be calculated as follows:

      i. For a conditioned building, the product of the square feet of conditioned space of the building times the applicable allotment of watts per square foot described in TABLE 140.6-B.

      ii. For an unconditioned building, the product of the square foot of unconditioned space of the building times the applicable allotment of watts per square feet described in TABLE 140.6-B.

   B. The Area Category Method, as described in Section 140.6(c)2, shall be used either by itself for all areas in the building, or when some areas in the building use the Tailored Method described in Section 140.6(c)3. Under the Area Category Method (either by itself or in conjunction with the Tailored Method), as described more fully in Section 140.6(c)2, and subject to the adjustments listed there, the allowed Indoor Lighting Power Density allotment for general lighting shall be calculated for each area in the building as follows:

      i. For conditioned areas, by multiplying the conditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in TABLE 140.6-C (or TABLE 140.6-D if the Tailored Method is used for that area).

      ii. For unconditioned areas, by multiplying the unconditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in TABLE 140.6-C (or TABLE 140.6-D if the Tailored Method is used for that area).

      The Allowed Indoor Lighting Power Density allotment for general lighting for one area for which the Area Category Method was used may be increased up to the amount that the Allowed Indoor Lighting Power Density allotment for general lighting for another area using the Area Category Method or Tailored Method is decreased, except that such increases and decreases shall not be made between conditioned and unconditioned space.

   C. The Tailored Method, as described in Section 140.6(c)3, shall be used either by itself for all areas in the building, or when some areas in the building use the Area Category Method described in Section 140.6(c)2. Under the Tailored Method (either by itself or in conjunction with the Area Category Method) as described more fully in Section 140.6(c)3, and subject to the adjustments listed there, allowed Indoor Lighting Power Density allotment for general lighting shall be calculated for each area in the building as follows:

      i. For conditioned areas, by multiplying the conditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in TABLE140.6-D (or TABLE140.6-C if the Area Category Method is used for that area);

      ii For unconditioned areas, by multiplying the unconditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in TABLE140.6-D (or TABLE140.6-C if the Area Category Method is used for that area);

      The Allowed Indoor Lighting Power Density allotment for general lighting for one area for which the Tailored Method was used may be increased up to the amount that the Allowed Indoor Power Lighting Density for general lighting for another area is decreased, but only if the Tailored Method or Area Category Method was used for the other area, except that such increases and decreases shall not be made between conditioned and unconditioned space.

   D. If the Area Category Method is used for an area, the Tailored Method may not be used for that area. If the Tailored Method is used for an area, the Area Category Method may not be used for that area.

4. Allowed Indoor Lighting Power Density allotments for all lighting power allotments other than general lighting shall be restricted as follows:

   A. When using the Area Category Method, allowed Indoor Lighting Power allotments for specialized task work; ornamental; precision commercial and industrial work; white board or chalk board; accent, display and feature; decorative; or Videoconferencing Studio; may not be increased as a result of, or otherwise traded off against, decreasing any other allotment; and

   B. When using the Tailored Method, allowed Indoor Lighting Power allotments for wall display; floor display and task; ornamental/special effect; or very valuable display case; may not be increased, or otherwise traded between any of the separate allotments.

(c) **Calculation of Allowed Indoor Lighting Power Density: Specific Methodologies.** The allowed indoor Lighting Power Density for each building type, or each primary function area shall be calculated using only one of the methods in Subsection 1, 2 or 3 below as applicable.

1. **Complete Building Method.** Requirements for using the Complete Building Method include all of the following:

   A. The Complete Building Method shall be used only for building types, as defined in Section 100.1, that are specifically listed in TABLE 140.6-B. (For example, retail and wholesale stores, hotel/motel, and highrise residential buildings shall not use this method.)

   B. The Complete Building Method shall be used only on projects involving:

      i. Entire buildings with one type of use occupancy; or

         **EXCEPTION to Section 140.6(c)1Bi:** If a parking garage plus another type of use listed in TABLE 140.6-B are part of a single building, the parking garage portion of the building and other type of use portion of the building shall each separately use the Complete Building Method.

      ii. Mixed occupancy buildings where one type of use makes up at least 90 percent of the entire building (in which case, when applying the Complete Building Method, it shall be assumed that the primary use is 100 percent of the building); or

      iii. A tenant space where one type of use makes up at least 90 percent of the entire tenant space (in which case, when applying the Complete Building Method, it shall be assumed that the primary use is 100 percent of the tenant space).

   C. The Complete Building Method shall be used only when the applicant is applying for a lighting permit and submits plans and specifications for the entire building or the entire tenant space.

   D. Under the Complete Building Method, the allowed indoor Lighting Power allotment is the Lighting Power Density value times the floor area of the entire building.

2. **Area Category Method.** Requirements for using the Area Category Method include all of the following:

   A. The Area Category Method shall be used only for primary function areas, as defined in Section 100.1, that are listed in TABLE 140.6-C.

   B. Primary Function Areas in TABLE 140.6-C shall not apply to a complete building. Each primary function area shall be determined as a separate area.

   C. For purposes of compliance with Section 140.6(c)2, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in TABLE 146.0-C.

   D. Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a Primary Function Area.

   E. If at the time of permitting for a newly constructed building, a tenant is not identified for a multi-tenant area, a maximum of 0.6 watts per square foot shall be allowed for the lighting in each area in which a tenant has not been identified. The area shall be classified as Unleased Tenant Area.

   F. Under the Area Category Method, the allowed indoor Lighting Power Density for each primary area is the Lighting Power Density value in TABLE 140.6-

C times the square feet of the primary function. The total allowed indoor Lighting Power Density for the building is the sum of all allowed indoor Lighting Power Densities for all areas in the building.

G. In addition to the allowed indoor Lighting Power Density calculated according to Sections 140.6(c)2. A through F, the building may add additional lighting power allowances for specialized task work,

ornamental, precision, accent, display, decorative, and white boards and chalk boards, in accordance with the footnotes in TABLE 140.6-C under the following conditions:

i. Only primary function areas having a footnote next to the allowed Lighting Power Density allotments in TABLE 140.6-C shall qualify for the added lighting power allowances in accordance with the correlated footnote listed at the bottom of the table; and

ii. The additional lighting power allowances shall be used only if the plans clearly identify all applicable task areas and the lighting equipment designed to illuminate these tasks; and

iii. Tasks that are performed less than two hours per day or poor quality tasks that can be improved are not eligible for the additional lighting power allowances; and

iv. The additional lighting power allowances shall not utilize any type of luminaires that are used for general lighting in the building; and

v. The additional lighting power allowances shall not be used when using the Complete Building Method, or when the Tailored Method is used for any area in the building; and

vi. The additional lighting power allowed is the smaller of lighting power listed in the applicable footnote in TABLE 140.6-C, or the actual design wattage may be added to the allowed lighting power; and

vii. In addition to all other additional lighting power allowed under Sections 140.6(c)2Gi through vi, up to 1.5 watts per square foot of additional lighting power shall be allowed in a videoconferencing studio, as defined in Section 100.1, provided the following conditions are met:

a. A completed and signed Installation Certificate is prepared and submitted in accordance with Section 130.4(b), specifically detailing compliance with the applicable requirements of Section 140.6(c)2Gvii; and

b. The Videoconferencing Studio is a room with permanently installed videoconferencing cameras, audio equipment, and playback equipment for both audio-based and video-based two-way communication between local and remote sites; and

c. General lighting is switched in accordance with TABLE 130.1-A; and

d. Wall wash lighting is separately switched from the general lighting system; and

e. All of the lighting in the studio, including general lighting and additional lighting power allowed by Section 140.6(c)2Gvii is controlled by a multiscene programmable control system (also known as a scene preset control system).

3. **Tailored Method.** Requirements for using the Tailored Method include all of the following:

A. The Tailored Method shall be used only for primary function areas listed in TABLE 140.6-D, as defined in Section 100.1, and for IES allowances listed in Section 140.6(c)3H.

B. Allowed Indoor Lighting Power Density allotments for general lighting shall be determined according to Section 140.6(c)3G or H, as applicable. General lighting shall not qualify for a mounting height multiplier.

C. For compliance with this Item, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in TABLE 140.6-D.

D. Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a Primary Function Area.

E. In addition to the allowed indoor Lighting Power Density allotments for general lighting calculated according to Sections 140.6(c)3G or H, as applicable, the building may add additional lighting power allowances for wall display, floor display and task lighting, ornamental/special effects, and very valuable display cases according to Section 140.6(c)3I through L.

F. The general lighting system shall not use narrow beam direction lamps, wall-washer, valance, direct cove, or perimeter linear slot types of lighting systems.

G. Determine allowed indoor Lighting Power Density allotments for general lighting for primary function areas listed in TABLE 140.6-D as follows:

   i. Use the IES Illuminance values (Lux) listed in Column 2 to determine the Allowed General Lighting Power Density allotments for the area.

   ii. Determine the room cavity ratio (RCR) for the area. The RCR shall be calculated according to the applicable equation in TABLE 140.6-F.

   iii. Find the allowed Lighting Power Density allotments in TABLE 140.6-G that is applicable to the IES illuminance value (Lux) from Column 2 of Table 140.6-D (as described in Item i.) and the RCR determined in accordance with TABLE 140.6-F (as described in Item ii).

   iv. Determine the square feet of the area in accordance with Section 140.6(c)3C and D.

   v. Multiply the allowed Lighting Power Density allotment, as determined in accordance with Item iii by the square feet of each primary function area, as determined in accordance with Item iv. The product is the Allowed Indoor Lighting Power Density allotment for general lighting for the area.

H. Determine allowed indoor Lighting Power Density allotments for general lighting for only specific primary function areas NOT listed in TABLE 140.6-D as follows:

   i. Use this Section only to calculate allowed indoor lighting power densities for general lighting in the following primary function areas. Do not use Section 140.6(c)3H for any primary function areas NOT listed below:

      a. Exercise Center, Gymnasium

      b. Medical and Clinical Care

      c. Police Stations and Fire Stations

      d. Public rest areas along state and federal roadways

      e. Other primary function areas that are not listed in TABLE 140.6-D

   ii. When calculating allowed indoor Lighting Power Density allotments for general lighting using Section 140.6(c)3H, the building shall not add additional lighting power allowances for any other use, including but not limited to wall display, floor display and task, ornamental/special effects, and very valuable display case lighting.

   iii. Calculate the allowed indoor Lighting Power Density for each primary function area in the building as follows:

      a. Determine the illuminance values (Lux) according to the Tenth Edition IES Lighting Handbook (IES HB), using the Recommended Horizontal Maintained Illuminance Targets for Observers 25-65 years old for illuminance.

      b. Determine the room cavity ratio (RCR) for area. The RCR shall be calculated according to the applicable equation in TABLE 140.6-F.

      c. Find the allowed lighting power density in TABLE 140.6-G that is applicable to the illuminance value (Lux) determined in accordance with

Item (a) and the RCR determined in accordance with Item (b).

d. Determine the square feet of the area. For compliance with this item, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in Item (i). Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a Primary Function Area.

e. Multiply the square feet determined in accordance with Item (d), by the allowed lighting power density determined in accordance with item (c). The product is the Allowed Indoor Lighting Power Density allotment for general lighting for the area.

I. Determine additional allowed power for wall display lighting according to column 3 of Table 140.6-D for each primary function area as follows:

i. Additional wall display lighting power shall not be available when using Section 140.6(c)3H for determining the Allowed Indoor Lighting Power Density allotment for general lighting for the area.

ii. Floor displays shall not qualify for wall display allowances.

iii. Qualifying wall lighting shall:

a. Be mounted within 10 feet of the wall having the wall display. When track lighting is used for wall display, and where portions of that lighting track are more than 10 feet from the wall and other portions are within 10 feet of the wall, portions of track more than 10 feet from the wall shall not be used for the wall display allowance.

b. Be a lighting system type appropriate for wall lighting. Lighting systems appropriate for wall lighting are lighting track adjacent to the wall, wall-washer luminaires, luminaires behind a wall valance or wall cove, or accent light. (Accent luminaires are adjustable or fixed luminaires with PAR, R, MR, AR, or other directional lamp types.)

iv. Additional allowed power for wall display lighting is available only for lighting that illuminates walls having wall displays. The length of display walls shall include the length of the perimeter walls, including but not limited to closable openings and permanent full height interior partitions. Permanent full height interior partitions are those that (I) extend from the floor to no more than two feet of the ceiling or are taller than ten feet, and (II) are permanently anchored to the floor, provided, however, that neither commercial industrial stacks nor industrial storage stacks are permanent full height interior partitions.

v. The wall display mounting height multiplier is the applicable factor from TABLE 140.6-E. Mounting height is the distance from the finished floor to the bottom of the luminaire. Wall display lighting with varying mounting heights shall be separately determined under Item vi.

vi. The additional allowed power for wall display lighting shall be the smaller of:

a. The product of wall display power determined in accordance with TABLE 140.6-D, times the wall display lengths determined in accordance with Item iv, times the mounting height multiplier determined in accordance with Item v; or

b. The actual power used for the wall display lighting systems.

J. Determine additional allowed power for floor display lighting and task lighting as follows:

i. Neither additional allowed power for floor display lighting nor additional allowed power for task lighting shall be available when using Section 140.6(c)3H for determining allowed indoor Lighting Power Density allotment for general lighting.

ii. Displays that are installed against a wall shall not qualify for the floor display lighting power allowances.

iii. Lighting internal to display cases shall be counted as floor display lighting in accordance with Section 140.6(c)3J; or very valuable display case lighting in accordance with Section 140.6(c)3Liii and iv.

iv. Additional allowed power for floor display lighting, and additional allowed power for task lighting, may be used by qualifying floor display lighting

systems, qualifying task lighting systems, or a combination of both. For floor areas qualifying for both floor display and task lighting power allowances, the additional allowed power shall be used only once for the same floor area, so that the allowance shall not be additive.

v. Qualifying floor display lighting shall:

a. Be mounted no closer than 2 feet to a wall.

b. Consist of only (I) directional lighting types, such as PAR, R, MR, AR; or (II) lighting employing optics providing directional display light from nondirectional lamps.

c. If track lighting is used, shall be only track heads that are classified as direction lighting types.

vi. Qualifying task lighting shall:

a. Be located immediately adjacent to and capable of illuminating the task for which it is installed.

b. Be of a type different from the general lighting system.

c. Be separately switched from the general lighting system.

vii. If there are illuminated floor displays, floor display lighting power shall be used only if allowed by column 4 of TABLE 140.6-D.

viii. Additional allowed power for a combination of floor display lighting and task lighting shall be available only for (I) floors having floor displays; or (II) floors not having floor displays but having tasks having illuminance recommendations that appear in the Tenth Edition of the IES Lighting Handbook and that are higher than the general lighting level in column 2 of TABLE 140.6-D. The square footage of floor display or the square footage of task areas shall be determined in accordance with Section 140.6(c)3C and D, except that any floor area designed to not have floor displays or tasks, such as floor areas designated as a path of egress, shall not be included for the floor display allowance.

ix. For floor display lighting where the bottom of the luminaire is 12 feet or higher above the finished floor, the wattage allowed in column 4 of TABLE 140.6-D may be increased by multiplying the floor display lighting power allowance by the appropriate factor from TABLE 140.6-E

Luminaire mounting height is the distance from the finished floor to the bottom of the luminaire. Wall display lighting with varying mounting heights shall be separately determined under Item x.

x. The additional allowed power for floor display lighting for each applicable area shall be the smaller of:

a. The product of allowed floor display and task lighting power determined in accordance with Section 140.6(c)3Jvii times the floor square footage determined in accordance with Section 140.6(c)3Jviii times the height multiplier if appropriate in accordance with Section 140.6(c)3Jix; or

b. The actual power used for the floor display lighting systems.

K. Determine additional allowed power for ornamental/special effects lighting as follows:

i. Additional allowed power for ornamental/special effects lighting shall not be available when using Section 140.6(c)3H for determining general Lighting Power Density allowances.

ii. Qualifying ornamental lighting includes luminaires such as chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights and light color panels when any of those lights are used in a decorative manner that does not serve as display lighting or general lighting.

iii. Additional lighting power for ornamental/special effects lighting shall be used only if allowed by Column 5 of TABLE 140.6-D.

iv. Additional lighting power for ornamental/special effects lighting shall be used only in areas having ornamental/special effects lighting. The square

footage of the floor area shall be determined in accordance with Section 140.6(c)3C and D, and it shall not include floor areas not having ornamental/special effects lighting.

v. The additional allowed power for ornamental/special effects lighting for each applicable area shall be the smaller of:

a. The product of the allowed ornamental/special effects lighting power determined in accordance with Section 140.6(c)3Kiii, times floor square footage determined in accordance with Section 140.6(c)3Kiv; or

b. The actual power of allowed ornamental/special effects lighting.

L. Determine additional allowed power for very valuable display case lighting as follows:

i. Additional allowed power for very valuable display case lighting shall not be available when using Section 140.6(c)3H for determining general Lighting Power Density allowances.

ii. Additional allowed power for very valuable display case lighting shall be available only for display cases in appropriate function areas in retail merchandise sales, museum and religious worship.

iii. To qualify for additional allowed power for very valuable display case lighting, a case shall contain jewelry, coins, fine china, fine crystal, precious stones, silver, small art objects and artifacts, and/or valuable collections the display of which involves customer inspection of very fine detail from outside of a locked case.

iv. Qualifying lighting includes internal display case lighting or external lighting employing highly directional luminaires specifically designed to illuminate the case or inspection area without spill light, and shall not be fluorescent lighting unless installed inside of a display case.

v. If there is qualifying very valuable display case lighting, in accordance with Section 140.6(c)3Liii, the smallest of the following separate lighting power for display cases presenting very valuable display items is permitted:

a. The product of the area of the primary function and 0.8 watt per square foot; or

b. The product of the area of the display case and 12 watts per square foot; or

c. The actual power of lighting for very valuable displays.

(d) **Automatic Daylighting Controls in Secondary Daylit Zones.** All luminaires providing general lighting that is in, or partially in a Secondary Sidelit Daylit Zone as defined in Section 130.1(d)1C, and that is not in a Primary Sidelit Daylit Zone shall:

1. Be controlled independently from all other luminaires by automatic daylighting controls that meet the applicable requirements of Section 110.9; and

2. Be controlled in accordance with the applicable requirements in Section 130.1(d)2; and

3. All Secondary Sidelit Daylit Zones shall be shown on the plans submitted to the enforcing agency.

**EXCEPTION 1 to Section 140.6(d):** Luminaires in Secondary Sidelit Daylit Zone(s) in areas where the total wattage of general lighting is less than 120 Watts.

**EXCEPTION 2 to Section 140.6(d):** Luminaires in parking garages complying with Section 130.1(d)3.

*TABLE 140.6-A LIGHTING POWER DENSITY ADJUSTMENT FACTORS (PAF)*

| TYPE OF CONTROL | | TYPE OF AREA | | FACTOR |
|---|---|---|---|---|
| a. To qualify for any of the Power Adjustment Factors in this table, the installation shall comply with the applicable requirements in Section 140.6(a)2<br>b. Only one PAF may be used for each qualifying luminaire unless combined below.<br>c. Lighting controls that are required for compliance with Part 6 shall not be eligible for a PAF | | | | |
| 1. Partial-ON Occupant Sensing Control | | Any area ≤ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, conference or waiting room. | | 0.20 |
| 2. Occupant Sensing Controls in Large Open Plan Offices | | In open plan offices > 250 square feet: One sensor controlling an area that is: | No larger than 125 square feet | 0.40 |
| | | | From 126 to 250 square feet | 0.30 |
| | | | From 251 to 500 square feet | 0.20 |
| 3. Dimming System | Manual Dimming | Hotels/motels, restaurants, auditoriums, theaters | | 0.10 |
| | Multiscene Programmable | | | 0.20 |
| 4. Demand Responsive Control | | All building types less than 10,000 square feet.<br>Luminaires that qualify for other PAFs in this table may also qualify for this demand responsive control PAF | | 0.05 |
| 5. Combined Manual Dimming plus Partial-ON Occupant Sensing Control | | Any area ≤ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, conference or waiting room | | 0.25 |

*TABLE 140.6-B COMPLETE BUILDING METHOD LIGHTING POWER DENSITY VALUES*

| TYPE OF BUILDING | ALLOWED LIGHTING POWER DENSITY (WATTS PER SQUARE FOOT) |
|---|---|
| Auditorium Building | 1.5 |
| Classroom Building | 1.1 |
| Commercial and Industrial Storage Building | 0.6 |
| Convention Center Building | 1.2 |
| Financial Institution Building | 1.1 |
| General Commercial Building/Industrial Work Building | 1.0 |
| Grocery Store Building | 1.5 |
| Library Building | 1.3 |
| Medical Building/Clinic Building | 1.1 |
| Office Building | 0.8 |
| Parking Garage Building | 0.2 |
| Religious Facility Building | 1.6 |
| Restaurant Building | 1.2 |
| School Building | 1.0 |
| Theater Building | 1.3 |
| All others buildings | 0.6 |

*TABLE 140.6-C AREA CATEGORY METHOD - LIGHTING POWER DENSITY VALUES (WATTS/FT²)*

| PRIMARY FUNCTION AREA | | ALLOWED LIGHTING POWER (W/ft²) | | PRIMARY FUNCTION AREA | | ALLOWED LIGHTING POWER (W/ft²) |
|---|---|---|---|---|---|---|
| Auditorium Area | | 1.5 [3] | | Library Area | Reading areas | 1.2 [3] |
| Auto Repair Area | | 0.9 [2] | | | Stack areas | 1.5 [3] |
| Beauty Salon Area | | 1.7 | | Lobby Area | Hotel lobby | 1.1 [3] |
| Civic Meeting Place Area | | 1.3 [3] | | | Main entry lobby | 1.5 [3] |
| Classroom, Lecture, Training, Vocational Areas | | 1.2 [5] | | Locker/Dressing Room | | 0.8 |
| Commercial and Industrial Storage Areas (conditioned and unconditioned) | | 0.6 | | Lounge Area | | 1.1 [3] |
| Commercial and Industrial Storage Areas (refrigerated) | | 0.7 | | Malls and Atria | | 1.2 [3] |
| Convention, Conference, Multipurpose and Meeting Center Areas | | 1.4 [3] | | Medical and Clinical Care Area | | 1.2 |
| Corridor, Restroom, Stair, and Support Areas | | 0.6 | | Office Area | > 250 square feet | 0.75 |
| Dining Area | | 1.1 [3] | | | ≤ 250 square feet | 1.0 |
| Electrical, Mechanical, Telephone Rooms | | 0.7 [2] | | Parking Garage Area | Parking Area | 0.14 |
| Exercise Center, Gymnasium Areas | | 1.0 | | | Dedicated Ramps | 0.3 |
| Exhibit, Museum Areas | | 2.0 | | | Daylight Adaptation Zones [9] | 0.6 |
| Financial Transaction Area | | 1.2 [3] | | Religious Worship Area | | 1.5 [3] |
| General Commercial and Industrial Work Areas | Low bay | 0.9 [2] | | Retail Merchandise Sales, Wholesale Showroom Areas | | 1.2 [6 and 7] |
| | High bay | 1.0 [2] | | | | |
| | Precision | 1.2 [4] | | Theater Area | Motion picture | 0.9 [3] |
| Grocery Sales Area | | 1.2 [6 and 7] | | | Performance | 1.4 [3] |

*CONTINUED: TABLE 140.6-C AREA CATEGORY METHOD - LIGHTING POWER DENSITY VALUES (WATTS/FT²)*

| | | | | |
|---|---|---|---|---|
| Hotel Function Area | 1.5 [3] | | Transportation Function Area | 1.2 |
| Kitchen, Food Preparation Areas | 1.6 | | Videoconferencing Studio | 1.2 [8] |
| Laboratory Area, Scientific | 1.4 [1] | | Waiting Area | 1.1 [3] |
| Laundry Area | 0.9 | | All other areas | 0.6 |

Footnotes for this table are listed below.

FOOTNOTES FOR TABLE 140.6-C:

See Section 140.6(c)2 for an explanation of additional lighting power available for specialized task work, ornamental, precision, accent, display, decorative, and white boards and chalk boards, in accordance with the footnotes in this table. The smallest of the added lighting power listed in each footnote below, or the actual design wattage, may be added to the allowed lighting power only when using the Area Category Method of compliance.

| Footnote number | Type of lighting system allowed | Maximum allowed added lighting power. ($W/ft^2$ of task area unless otherwise noted) |
|---|---|---|
| 1 | Specialized task work | 0.2 $W/ft^2$ |
| 2 | Specialized task work | 0.5 $W/ft^2$ |
| 3 | Ornamental lighting as defined in Section 100.1 and in accordance with Section 140.6.(c)2. | 0.5 $W/ft^2$ |
| 4 | Precision commercial and industrial work | 1.0 $W/ft^2$ |
| 5 | Per linear foot of white board or chalk board. | 5.5 W per linear foot |
| 6 | Accent, display and feature lighting - luminaires shall be adjustable or directional | 0.3 $W/ft^2$ |
| 7 | Decorative lighting - primary function shall be decorative and shall be in addition to general illumination. | 0.2 $W/ft^2$ |
| 8 | Additional Videoconferencing Studio lighting complying with all of the requirements in Section 140.6(c)2Gvii. | 1.5 $W/ft^2$ |
| 9 | Daylight Adaptation Zones shall be no longer than 66 feet from the entrance to the parking garage | |

*TABLE 140.6-D TAILORED METHOD LIGHTING POWER ALLOWANCES*

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| **Primary Function Area** | **General Illumination Level (Lux)** | **Wall Display Power (W/ft)** | **Allowed Combined Floor Display Power and Task Lighting Power (W/ft²)** | **Allowed Ornamental/ Special Effect Lighting** |
| Auditorium Area | 300 | 2.25 | 0.3 | 0.5 |
| Civic Meeting Place | 300 | 3.15 | 0.2 | 0.5 |
| Convention, Conference, Multipurpose, and Meeting Center Areas | 300 | 2.50 | 0.4 | 0.5 |
| Dining Areas | 200 | 1.50 | 0.6 | 0.5 |
| Exhibit, Museum Areas | 150 | 15.0 | 1.2 | 0.5 |
| Financial Transaction Area | 300 | 3.15 | 0.2 | 0.5 |
| Grocery Store Area | 500 | 8.00 | 0.9 | 0.5 |
| Hotel Function Area | 400 | 2.25 | 0.2 | 0.5 |
| Lobby Area: | | | | |
| Hotel lobby | 200 | 3.15 | 0.2 | 0.5 |
| Main entry lobby | 200 | 0 | 0.2 | 0 |
| Lounge Area | 200 | 7.00 | 0 | 0.5 |
| Malls and Atria | 300 | 3.50 | 0.5 | 0.5 |
| Religious Worship Area | 300 | 1.50 | 0.5 | 0.5 |
| Retail Merchandise Sales, and Showroom Areas | 400 | 14.00 | 1.0 | 0.5 |
| Theater Area: | | | | |
| Motion picture | 200 | 3.00 | 0 | 0.5 |
| Performance | 200 | 6.00 | 0 | 0.5 |
| Transportation Function Area | 300 | 3.15 | 0.3 | 0.5 |
| Waiting Area | 300 | 3.15 | 0.2 | 0.5 |

*TABLE 140.6-E ADJUSTMENTS FOR MOUNTING HEIGHT ABOVE FLOOR*

| **Height in feet above finished floor and bottom of luminaire(s)** | **Floor Display or Wall Display – Multiply by** |
|---|---|
| < 12' | 1.00 |
| 12' to 16' | 1.15 |
| > 16’ | 1.30 |

*TABLE 140.6-F ROOM CAVITY RATIO (RCR) EQUATIONS*

| |
|---|
| Determine the Room Cavity Ratio for TABLE 140.6-G using one of the following equations. |
| Room cavity ratio for rectangular rooms $$RCR = \frac{5 \times H \times (L + W)}{L \times W}$$ |
| Room cavity ratio for irregular-shaped rooms $$RCR = \frac{2.5 \times H \times P}{A}$$ |
| Where: L =Length of room; W = Width of room; H =Vertical distance from the work plane to the centerline of the lighting fixture; P = Perimeter of room, and A = Area of room |

*TABLE 140.6-G ILLUMINANCE LEVEL (LUX) POWER DENSITY VALUES (WATTS/FT²)*

| Illuminance Level (Lux) | RCR ≤ 2.0 | RCR > 2.0 and ≤ 3.5 | RCR > 3.5 and ≤ 7.0 | RCR > 7.0 |
|---|---|---|---|---|
| 50 | 0.2 | 0.3 | 0.4 | 0.6 |
| 100 | 0.4 | 0.6 | 0.8 | 1.2 |
| 200 | 0.6 | 0.8 | 1.3 | 1.9 |
| 300 | 0.8 | 1.0 | 1.4 | 2.0 |
| 400 | 0.9 | 1.1 | 1.5 | 2.2 |
| 500 | 1.0 | 1.2 | 1.6 | 2.4 |
| 600 | 1.2 | 1.4 | 2.0 | 2.9 |
| 700 | 1.4 | 1.7 | 2.3 | 3.3 |
| 800 | 1.6 | 1.9 | 2.6 | 3.8 |
| 900 | 1.8 | 2.2 | 3.0 | 4.3 |
| 1000 | 1.9 | 2.4 | 3.3 | 4.8 |

# SECTION 140.7 – REQUIREMENTS FOR OUTDOOR LIGHTING

(a) An outdoor lighting installation complies with this section if it meets the requirements in Subsections (b) and (c), and the actual outdoor lighting power installed is no greater than the allowed outdoor lighting power calculated under Subsection (d). The allowed outdoor lighting shall be calculated according to Outdoor Lighting Zone in Title 24, Part 1, Section 10-114.

**EXCEPTIONS to Section 140.7(a):** When more than 50 percent of the light from a luminaire falls within one or more of the following applications, the lighting power for that luminaire shall be exempt from Section 140.7:

1. Temporary outdoor lighting.
2. Lighting required and regulated by the Federal Aviation Administration, and the Coast Guard.
3. Lighting for public streets, roadways, highways, and traffic signage lighting, including lighting for driveway entrances occurring in the public right-of-way.
4. Lighting for sports and athletic fields, and children's playgrounds.
5. Lighting for industrial sites, including but not limited to, rail yards, maritime shipyards and docks, piers and marinas, chemical and petroleum processing plants, and aviation facilities.
6. Lighting specifically for Automated Teller Machines as required by California Financial Code Section 13040, or required by law through a local ordinance.
7. Lighting of public monuments.
8. Lighting of signs complying with the requirements of Sections 130.3 and 140.8.
9. Lighting of tunnels, bridges, stairs, wheelchair elevator lifts for American with Disabilities Act (ADA) compliance, and ramps that are other than parking garage ramps.
10. Landscape lighting.
11. In theme parks: outdoor lighting only for themes and special effects.
12. Lighting for outdoor theatrical and other outdoor live performances, provided that these lighting systems are additions to area lighting systems and are controlled by a multiscene or theatrical cross-fade control station accessible only to authorized operators.
13. Outdoor lighting systems for qualified historic buildings, as defined in the California Historic Building Code (Title 24, Part 8), if they consist solely of historic lighting components or replicas of historic lighting components. If lighting systems for qualified historic buildings contain some historic lighting components or replicas of historic components, combined with other lighting components, only those historic or historic replica components are exempt. All other outdoor lighting systems for qualified historic buildings shall comply with Section 140.7.

(b) **Outdoor Lighting Power Trade-offs.** Outdoor lighting power trade-offs shall be determined as follows:

1. Allowed lighting power determined according to Section 140.7(d)1 for general hardscape lighting allowance may be traded to specific applications in Section 140.7(d)2, provided the hardscape area from which the lighting power is traded continues to be illuminated in accordance with Section 140.7(d)1A.

2. Allowed lighting power determined according to Section 140.7(d)2 for additional lighting power allowances for specific applications shall not be traded between specific applications, or to hardscape lighting in Section 140.7(d)1.

3. Trading off lighting power allowances between outdoor and indoor areas shall not be permitted.

(c) **Calculation of Actual Lighting Power.** The wattage of outdoor luminaires shall be determined in accordance with Section 130.0(c).

(d) **Calculation of Allowed Lighting Power.** The allowed lighting power shall be the combined total of the sum of the general hardscape lighting allowance determined in accordance with Section 140.7(d)1, and the sum of the additional lighting power allowance for specific applications determined in accordance with Section 140.7(d)2.

1. **General Hardscape Lighting Allowance.** Determine the general hardscape lighting power allowances as follows:

   A. The general hardscape area of a site shall include parking lot(s), roadway(s), driveway(s), sidewalk(s), walkway(s), bikeway(s), plaza(s), and other improved area(s) that are illuminated. In plan view of the site, determine the illuminated hardscape area, which is defined as any hardscape area that is within a square pattern around each luminaire or pole that is ten times the luminaire mounting height with the luminaire in the middle of the pattern, less any areas that are within a building, beyond the hardscape area, beyond property lines, or obstructed by a structure. The illuminated hardscape area shall include portions of planters and landscaped areas that are within the lighting application and are less than or equal to 10 feet wide in the short dimensions and are enclosed by hardscape or other improvement on at least three sides. Multiply the illuminated hardscape area by the Area Wattage Allowance (AWA) from TABLE 140.7-A for the appropriate Lighting Zone.

   B. Determine the perimeter length of the general hardscape area. The total perimeter shall not include portions of hardscape that is not illuminated according to Section 140.7(d)1A. Multiply the hardscape perimeter by the Linear Wattage Allowance (LWA) for hardscape from TABLE 140.7-A for the appropriate lighting zone. The perimeter length for hardscape around landscaped areas and permanent planters shall be determined as follows:

      i. Landscaped areas completely enclosed within the hardscape area, and which have a width or length less than 10 feet wide, shall not be added to the hardscape perimeter length.

      ii. Landscaped areas completely enclosed within the hardscape area, and which width or length is a minimum of 10 feet wide, the perimeter of the landscaped areas or permanent planter shall be added to the hardscape perimeter length.

      iii. Landscaped edges that are not abutting the hardscape shall not be added to the hardscape perimeter length.

   C. Determine the Initial Wattage Allowance (IWA) for general hardscape lighting from TABLE 140.7-A for the appropriate lighting zone. The hardscape area shall be permitted one IWA per site.

   D. The general hardscape lighting allowance shall be the sum of the allowed watts determined from (A), (B) and (C) above.

2. **Additional Lighting Power Allowance for Specific Applications.** Additional lighting power for specific applications shall be the smaller of the additional lighting allowances for specific applications determined in accordance with TABLE 140.7-B for the appropriate lighting zone, or the actual installed lighting power meeting the requirements for the allowance.

*TABLE 140.7-A GENERAL HARDSCAPE LIGHTING POWER ALLOWANCE*

| Type of Power Allowance | Lighting Zone 1 | Lighting Zone 2 | Lighting Zone 3 | Lighting Zone 4 |
|---|---|---|---|---|
| Area Wattage Allowance (AWA) | 0.035 W/ft² | 0.045 W/ft² | 0.090 W/ft² | 0.115 W/ft² |
| Linear Wattage Allowance (LWA) | 0.25 W/lf | 0.45 W/lf | 0.60 W/lf | 0.85 W/lf |
| Initial Wattage Allowance (IWA) | 340 W | 510 W | 770 W | 1030 W |

*TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS*
*All area and distance measurements in plan view unless otherwise noted.*

| Lighting Application | Lighting Zone 1 | Lighting Zone 2 | Lighting Zone 3 | Lighting Zone 4 |
|---|---|---|---|---|
| WATTAGE ALLOWANCE PER APPLICATION. Use all that apply as appropriate. | | | | |
| **Building Entrances or Exits.** Allowance per door. Luminaires qualifying for this allowance shall be within 20 feet of the door. | 30 watts | 60 watts | 90 watts | 90 watts |
| | | | | |
| **Primary Entrances to Senior Care Facilities, Police Stations, Hospitals, Fire Stations, and Emergency Vehicle Facilities.** Allowance per primary entrance(s) only. Primary entrances shall provide access for the general public and shall not be used exclusively for staff or service personnel. This allowance shall be in addition to the building entrance or exit allowance above. Luminaires qualifying for this allowance shall be within 100 feet of the primary entrance. | 45 watts | 80 watts | 120 watts | 130 watts |
| **Drive Up Windows.** Allowance per customer service location. Luminaires qualifying for this allowance shall be within 2 mounting heights of the sill of the window. | 40 watts | 75 watts | 125 watts | 200 watts |
| **Vehicle Service Station Uncovered Fuel Dispenser.** Allowance per fueling dispenser. Luminaires qualifying for this allowance shall be within 2 mounting heights of the dispenser. | 120 watts | 175 watts | 185 watts | 330 watts |
| **WATTAGE ALLOWANCE PER UNIT LENGTH (w/linear ft). May be used for one or two frontage side(s) per site.** | | | | |
| **Outdoor Sales Frontage.** Allowance for frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. Luminaires qualifying for this allowance shall be located between the principal viewing location and the frontage outdoor sales area. | No Allowance | 22.5 W/linear ft | 36 W/linear ft | 45 W/linear ft |
| **WATTAGE ALLOWANCE PER HARDSCAPE AREA (W/ft²). May be used for any illuminated hardscape area on the site.** | | | | |
| **Hardscape Ornamental Lighting.** Allowance for the total site illuminated hardscape area. Luminaires qualifying for this allowance shall be rated for 100 watts or less as determined in accordance with Section 130.0(d), and shall be post-top luminaires, lanterns, pendant luminaires, or chandeliers. | No Allowance | 0.02 W/ft² | 0.04 W/ft² | 0.06 W/ft² |
| **WATTAGE ALLOWANCE PER SPECIFIC AREA (W/ft²). Use as appropriate provided that none of the following specific applications shall be used for the same area.** | | | | |
| **Building Facades.** Only areas of building façade that are illuminated shall qualify for this allowance. Luminaires qualifying for this allowance shall be aimed at the façade and shall be capable of illuminating it without obstruction or interference by permanent building features or other objects. | No Allowance | 0.18 W/ft² | 0.35 W/ft² | 0.50 W/ft² |
| **Outdoor Sales Lots.** Allowance for uncovered sales lots used exclusively for the display of vehicles or other merchandise for sale. Driveways, parking lots or other non sales areas shall be considered hardscape areas even if these areas are completely surrounded by sales lot on all sides. Luminaires qualifying for this allowance shall be within 5 mounting heights of the sales lot area. | 0.164 W/ft² | 0.555 W/ft² | 0.758 W/ft² | 1.285 W/ft² |
| **Vehicle Service Station Hardscape.** Allowance for the total illuminated hardscape area less area of buildings, under canopies, off property, or obstructed by signs or structures. Luminaires qualifying for this allowance shall be illuminating the hardscape area and shall not be within a building, below a canopy, beyond property lines, or obstructed by a sign or other structure. | 0.014 W/ft² | 0.155 W/ft² | 0.308 W/ft² | 0.485 W/ft² |
| **Vehicle Service Station Canopies.** Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy. | 0.514 W/ft² | 1.005 W/ft² | 1.300 W/ft² | 2.200 W/ft² |
| **Sales Canopies.** Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy. | No Allowance | 0.655 W/ft² | 0.908 W/ft² | 1.135 W/ft² |
| **Non-sales Canopies.** Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy. | 0.084 W/ft² | 0.205 W/ft² | 0.408 W/ft² | 0.585 W/ft² |
| **Guard Stations.** Allowance up to 1,000 square feet per vehicle lane. Guard stations provide access to secure areas controlled by security personnel who stop and may inspect vehicles and vehicle occupants, including identification, documentation, vehicle license plates, and vehicle contents. Qualifying luminaires shall be within 2 mounting heights of a vehicle lane or the guardhouse. | 0.154 W/ft² | 0.355 W/ft² | 0.708 W/ft² | 0.985 W/ft² |

*CONTINUED: TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS*

*All area and distance measurements in plan view unless otherwise noted.*

| Lighting Application | | Lighting Zone 1 | Lighting Zone 2 | Lighting Zone 3 | Lighting Zone 4 |
|---|---|---|---|---|---|
| | **Student Pick-up/Drop-off zone.** Allowance for the area of the student pick-up/drop-off zone, with or without canopy, for preschool through 12th grade school campuses. A student pick-up/drop off zone is a curbside, controlled traffic area on a school campus where students are picked-up and dropped off from vehicles. The allowed area shall be the smaller of the actual width or 25 feet, times the smaller of the actual length or 250 feet. Qualifying luminaires shall be within 2 mounting heights of the student pick-up/drop-off zone. | No Allowance | 0.12 W/ft² | 0.45 W/ft² | No Allowance |
| | **Outdoor Dining.** Allowance for the total illuminated hardscape of outdoor dining. Outdoor dining areas are hardscape areas used to serve and consume food and beverages. Qualifying luminaires shall be within 2 mounting heights of the hardscape area of outdoor dining. | 0.014 W/ft² | 0.135 W/ft² | 0.240 W/ft² | 0.400 W/ft² |
| | **Special Security Lighting for Retail Parking and Pedestrian Hardscape.** This additional allowance is for illuminated retail parking and pedestrian hardscape identified as having special security needs. This allowance shall be in addition to the building entrance or exit allowance. | 0.007 W/ft² | 0.009 W/ft² | 0.019 W/ft² | No Allowance |

# SECTION 140.8 – REQUIREMENTS FOR SIGNS

This section applies to all internally illuminated and externally illuminated signs, unfiltered light emitting diodes (LEDs), and unfiltered neon, both indoor and outdoor. Each sign shall comply with either Subsection (a) or (b), as applicable.

(a) **Maximum Allowed Lighting Power.**

1. For internally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 12 watts per square foot. For double-faced signs, only the area of a single face shall be used to determine the allowed lighting power.
2. For externally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 2.3 watts per square foot. Only areas of an externally lighted sign that are illuminated without obstruction or interference, by one or more luminaires, shall be used.
3. Lighting for unfiltered light emitting diodes (LEDs) and unfiltered neon shall comply with Section 140.8(b).

(b) **Alternate Lighting Sources.** The sign shall comply if it is equipped only with one or more of the following light sources:

1. High pressure sodium lamps; or
2. Metal halide lamps that are:
   A. Pulse start or ceramic served by a ballast that has a minimum efficiency of 88 percent or greater; or
   B. Pulse start that are 320 watts or smaller, are not 250 watt or 175 watt lamps, and are served by a ballast that has a minimum efficiency of 80 percent.

      Ballast efficiency is the measured output wattage to the lamp divided by the measured operating input wattage when tested according to ANSI C82.6-2005.
3. Neon or cold cathode lamps with transformer or power supply efficiency greater than or equal to following:
   A. A minimum efficiency of 75 percent when the transformer or power supply rated output current is less than 50 mA; or
   B. A minimum efficiency of 68 percent when the transformer or power supply rated output current is 50 mA or greater.

      The ratio of the output wattage to the input wattage is at 100 percent tubing load.
4. Fluorescent lighting systems meeting one of the following requirements:
   A. Use only lamps with a minimum color rendering index (CRI) of 80; or
   B. Use only electronic ballasts with a fundamental output frequency not less than 20 kHz.
5. Light emitting diodes (LEDs) with a power supply having an efficiency of 80 percent or greater; or

   **EXCEPTION to Section 140.8(b)5:** Single voltage external power supplies that are designed to convert 120 volt AC input into lower voltage DC or AC output, and have a nameplate output power less than or equal to 250 watts, shall comply with the applicable requirements of the Appliance Efficiency Regulations (Title 20).

6. Compact fluorescent lamps that do not contain a medium screw base sockets (E24/E26).

**EXCEPTION 1 to Section 140.8:** Unfiltered incandescent lamps that are not part of an electronic message center (EMC), an internally illuminated sign, or an externally illuminated sign.

**EXCEPTION 2 to Section 140.8:** Exit signs. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.

**EXCEPTION 3 to Section 140.8:** Traffic Signs. Traffic signs shall meet the requirements of the Appliance Efficiency Regulations.

*Lutron White paper*

# Mandatory Lighting Control Requirements

Section 10 Regulations
Section 100 All Occupancies – General(w/ defs)
Section 110 Systems and Equipment
Section 120 Mechanical
Section 130 Lighting and Controls
Section 140 Performance/Prescriptive Methods
Section 141 Additions/Alterations
Section 150 Residential

## Self Contained Control Devices to T24

*§110.9: Mandatory Requirements for Lighting Control Devices & Systems, Ballasts & Luminaires*

***Self-Contained*** *is a unitary lighting control module where no additional components are required for a fully functional lighting control.*

***Lighting control*** *where two or more components are required to be installed in the field to provide all of the functionality required to make up a fully functional and compliant lighting control."*

Time-Switch Controls

Automatic Time-Switch

- Astronomic Time-Switch Controls
- Multi-Level Astronomical Time-Switch Controls
- Outdoor Astronomic Time-Switch Controls (w/Setback)

Automatic Daylight Controls

Lighting Photo Controls

Dimmer Controls

Occupancy, Motion, and Vacancy Sensor Controls

- Occupancy Sensors
- Motion Sensors
- Vacancy Sensors
- Partial-On Sensors
- Partial-Off Sensors

Exception that users should not be able to convert manual-on to AUTO ON when required by code.

## Luminaire Labeling *§130.0(c)1 Luminaire Classifications & Power*

- Every luminaire shall have their max re-lamping wattage on **permanent, preprinted factory installed label**.
- No “Peel Down Labels” **except** for below single lamp products where no changes are needed to the housing, ballast, transformer to use a different lamp:
- **HIDs** with integral electronic ballast and 150 watts max re-lamping wattage.
- **Low-voltage ≤ 24 volts** (except track systems) with 50 watts maximum re-lamping wattage.
- **Compact fluorescents** with an integral electronic ballast, with 42 watts maximum re-lamping wattage.

# Line Voltage Luminaires

*§130.0(c)2 Mandatory Lighting Requirements - General*

- §130.0(c)2-5 Wattage for luminaires with line voltage holders and no transformers/ballasts:
  - Is max relamping wattage
  - **Recessed with medium screw base** shall not be less than 50W
  - Units with changeable trims or modular components allowing other lighting technologies are still **Incandescent Fixtures**
- Screw Based adaptors can't be used to go from Incandescent to non-incandescent
- Screw Based luminaries can't go from Incandescent to LED

# Ballasted Luminaires *§130.0(c)6 Mandatory Lighting Requirements - General*

Wattage of luminaires with internal or remote ballasts is lamp/ballast combo via UL 1598

- Per manufacture's literature or testing.
  - Replacement of lamps with linear lamps of another technology does not change the luminaire.

# Line Track Luminaires *§130.0(c)7 Mandatory Lighting Requirements - General*

Wattage for line voltage track is

For tracks rated > 20A, use VA of circuit

For tracks rated ≤ 20A, use

- VA of branch circuit, or
- Higher total all rated luminaire wattages, or 45 W/ft., or
- When using integral current limiter, higher of VA of CEC Certified current limiter or 12.5 w/ft, (with reference to 130.4(B)iii) or
- When using dedicated track current limiter panel, sum of all V*A for the panel.

## Luminaires & Systems with Transformers *§130.0(c)8 Mandatory*

*Lighting Requirements - General*

- LV luminaires where lamps and luminaires **cannot be added** without re-wiring, wattage is the lamp/transformer combo

- LV luminaires where lamps and luminaires **can be added** without re-wiring, wattage is transformer's max rated input wattage

# LED and LED Light Engines

*§130.0(c)9 Mandatory Lighting Requirements - General*

- Wattage for LEDs:
  - Maximum rated input wattage of the system, per IES LM-79-08.
  - Note that an LED Lamp does not make it an LED Fixture for
    - compliance with Part 6.
- Wattage for LED Systems where luminaires and Light Engines **<u>can be added</u>** without re-wiring, use driver's max rated input wattage

# Other *130.0(c)10 – (d) Mandatory Lighting Requirements - General*

- Wattage for all other lighting equipment shall be max rated wattage or operating input wattage of the system.

- All Lighting Controls shall meet §110.9, and be installed per manufacturer's Instructions.

## *§ 130.1* Indoor Lighting Controls that shall be installed

# Overview

*§130.1: Indoor Lighting Controls that shall be installed*

- §130.1(a) Area controls
- §130.1(b) Multi-level lighting controls
- §130.1(c) Shut-off controls
- §130.1(d) Daylighting
- §130.1(e) Demand Response

# Area Controls *§130.1(a)1-3: Area Controls*

- All luminaries need manually switched On and Off Lighting Controls, and each area enclosed by ceiling height partition shall be independently controlled
  - Exception for .2 W/ft$^2$ (was .3W/ft$^2$)
    - Must be designated an Emergency Egress Area on plans
      - Lighting's switches only accessible to Authorized Personnel.
- Lighting Controls must be:
  - Readily accessible
  - Operated by a manual switch in room ~~or occupancy sensor~~
  - Malls, Auditoriums, Sales Floors, Industrial, convention/Arenas can be pilot lit
  - If controlling dimmable fixtures, control must go to all mandated levels
  - 2 or more stall restrooms switch accessible to only Authorized Personnel
  - Other devices may be installed as long the above functionality is not lost.

# Area Control *§130.1(a)4: Area Controls*

Requires separately switched lighting systems

- General lighting vs. all other
- Floor and Wall Display, Window Display, Case Display, Ornamental, and Special Effects Lighting separately controlled via 20A circuits or less (old §135)
- When Track Lighting is used, General, Display, Ornamental and Special Effects must be separately controlled.

# General Lighting Multi-level Controls

*§130.1(b): Multi-Level Controls*

- If Area ≥ 100 ft² and > 0.5 W/ft²
  - Meet control step and uniformity criteria
    - (T130.1-A)
  - Each luminaire shall be controlled by at least one of following:
  - Manual dimming,
  - Lumen maintenance,
  - Tuning,
  - Automatic daylighting controls, or
  - Demand responsive controls

- Exceptions
  - Classrooms with a connected general lighting load ≤
    - 0.7 W/ft² can have at least one step between 30-70% full rated power
  - Areas with a single 1- or 2-lamp luminaire

## *Table 130.1-A: Multi-Level Lighting Controls & Uniformity Requirements*

| General Lighting Luminaire Type | Minimum Steps (% full power) | Uniform illuminance |
|---|---|---|
| Line Voltage except GU-24,<br>Low Voltage Incandescent,<br>LED lamps and systems (& GU-24) | Continuous dimming<br>10 – 100% of full power | Continuous dimming |
| Linear/U-bent FL lamps > 13W | 1. Full Power<br>2. High (80-85%)<br>3. Medium (50-75%)<br>4. Low (20-40%) | Stepped dimming,<br>Continuous dimming,<br>Switching alternate lamps in a luminaire (min 4) |
| CF pin based > 20W<br>GU-24 FL based > 20W | Continuous dimming<br>20 – 100% of full power | Continuous dimming |
| Linear/U-bent FL lamps ≤ 13W<br>Pin based CF ≤ 20W<br>GU-24 FL ≤ 20W<br>Track Lighting | One step 30-70% | Stepped dimming,<br>Continuous dimming,<br>Switching alternate lamps<br>Track can use multi-circuit switching |
| HID > 20 W<br>Induction >25 W<br>and others | One step 50-70% | Stepped dimming,<br>Continuous dimming,<br>Alternate (min 2) lamps in a luminaire |

Dimming = "Enabling Technology"

Exemption: **Spaces < 100 ft$^2$, or ≤ 0.5 W/ft$^2$**
**Classrooms ≤ 0.7 W/ft$^2$**
**Space with just a 1- or 2-lamp fixture.**

A **GU24** connector is fitting for compact fluorescent light bulbs (CFL) that uses a bayonet mount bi-pin connector instead of the Edison screw fitting used on many incandescent light bulbs. The GU24 fitting allows the overall length of the bulb to be shorter since the threaded base is eliminated.

# Shut-off Requirements_*§130.1(c)1: Shut-off Controls*

- All interior lighting shall turn Off automatically when space typically unoccupied, by using:
  - Occupancy sensor,
  - Automatic time switch,
  - Other signal or device
  - Separate Controls per floor
  - Separate Controls per 5,000 $ft^2$
  - 20,000 $ft^2$ for Malls, auditoriums, Single tenant Retail, Industrial, Convention, Arenas
  - Separate Controls for General, Display, Ornamental, and Display Case lighting (?)
  - Exceptions:
  - 24/365 operational areas
  - Areas that require Occupancy Sensors, or Partial On/Off Sensors
  - ~~Corridor, guest-rooms & dwelling units, parking garages~~
  - .05 $W/ft^2$ (was .3 $W/ft^2$) in Office Buildings security/emergency egress
  - Electrical Equipment Rooms

# Countdown Timers and Time Clocks *§130.1(c)2-4: Shut-off Controls*

- Countdown timer switches cannot be used as an Auto Off Device, except
  - Single Stall bathrooms or closets < 70 $ft^2$, if timer ≤10 minutes
  - Server Aisles, if timer ≤ 30 minutes
- Timeclock Override switching device
  - Meets Area Control requirements
  - Allow override ≤ 2 hours

  Malls, Single Tenant Retail, Auditoriums, Industrials, and Arenas allowed longer via captive key switches
- Most sites require automatic holiday shutoff
  - Not needed in churches, retailers, restaurants or theatres.

# Mandatory use of Sensors

*§130.1(c)5: Indoor Lighting Controls*

Occupancy sensors must be installed in the following areas to shut off the lighting:

1. Offices ≤ 250 $ft^2$
2. Multipurpose rooms ≤ 1000 $ft^2$
3. Classrooms any size
4. Conference rooms any size

(d) Controls must allow the lights to be manually shut off in compliance with §130.1(a) regardless of the sensor's status

# Partial ON/OFF Sensor (w/ Auto Off)

*§130.1(c)6: Indoor Lighting Controls*

| Space | Requirements |
|---|---|
| Warehouse<br>Aisles & Open Areas | *Sensor required for Hi/Lo ≥ 50% during the day, turn off when vacant*<br>*If LPD ≤ 80% area LPD, ≥ 40% reduction*<br>*If metal halide, ≥ 40% reduction* |
| Library Stack Aisles<br>one end ≥ 10 ft, and<br>both ends ≥ 20 ft | *Sensor required for Hi/Lo ≥ 50% during the day, turn off when vacant*<br>*Independent zones for each aisle* |
| Corridors & Stairwells | *Sensor required for Hi/Lo (at least 50%) during the day in each* ***separate*** *space and* ***shall be automatically activated from all designed paths of egress*** |

# Partial ON/OFF Sensor (w/o Auto Off)

*§130.1(c)7: Indoor Lighting Controls*

| Space | Requirements |
|---|---|
| Common Area Corridors in Hotels/Motels<br><br>High rise Residential | *Hi/Lo (at least 50%) during the day in each separate space and shall be automatically activated from all designed paths of egress.*<br>*If LPD is ≤ 80% area method, ≥ 40% reduction* |
| Parking garages (Interior)<br>Parking areas<br>Loading and unloading areas | *Reduce general lighting watts to 20-50%*<br>*One sensor per 500 Watts max.*<br>*Meet uniformity levels in 131-A*<br>*Control each separate space and shall be automatically activated from all designed paths of egress.*<br>*If HID efficacy > 75 lumens/W, 20 - 60%* |

# Guestroom *§130.1(c)8: Indoor Lighting Controls*

- Ensure hotel and motel guest room lights are off within 30 minutes of space being vacated using:
  - Occupancy Sensors,
  - Automatic Controls, or
  - Captive Card Key

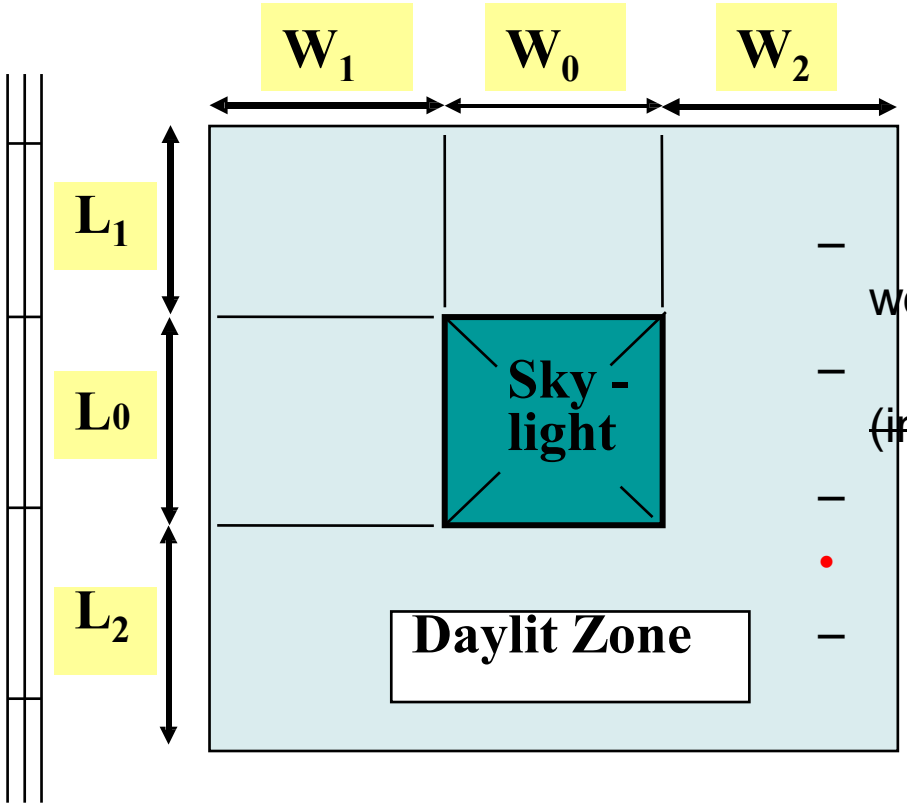
- Exemption for 1 high efficacy luminaire separately switched and within 6’ of the door.

# Daylighting Definitions *§130.1(d): Daylit Areas*

- Three different Daylight Zones
- DO NOT double count overlapping areas
  - Skylit Daylight Area
  - Primary Sidelit Daylight Area
  - Secondary Sidelit Daylight Area

# Skylit Area *§130.1(d)1A: Daylit Areas*

- Control luminaires in or partially in the daylit area



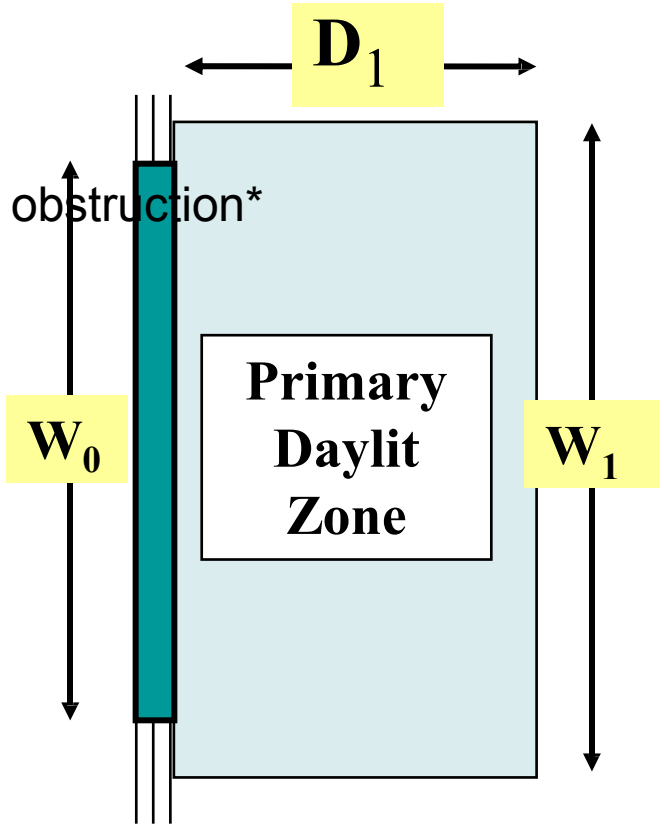

$L_1$, $L_2$, $W_1$,$W_2$ = smallest of the following values:

- 70% of ceiling height of skylight or well, or
- ~~Distance to a Primary Sidelit edge (includes Rooftop Monitor Daylit), or~~
- Distance to permanent obstruction > 50% floor to skylight bottom
- Floor shape matches skylight

**Daylit area= L x W = $(L_1+L_o+L_2)$ x $(W_1+W_0+W_2)$**

# Primary Sidelit Area *§130.1(d)1B: Daylit Areas*

## Control luminaires in the Primary Sidelit area



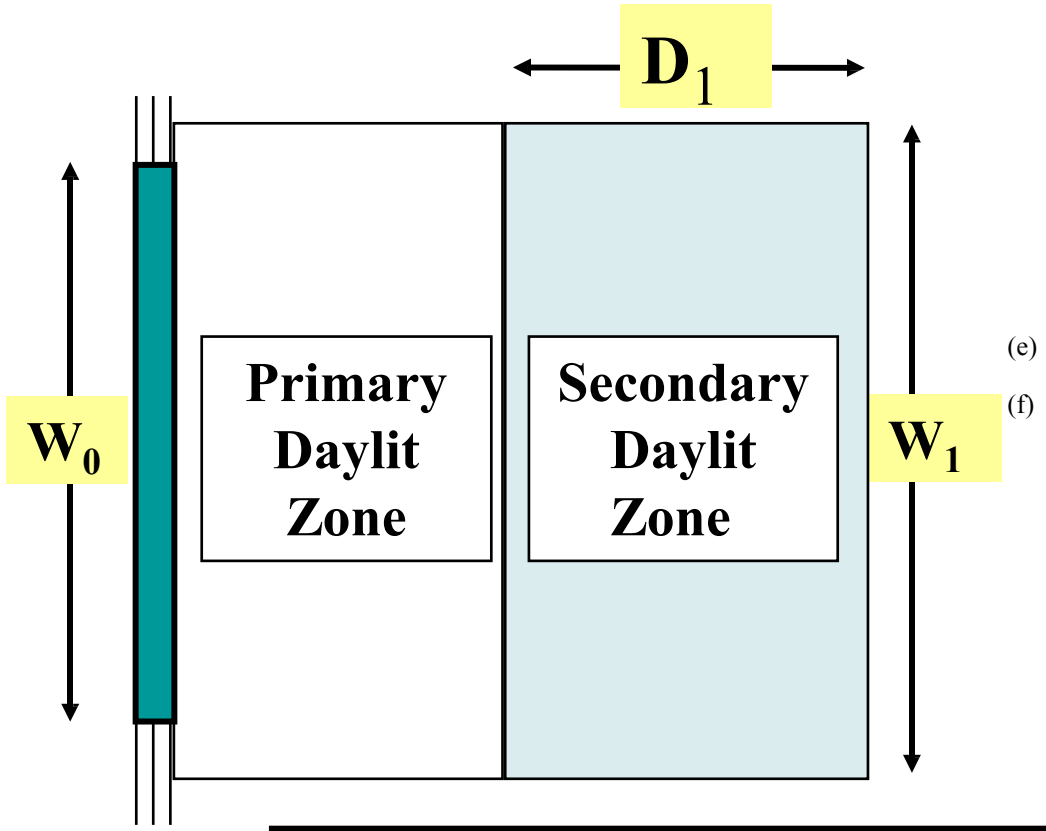

$D_1$ = **Window Head Height**, or
Distance to closest 60" high permanent

$W_1$= Window Width ($W_0$) + (on each side)
(c) .5 x Window Head Height, or
(d) Distance to closest 60" high permanent obstruction

**Primary Sidelit area = ($D_1$) x ($W_1$)**

*** Per Code, Cubical Walls ARE NOT Permanent**

# Secondary Sidelit Area *§130.1(d)1C: Daylit Areas*




$D_1$ = **Window Head Height**, or

- Distance to closest 60" high permanent obstruction*

$W_1$= Window Width ($W_0$) + (on each side):

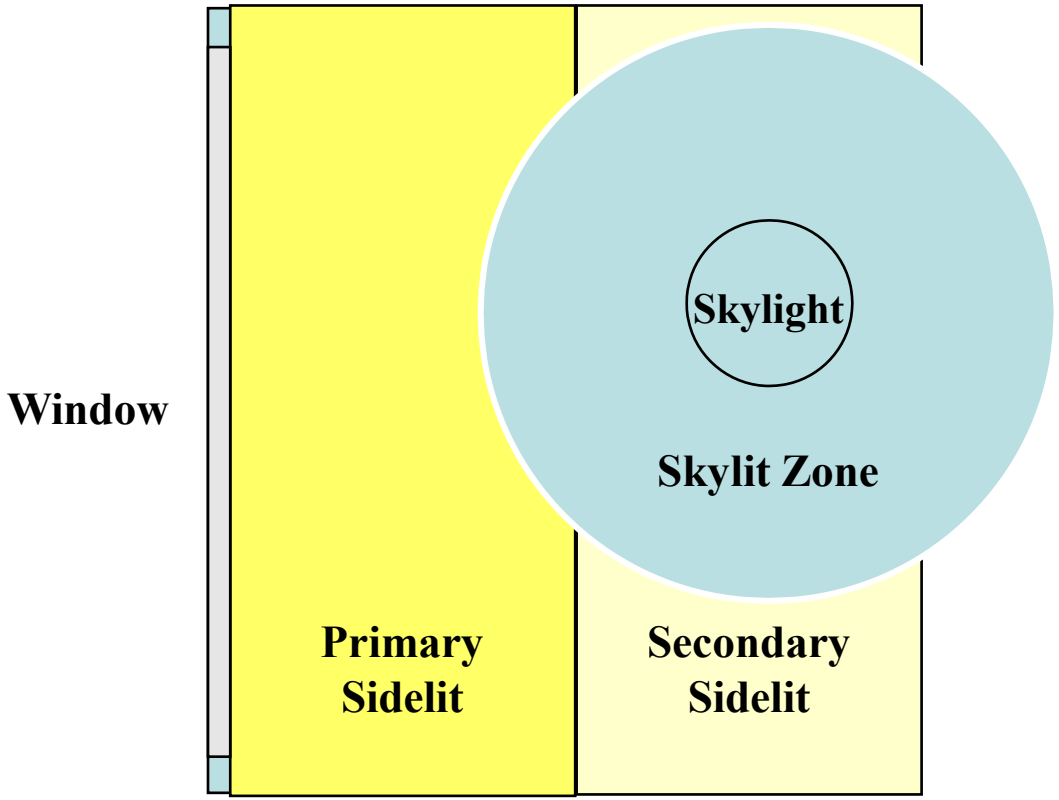
(e) .5 x Window Head Height or

(f) Distance to closest 60" high permanent obstruction

**Secondary Sidelit area = ($D_1$) x ($W_1$)**

*** Per Code, Cubical Walls ARE NOT Permanent**

# Daylight Zones




**Remember the new Hierarchy:**
**Skylit beats Primary Sidelit, &**
**Skylit beats Secondary Sidelit**

# Daylight Areas *§130.1(d)2A-C: Daylight*

- **General Lighting** luminaires totally or partially in the Skylit daylight area and/or the Primary Sidelit daylight area shall have automatic daylighting controls.
- Show Skylit and Primary Sidelit zones on the plans
- Control luminaires in primary sidelit areas
  - separately from skylit areas.
- **WARNING**!!! 140.6(d) requires control of Secondary Sidelit fixtures for perscriptive method

# Automatic Daylighting Control Device

*§130.1(d)2D: Daylight*

Install Automatic Daylighting Controls:

- Photosensors & calibration controls not accessible to unauthorized people.
- Daylighting controls provide multi-level lighting per Table 130.1-A
- Exemption of multi-level if LPD < 0.3 W/ft$^2$
- Exemption of multi-level if adding Skylights to a existing site

Combined illuminance from controlled lighting and daylight shall not be less than controlled lighting with no daylight.

When daylight illuminance >150% of design electric level at full power, the general lighting in that zone shall be reduced by minimum 65%

**i.e. DOES NOT mandate full off**

Exceptions

Total installed general lighting power **Skylit + Primary Sidelit zones < 120W**

- When glazing in room is < 24 ft$^2$

# Parking Garage Daylighting *§130.1(d)3: Daylight*

- In Parking Garages with > 36 $ft^2$ of windows or openings, luminaires **in primary and secondary sidelit** daylit zones shall be controlled independently by automatic daylighting controls.
  - Show zones on plans
  - Ensure photosensors and calibrations are not accessible to unauthorized people
  - Utilize **multi-level, continuous dimming, or ON/OFF** daylighting controls
  - Combined illuminance from controlled lighting and daylight shall not be less than controlled lighting with no daylight.
  - In Primary Sidelit zones, when illuminance is >150% of controlled lighting, the general lighting in that zone shall be at 0% power


**i.e. DOES mandate full off**

# Demand Responsive Controls *§130.1(e): Indoor Lighting Controls*

- In buildings > 10,000 $ft^2$, total lighting power shall be capable of being automatically reduced by a DR signal by at least 15%
- Lighting reduction shall be uniform per Table 130.1- A
- Non-habitable spaces do not count toward this requirement
  - Spaces < 0.5W/ $ft^2$ shall not count toward total power

- Per 130.5(e) DRC and equipment shall be capable of receiving and automatically responding to at least one standards based messaging protocol.

# *§130.2*

# Exterior Lighting and Cutoff *§130.2(a)-(b): Outdoor Lighting Controls and Equipment*

Outdoor incandescent luminaires >100W controlled by a motion sensor

- **Exceptions**: Health or life safety, pools, temp., theme parks, LED/Neon and Sign Lighting

Outdoor luminaires > 150W follow **Backlight, Uplight, & Glare** (BUG) requirements:

- No Backlight Requirements
- Max zonal Uplight lumens: Table 130.2-A
- Max zonal Glare lumens: Table 130.2-B
- **Exceptions:**

- Signs, façade lighting (not wallpacks), statutes, bridges, health or
- life safety lighting to be cutoff, temp…
- When replacing some existing Pole Luminaires
- Luminaires that illuminate public right of way roads, sidewalks, and bikeways

# Exterior Lighting and Cutoff

*§130.2(a)-(b): Outdoor Lighting Controls and Equipment*

**Uplight Ratings**

*TABLE 130.2-A Uplight Ratings (Maximum Zonal Lumens)*

| Secondary Solid Angle | Maximum Zonal Lumens per Outdoor Lighting Zone | | | |
|---|---|---|---|---|
| | OLZ 1 | OLZ 2 | OLZ 3 | OLZ 4 |
| Uplight High (UH)<br>100 to 180 degrees | 10 | 50 | 500 | 1,000 |
| Uplight Low (UL)<br>90 to <100 degrees | 10 | 50 | 500 | 1,000 |

**Glare Ratings - Asymmetrical**

*TABLE 130.2-B Glare Ratings (Maximum Zonal Lumens)*

| Glare Rating for Asymmetrical Luminaire Types (Type I, Type II, Type III, Type IV) | | | | |
|---|---|---|---|---|
| Secondary Solid Angle | Maximum Zonal Lumens per Outdoor Lighting Zone | | | |
| | OLZ 1 | OLZ 2 | OLZ 3 | OLZ 4 |
| Forward Very High (FVH)<br>80 to 90 degrees | 100 | 225 | 500 | 750 |
| Backlight Very High (BVH)<br>80 to 90 degrees | 100 | 225 | 500 | 750 |
| Forward High (FH)<br>60 to <80 degrees | 1,800 | 5,000 | 7,500 | 12,000 |
| Backlight High (BH)<br>60 to <80 degrees | 500 | 1,000 | 2,500 | 5,000 |

**Glare Ratings - Quadrilateral Symmetrical**

| Glare Rating for Quadrilateral Symmetrical Luminaire Types (Type V, Type V Square) | | | | |
|---|---|---|---|---|
| Secondary Solid Angle | Maximum Zonal Lumens per Outdoor Lighting Zone | | | |
| | OLZ 1 | OLZ 2 | OLZ 3 | OLZ 4 |
| Forward Very High (FVH)<br>80 to 90 degrees | 100 | 225 | 500 | 750 |
| Backlight Very High (BVH)<br>80 to 90 degrees | 100 | 225 | 500 | 750 |
| Forward High (FH)<br>60 to <80 degrees | 1,800 | 5,000 | 7,500 | 12,000 |
| Backlight High (BH)<br>60 to <80 degrees | 1,800 | 5,000 | 7,500 | 12,000 |

# Outdoor Controls

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*§130.2(c)1-2: Outdoor Lighting Controls*

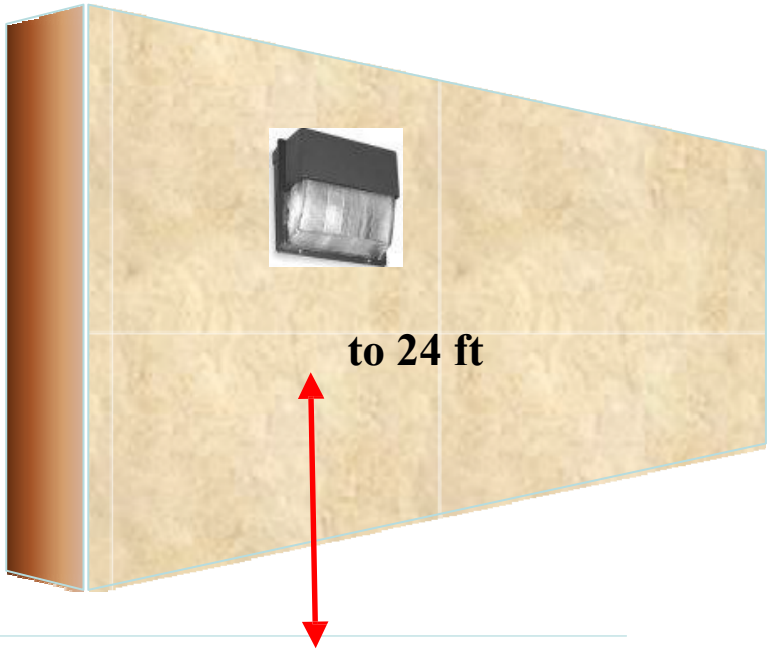
- All installed outdoor lighting shall:
  - Have Auto-OFF by a photo control or astronomical time switch;
  - Be circuited and controlled to turn off independently from other electrical loads by an automatic scheduling control.
- Exceptions:
  - Lights that health and life safety regulations say cannot be turned off, and
  - 24/7 Tunnel Lighting

# Controls for Outdoor Lighting

*§130.2(c)3: Outdoor Lighting Controls*

- Outdoor luminaires with bottoms ≤ 24’ above ground need:
  - Motion or other controls so when area is unoccupied there’s a 40-80% power reduction (or dim to somewhere 40-80%), and have Auto On functionality
  - No more than 1,500W lighting controlled together
  - Includes Wall Packs per §130.2(c)5

- Excludes
  - Some specific application lighting (see next slides §130.2(c)4-5)
  - Pole mtd luminaires w/max power ≤ 75W
  - Non-pole luminaires w/max power ≤ 30W
  - Linear lighting with max ≤ 4W/ft



# Outdoor Sales Frontage, Lots & Canopies

*§130.2(c)4: Outdoor Lighting Controls*

- Install automatic lighting controls to meet:
  - A distributed “part-night” device, or
  - Motion sensors capable of automatically reducing lighting power by at 40-80%, and which have auto-on functionality.

**Part-Night Outdoor Lighting Control is a time or occupancy-based system programmed to reduce power or turn off an outdoor luminaire for a portion of the night**

# Façade, Ornamental Hardscape & Dining

*§130.2(c)5: Outdoor Lighting Controls*

- Install automatic lighting controls that meet the following:
  - A distributed part-night device, or
  - Motion sensors capable of automatically reducing lighting power by at least 40 – 80%, and which have auto-on functionality, or
  - A centralized time-based zone switching capable of automatically reducing lighting power by at least 50%.
- Does not include Wall Packs

# Acceptance and Certificate Requirements

*§130.4: Lighting Control Acceptance*

- Mandates certification of lighting controls before occupancy permit granted. Compliance with Part 6 requirements for plans, specifications, installation certificates, operating and maintenance info

- Acceptance testing performed on:
  - Automatic daylighting controls: §119, §131(c)2D,
  - Multi-level Astro: §119 and §131(d)2
  - Lighting Controls: §131(a)-(c), (e), (f) and §146(a)2D
  - Automatic Lighting Controls: §119 and §131(d)
  - Occupancy Sensors: §119 and §131(d)
  - Outdoor Lighting Controls: §119 and §132

- New! Installation Certificate requirements for specific applications
  - Includes Lighting Control Systems
  - EMCS
  - Integral or external current limiters
  - Interlocked systems (140.6(a)1
  - Power Adjustment Factors
  - Videoconference Studios

- **New Provider! The acceptance testing shall be performed by a Certified Lighting Controls Acceptance Test Technician (CLCATT).**

# CLCATT = “Cool Cat”

*§10-103-A: Lighting Control Acceptance Test Technician*

- Curricula: Acceptance Test Technician Certification Provider shall include the analysis, theory, and practical application of :
  - Lamp and ballast systems;
  - Line voltage switching controls;
  - Low voltage switching controls;
  - Dimming controls;
  - Occupancy sensors;
  - Photosensors;
  - Demand responsive signal inputs to lighting control systems;
  - Building Energy Efficiency Standards required lighting control systems;
  - Building Energy Efficiency Standards required lighting control system specific analytical/problem solving skills;
  - Integration of mechanical and electrical systems for Building Energy Efficiency Standards required lighting control installation and commissioning;
  - Safety procedures for low-voltage retrofits (<50 volts) to control line voltage systems (120 to 480 volts);
  - Accurate and effective tuning, calibration, and programming of Building Energy Efficiency Standards required lighting control systems;
  - Measurement of illuminance according to the Illuminating Engineering Society’s measurement procedures as provided in the IESNA Lighting Handbook, 10th Edition, 2011, which are incorporated by reference;
  - Building Energy Efficiency Standards lighting controls acceptance testing procedures; and
  - Building Energy Efficiency Standards acceptance testing compliance documentation for lighting controls.

- Section also covers
  - Hands-on training
  - Prequalification.
  - Instructor to Trainee Ratio
  - Tests
  - Recertification

# *§130.5* Electrical Power Distribution Systems

## Electrical Power Distribution Systems

New section in the Standards, for electrical measures which are not specifically related to lighting

(f) Added requirements for user accessible metering of total electrical use per Table 130.5-A (for larger rated panels)

(g) Disaggregation of electrical circuits according to Table 130.5-B (for larger size services).

**3.** Added maximum voltage drop requirements. **(Section 130.5(c)**

(h) Added mandatory requirement for receptacle controls in private offices, open office areas, reception lobbies, conference rooms, kitchens, and copy rooms to automatically shut off task lighting and other plug loads when the area is not occupied. **(Section 130.5(d))**

(i) Added requirements for demand responsive controls and equipment. **Section 130.5(e)**

(j) Added requirements for Energy Management Control Systems to meet to be recognized for compliance with Part 6. **Section 130.5(f)**

# Electrical Distribution Systems *§130.5(a): Electrical Distribution Systems*

Mandatory Measures for:

- **Metering**
  - Based upon size of electrical service
- New buildings wired to enable measuring energy use from a single point for each system
  - (Table 130.5b)
- Limits voltage drop for feeders (2%) and branch circuits (3%)
  - Matches California Energy Code 2010
- All buildings to be enabled to receive and act upon demand response signals
- Sets rules from when EMCS can be used

# Minimum for Electrical Load Metering *Table 130.5 A*

| Meter Type | Services < 50 kVA | Services 50 – 250 kVA | Services 250 - 1000 kVA | Services > 1000 kVA |
|---|---|---|---|---|
| Instantaneous (at the time) kWh demand | Required | Required | Required | Required |
| Historical peak demand (kW) | Not Required | Not Required | Required | Required |
| Resettable kWh | Required | Required | Required | Required |
| kWh per rate period | Not Required | Not Required | Not Required | Required |

# Minimum for Separation of Electrical Load

***(Table is Only Lighting, Plug and EV!)***

*Table 130.5 B*

| Meter Type | Services < 50 kVA | Services 50 – 250 kVA | Services 250 - 1000 kVA | Services > 1000 kVA |
|---|---|---|---|---|
| Lighting including exit, egress, and exterior lighting | Not Required | All loads in aggregate | All lighting disaggregated by floor, type, or area | All lighting disaggregated by floor, type, or area |
| Plug load, including appliances rated < 25 KVA | Not Required | All plug loads in aggregate<br>Groups of plug loads exceeding 25 kVA connected load in an area < 5,000 SF | All plug load separated by floor, type, or area<br>Groups of plug loads exceeding 25 kVA connected load in an area < 5,000 SF | All plug load separated by floor, type, or area<br>All groups of plug loads exceeding 25 kVA connected load in an area < 5,000 SF |
| Charging stations for EV | All loads in aggregate | All loads in aggregate | All loads in aggregate | All loads in aggregate |

**HVAC, water pumps, elevators, theatrical, commercial kitchens, renewable requirements not included in this table. See T24 for specific requirements**

# Controlled Receptacles

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*§130.5(d): Plug Loads*

- Controlled receptacles (CR) and uncontrolled receptacles (UCR) to be provided in **private office, open office space, reception lobby, conference room, kitchen, and copy room**.

- CRs to control task lighting and plug loads with automatic shut-off controls similar to Lighting 130.1(c)1-5 (includes Mandatory OS); and
- At least one CR within 6’ foot from each UCR, or a split wired duplex receptacle; and
- CR shall have a permanent marking to differentiate them from UCR, And
- In Open Offices, controlled circuits shall be installed to support office furniture with future CRs.

# Controlled Receptacles

*§130.5(d): Plug Loads*

- In **Hotel and motel guest rooms**, at least 50% of receptacles shall be Auto Off via sensors, captive key switches or automatic controls so they are off within 30 minutes of vacancy

- Plug in strips that use occupancy sensors shall not be used to comply with this code
  - Exception for workstations with permanent integral OS units

- Exceptions for fridges, water dispensers, clocks, copy room machinery, and above 20Amp.

## Compliance Road Choice

*§140.0: Performance vs. Prescriptive approaches.*

# Performance vs. Prescriptive

- Performance Method based on comparison of TDV energy against energy budget from §140.1 calculated with a CEC approved software.
  - Time Dependant Valuation (TDV) energy is the time varying energy used by the buildings, including space conditioning, water heating, lighting, and mechanical ventilation.
  - TDV varies for each hour of the year, and energy type, by climate zone, and building type.
- Prescriptive is per sections §140.2 - §140.8

# Prescriptive Requirements

*§140.2: Prescriptive Approach*

- When using the Prescriptive method, buildings must meet the following:
  - Building Envelope complies with **§140.3**(a), (b) and sometimes **(c)**
  - Space Conditioning complies with §140.4
  - Service Water-heating complies with §140.5
  - **Lighting System complies with §140.6**
  - **Outdoor Lighting System complies with §140.7**
  - **Interior and Exterior signs comply with §140.8**
  - Covered processes that comply with §140.9

# Skylights *§140.3(a) 6: Minimum Skylight Areas*

- Skylights shall not have an area greater than 5% of the gross exterior roof area
  - Exception: 10% for atria > 55 ft high
- Skylights must meet other requirements
  - U-factor
  - Solar Heat Gain coefficients
  - Area-Weighted Performance Rating VT
  - Material or diffuser Haze value >90%

# Large Spaces, ~~Bldgs ≤3Stories~~

*§143(c): Minimum Daylighting*

- Conditioned or Unconditioned spaces **> 5,000 ft²** (was 8,000 ft²) directly under roof, with ceilings >15 ft need **≥75%** (was 50%) of floor area (plan view) in Primary Sidelit and/or Skylit Daylit zones
  - Skylight to skylit area ratio ≥ 3.3%, or Min Eff. Aperture ≥ 1.1%
  - Primary sidelit daylit areas Eff. Aperture ≥ 10%

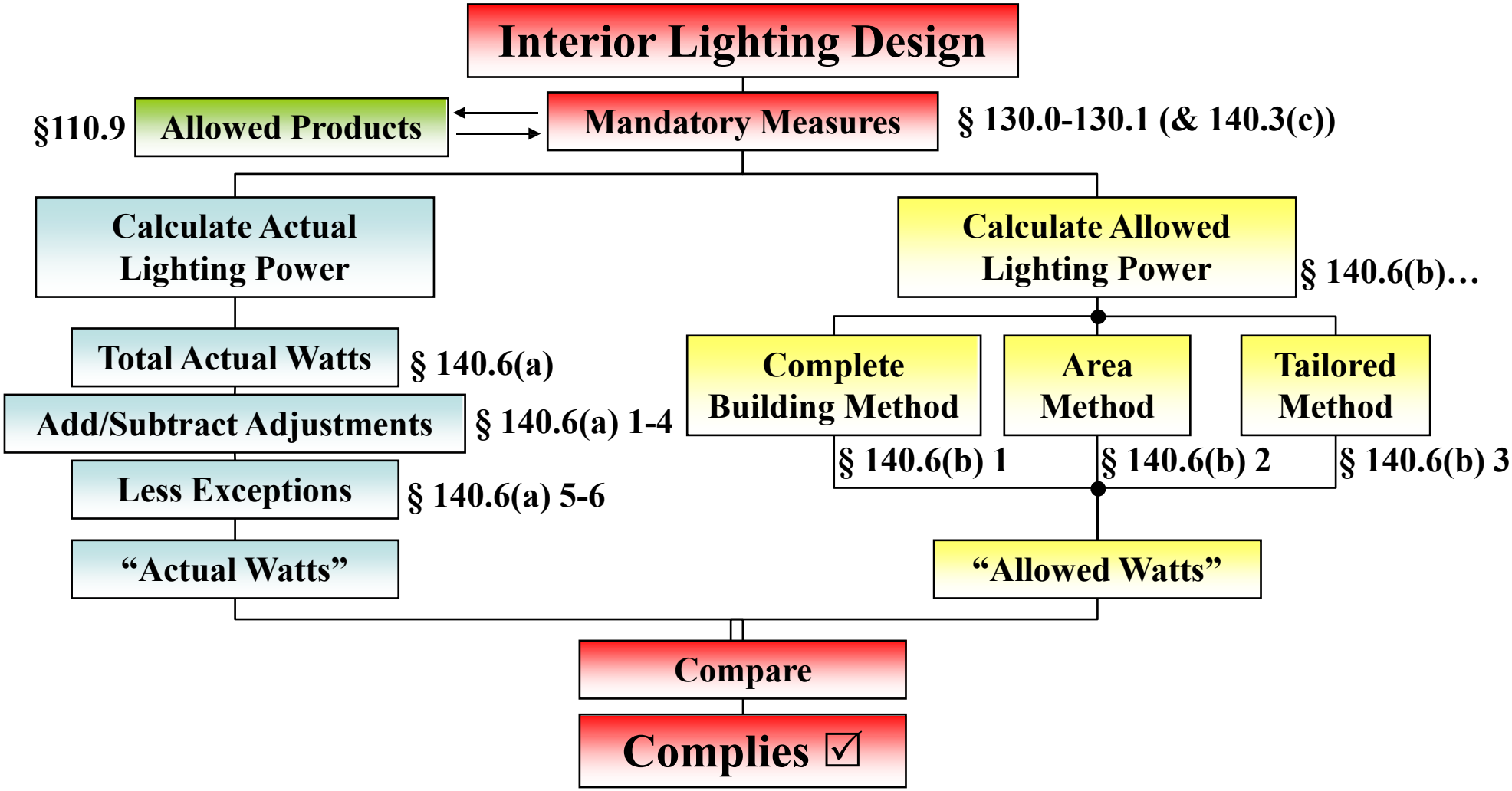
- Lighting in daylit area controlled per §130.1(d)

- Exceptions:
  - Climate zones 1 & 16, auditoriums, theatres, churches, museums, and Refrigerated warehouses.
  - Some buildings with future built out spaces
  - Enclosed spaces with LPD < .5W /ft²
  - (What about PV Systems?)

**Applications: Warehouses & ~~Big-box~~ most Retail**

# Prescriptive Indoor Lighting Overview

*§140.6: Prescriptive Requirements for Indoor Lighting*



# Actual Lighting Power Density (LPD)

*§146(a): Prescriptive Requirements for Indoor Lighting*

- Actual must be less than Allowed
- Include Permanent **and** Portable Lighting
  - **Exception**: Up to 0.3 watts/ft$^2$ (was 0.2) of portable lighting **for office areas** does not need to be included in the calculation
- Calculate Allowed Indoor Lighting Power with one of the following
  - Complete Building
  - Area Category
  - Tailored Method

# Interlocked Lighting

*§146(a)1: Prescriptive Requirements for Indoor Lighting*

- Allowed when **two** lighting systems used
  - If there are two, they must be interlocked
- For auditoriums, convention centers, conference rooms, multipurpose rooms, or theater
- Watts of the smaller interlocked lighting system can be excluded
- Lighting systems must be interlocked with a nonprogrammable double throw switch

# Reduction of Wattage through Controls

*§140.6(a) 2: Prescriptive Requirements for Indoor Lighting*

- Controlled watts of lighting may be reduced by watts times the PAF Table 146C

- Specific rules for each power adjustment factor in the table are discussed in §140.6(a)2
  - Only 1 PAF may be used for each qualifying luminaire. PAFs can't be added together unless allowed in the Table 140.6-A
  - Partial On (was Multilevel) Sensors must automatically turn on 30-70%

# Lighting Power Adjustment Factors

*Table 140.6-A: Lighting Power Adjustment Factors*

*TABLE 140.6-A LIGHTING POWER DENSITY ADJUSTMENT FACTORS (PAF)*

| TYPE OF CONTROL | | TYPE OF AREA | | FACTOR |
|---|---|---|---|---|
| a. To qualify for any of the Power Adjustment Factors in this table, the installation shall comply with the applicable requirements in Section 140.6(a)2<br>b. Only one PAF may be used for each qualifying luminaire unless combined below.<br>c. Lighting controls that are required for compliance with Part 6 shall not be eligible for a PAF | | | | |
| 1. Partial-ON Occupant Sensing Control | | Any area ≤ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, conference or waiting room. | | 0.20 |
| 2. Occupant Sensing Controls in Large Open Plan Offices | | In open plan offices > 250 square feet: One sensor controlling an area that is: | No larger than 125 square feet | 0.40 |
| | | | From 126 to 250 square feet | 0.30 |
| | | | From 251 to 500 square feet | 0.20 |
| 3. Dimming System | Manual Dimming | Hotels/motels, restaurants, auditoriums, theaters | | 0.10 |
| | Multiscene Programmable | | | 0.20 |
| 4. Demand Responsive Control | | All building types less than 10,000 square feet.<br>Luminaires that qualify for other PAFs in this table may also qualify for this demand responsive control PAF | | 0.05 |
| 5. Combined Manual Dimming plus Partial-ON Occupant Sensing Control | | Any area ≤ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, conference or waiting room | | 0.25 |

# Lighting Power Deductions *§140.6(a) 3: Lighting Wattage Excluded*

- Lighting Watts from many applications are exempted:
  - Some lighting in theme parks
  - Lighting for film, video, and photography studios
  - Theatrical controlled by multiscene or crossfade controller
  - Pre-installed in some refrigerators, freezers, vending machine
  - Lighting for plant growth (must have timeclock)
  - Lighting that is for sale
  - Exit Signs if they have maximum lamp power 5W/face
  - Guestrooms in Hotel/Motels, High-rise Residential Living quarters
  - Temporary Lighting Systems
  - Lighting in Elevators (per ASHRAE 90.1 2010?)
  - Others… See Complete List!

# Indoor Lighting Power General Rules

*§140.6(b) : Prescriptive Requirements for Indoor Lighting*

- Conditioned and unconditioned spaces must be calculated separately - no trading allowed
- No trading between indoor and outdoor areas
- Three possible methods
  - Complete Building Method
  - Area Category Method (can be combined with Tailored)
    - LPD for some tasks/items can't be raised by decreasing others
  - Tailored Method (can be combined with Area)
    - LPD for Wall / Floor / Ornamental / Valuable Case can't be traded

# Calc of Allowed Indoor Lighting Power Density

*§140.6(c)1 : Prescriptive Requirements for Indoor Lighting*

Choose between 3 methods

1) Complete Building Method

– Must be listed specifically, and can only apply to one building

• Exception: If combination parking garage and another type use building, then each portion can be determined separately.

– Can use for building or tenant space where one type of use accounts at least 90% of the space

# Complete Bldg. – Lighting Power Density

*Table 146-E*

*TABLE 140.6-B COMPLETE BUILDING METHOD LIGHTING POWER DENSITY VALUES ~~(WATTS/FT²)~~*

| TYPE OF BUILDING | ALLOWED LIGHTING POWER DENSITY (WATTS PER SQUARE FOOT) |
|---|---|
| Auditorium Building | 1.5 |
| Classroom Building | 1.1 |
| Commercial and Industrial Storage Building | 0.6 |
| Convention Center Building | 1.2 |
| Financial Institution Building | 1.1 |
| General Commercial Building/Industrial Work Building | 1.0 |
| Grocery Store Building | 1.5 |
| Library Building | 1.3 |
| Medical Building/Clinic Building | 1.1 |
| Office Building | 0.8 |
| Parking Garage Building | 0.2 |
| Religious Facility Building | 1.6 |
| Restaurant Building | 1.2 |
| School Building | 1.0 |
| Theater Building | 1.3 |
| All others buildings | 0.6 |

# Calculations of Allowed Indoor Lighting Power Density

*§140.6(c)2 : Prescriptive Requirements for Indoor Lighting*

Choose between 3 methods

Area Category Method

- Total allowed lighting power is the sum of the allowed lighting powers for all individual areas
- Multi-tenant areas with an unknown tenant, use 0.6W/ft$^2$ for lighting (Unleased Tenant Area)
- Allowance in Table's footnote for specialized tasks, ornamental, precision, accent, display, decorative, video conferencing, white and chalk boards under specific conditions

# Area Method – Lighting Power Density

*Table 140.6-C*

# Area Method –Lighting Power Density

*Table 140.6-C Footnotes*

FOOTNOTES FOR TABLE 140.6-C:

See Section 140.6(c)2 for an explanation of additional lighting power available for specialized task work, ornamental, precision, accent, display, decorative, and white boards and chalk boards, in accordance with the footnotes in this table. The smallest of the added lighting power listed in each footnote below, or the actual design wattage, may be added to the allowed lighting power only when using the Area Category Method of compliance.

| Footnote number | Type of lighting system allowed | Maximum allowed added lighting power, ($W/ft^2$ -of task area unless otherwise noted) |
|---|---|---|
| 1 | Specialized task work | 0.2 $W/ft^2$ |
| 2 | Specialized task work | 0.5 $W/ft^2$ |
| 3 | Ornamental lighting as defined in Section 100.1 and in accordance with Section 140.6.(c)2. | 0.5 $W/ft^2$ |
| 4 | Precision commercial and industrial work | 1.0 $W/ft^2$ |
| 5 | Per linear foot of white board or chalk board. | 5.5 W per linear foot |
| 6 | Accent, display and feature lighting - luminaires shall be adjustable or directional | 0.3 $W/ft^2$ |
| 7 | Decorative lighting - primary function shall be decorative and shall be in addition to general illumination. | 0.2 $W/ft^2$ |
| 8 | Additional Videoconferencing Studio lighting complying with all of the requirements in Section 140.6(c)2Gvii. | 1.5 $W/ft^2$ |
| 9 | Daylight Adaptation Zones shall be no longer than 66 feet from the entrance to the parking garage | |

# Calc of Allowed Indoor Lighting Power Density

*§140.6(c)3 : Prescriptive Requirements for Indoor Lighting*

Choose between 3 methods

Tailored Method

- Re-worked based on Lux vs. IES Type
- Use on projects with primary function areas that do not use the Area Category Method
- General Lighting can't be

  Narrow beam, wall washer, valence, direct cove, perimeter linear slot
- Voluminous clarifications for most specific applications have been added to the code

  Wall, Floor, Ornamental/Special Effect, Valuable Case

# Tailored Method *§146(c) 3A: Tailored Method*

- Start by determining spaces general lighting allowance (Column 2) from Table 146-G.
- If not listened, refer to IESNA Handbook's Design Guide for Horizontal Illuminance.
- Tasks less than 2 hours, or poor quality tasks, can't be used to justify types E, F, or G.

*TABLE 146-G ~~D~~ TAILORED METHOD SPECIAL LIGHTING POWER ALLOWANCES*

| 1 | 2 | 3 | 4 | 5 | ~~6~~ |
|---|---|---|---|---|---|
| Primary Function | Illumination Category | Wall Display Power (W/ft) | Allowed Floor Display Power (W/ft²) | Allowed Ornamental/ Special Effect Lighting | ~~Allowed Very Valuable Display Power (W/ft²)~~ |
| Auditorium | D | ~~2.5~~ 2.25 | 0.3 | 0.5 | ~~0~~ |
| Civic Meeting Place | D | ~~3.5~~ 3.15 | 0.2 | 0.5 | - |
| ~~Classrooms, lecture, training, vocational room~~ | ~~D~~ | ~~7~~ | ~~0~~ | ~~0~~ | ~~0~~ |
| Commercial and industrial storage<br>Inactive<br>Active: bulky items; large labels<br>Active: small items; small labels | ~~IESNA HB~~<br>B<br>C<br>D | ~~0~~ | ~~0~~ | ~~0~~ | ~~0~~ |
| Convention, conference, multipurpose and ing centers | D | 2.5 | 0.4 | 0.5 | ~~0~~ |
| ~~Corridors, restrooms, stairs and support~~ | ~~IESNA H~~ | ~~0~~ | | ~~0~~ | ~~0~~ |
| Correction Facility cells and day rooms | D | 0 | | | |
| Dining | | .5 | | 0.6 | ~~0~~ |
| Dressing room | D | 0 | | | |
| Education facilities<br>Classrooms, lecture, training, vocational room | D | 5.5 | 0 | 0 | |

Gone

# Tailored Method – Lighting Power Density *Table 140.6-D*

*TABLE 140.6-D TAILORED METHOD ~~SPECIAL~~ LIGHTING POWER ALLOWANCES ~~(THIS IS A REFORMATED VERSION OF THE TABLE ABOVE)~~*

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Primary Function Area | General Illumination Level (Lux) | Wall Display Power (W/ft) | Allowed Combined Floor Display Power and Task Lighting Power (W/ft²) | Allowed Ornamental/ Special Effect Lighting |
| Auditorium Area | 300 | 2.25 | 0.3 | 0.5 |
| Civic Meeting Place | 300 | 3.15 | 0.2 | 0.5 |
| Convention, Conference, Multipurpose, and Meeting Center Areas | 300 | 2.50 | 0.4 | 0.5 |
| Dining Areas | 200 | 1.50 | 0.6 | 0.5 |
| Exhibit, Museum Areas | 150 | 15.0 | 1.2 | 0.5 |
| Financial Transaction Area | 300 | 3.15 | 0.2 | 0.5 |
| Grocery Store Area | 500 | 8.00 | 0.9 | 0.5 |
| Hotel Function Area | 400 | 2.25 | 0.2 | 0.5 |
| Lobby Area: | | | | |
| Hotel lobby | 200 | 3.15 | 0.2 | 0.5 |
| Main entry lobby | 200 | 0 | 0.2 | 0 |
| Lounge ~~Recreation~~ Area | 200 | 7.00 | 0 | 0.5 |
| Malls and Atria | 300 | 3.50 | 0.5 | 0.5 |
| Religious Worship Area | 300 | 1.50 | 0.5 | 0.5 |
| Retail Merchandise Sales, and Showroom Areas | 400 | 14.00 | 1.0 | 0.5 |
| Theater Area: | | | | |
| Motion picture | 200 | 3.00 | 0 | 0.5 |
| Performance | 200 | 6.00 | 0 | 0.5 |
| Transportation Function Area | 300 | 3.15 | 0.3 | 0.5 |
| Waiting Area | 300 | 3.15 | 0.2 | 0.5 |

# Tailored Method - RCR

*Table 140.6-F*

- Determine Room Cavity Ratio of each space.

*TABLE 140.6-F ROOM CAVITY RATIO (RCR) EQUATIONS*

| |
|---|
| Determine the Room Cavity Ratio for ~~Table~~TABLE 140.6-G using one of the following equations. |
| Room cavity ratio for rectangular rooms $$RCR = \frac{5 \times H \times (L + W)}{L \times W}$$ |
| Room cavity ratio for irregular-shaped rooms $$RCR = \frac{2.5 \times H \times P}{A}$$ |
| Where: L =Length of room; W = Width of room; H =Vertical distance from the work plane to the centerline of the lighting fixture; P = Perimeter of room, and A = Area of room |
| |

# Tailored Method - Task Areas

*§146(c) 3A iv: Task Areas*

- Based on Lux and RCR, look up allowed LPD
- Multiply by Area $Ft^2$

*TABLE 140.6-G ILLUMINANCE LEVEL (LUX) POWER DENSITY VALUES (WATTS/FT²)*

| Illuminance Level (Lux) | RCR ≤ 2.0 | RCR > 2.0 and ≤ 3.5 | RCR > 3.5 and ≤ 7.0 | RCR > 7.0 |
|---|---|---|---|---|
| 50 | 0.2 | 0.3 | 0.4 | 0.6 |
| 100 | 0.4 | 0.6 | 0.8 | 1.2 |
| 200 | 0.6 | 0.8 | 1.3 | 1.9 |
| 300 | 0.8 | 1.0 | 1.4 | 2.0 |
| 400 | 0.9 | 1.1 | 1.5 | 2.2 |
| 500 | 1.0 | 1.2 | 1.6 | 2.4 |
| 600 | 1.2 | 1.4 | 2.0 | 2.9 |
| 700 | 1.4 | 1.7 | 2.3 | 3.3 |
| 800 | 1.6 | 1.9 | 2.6 | 3.8 |
| 900 | 1.8 | 2.2 | 3.0 | 4.3 |
| 1000 | 1.9 | 2.4 | 3.3 | 4.8 |

RCR

# Tailored Method - "Use it or Lose it"

WattStopper

*Table 140.6-D: Additional Allowed Power*

- For primary functions listed in Table 140.6-D, there may be Additional Allowed Power.
- If these additional powers aren't used, they're lost.

**Ornamental/Special**

**Floor Displays**

**Wall Displays**

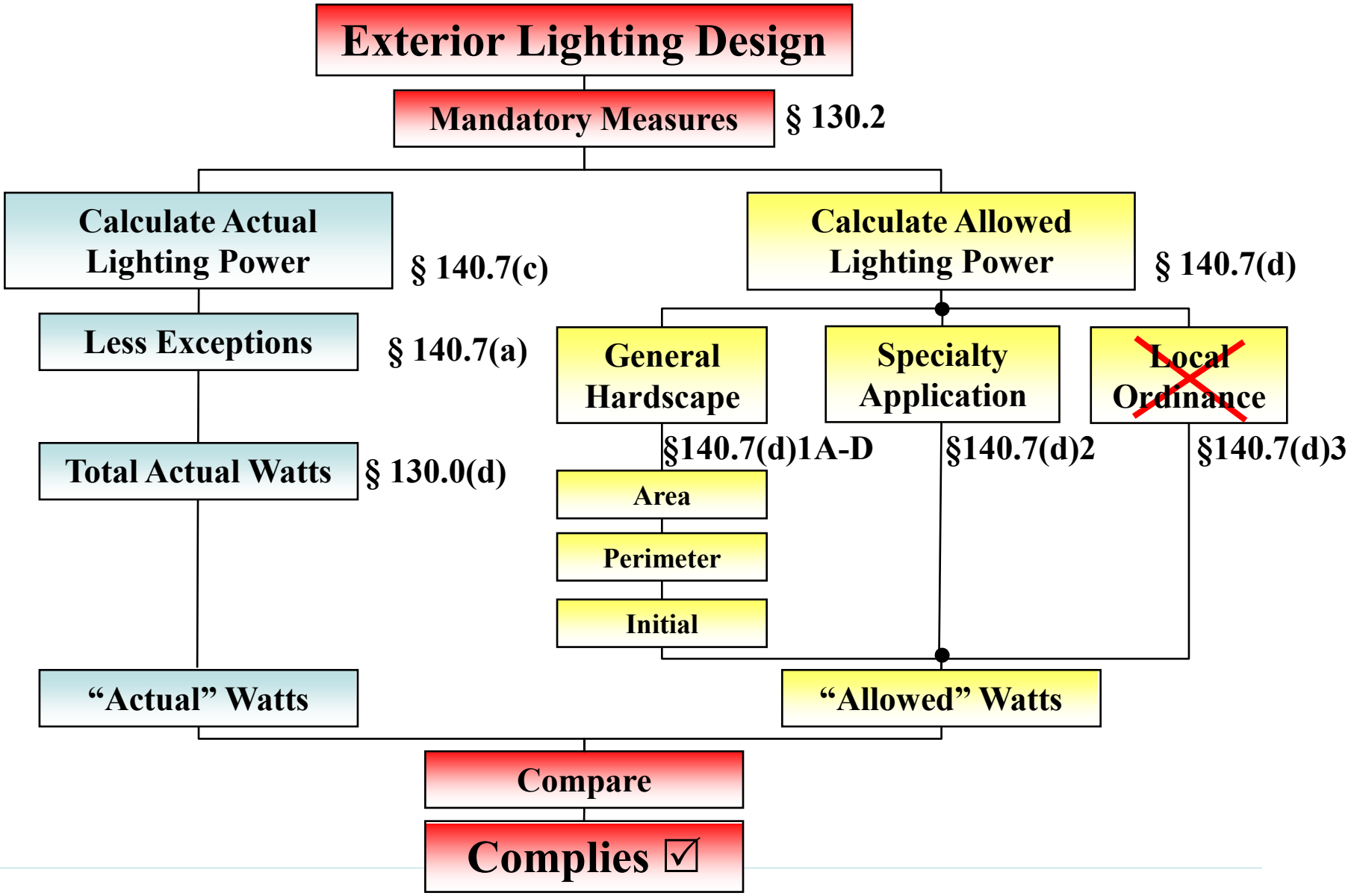
*TABLE 140.6-D TAILORED METHOD ~~SPECIAL~~ LIGHTING POWER ALLOWANCES ~~(THIS IS A REFORM VERSION OF THE TABLE ABOVE)~~*

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Primary Function Area | General Illumination Level (Lux) | Wall Display Power (W/ft) | Allowed Combined Floor Display Power and Task Lighting Power (W/ft²) | Allowed Ornamental/ Special Effect Lighting |
| Auditorium Area | 300 | 2.25 | 0.3 | 0.5 |
| Civic Meeting Place | 300 | 3.15 | 0.2 | 0.5 |
| Convention, Conference, Multipurpose, and Meeting Center Areas | 300 | 2.50 | 0.4 | 0.5 |
| Dining Areas | 200 | 1.50 | 0.6 | 0.5 |
| Exhibit, Museum Areas | 150 | 15.0 | 1.2 | 0.5 |
| Financial Transaction Area | 300 | 3.15 | 0.2 | 0.5 |

**Use It Or Lose It!**

# Prescriptive Outdoor Lighting Overview

*§140.7: Prescriptive Requirements for Outdoor Lighting*



# Outdoor Lighting *§140.7: Requirements for Outdoor Lighting*

- Compliance requires Actual LPD to be less than Allowed LPD
- Long list of exceptions when 50% light falls within following applications
  - Temporary, FAA required, roadway, sports fields, children's playgrounds, industrial site lighting, ATMs, public monuments, signs, ~~pools and water features,~~ tunnels, stairs, some ramps, landscape lighting, some historic lighting elements, etc...

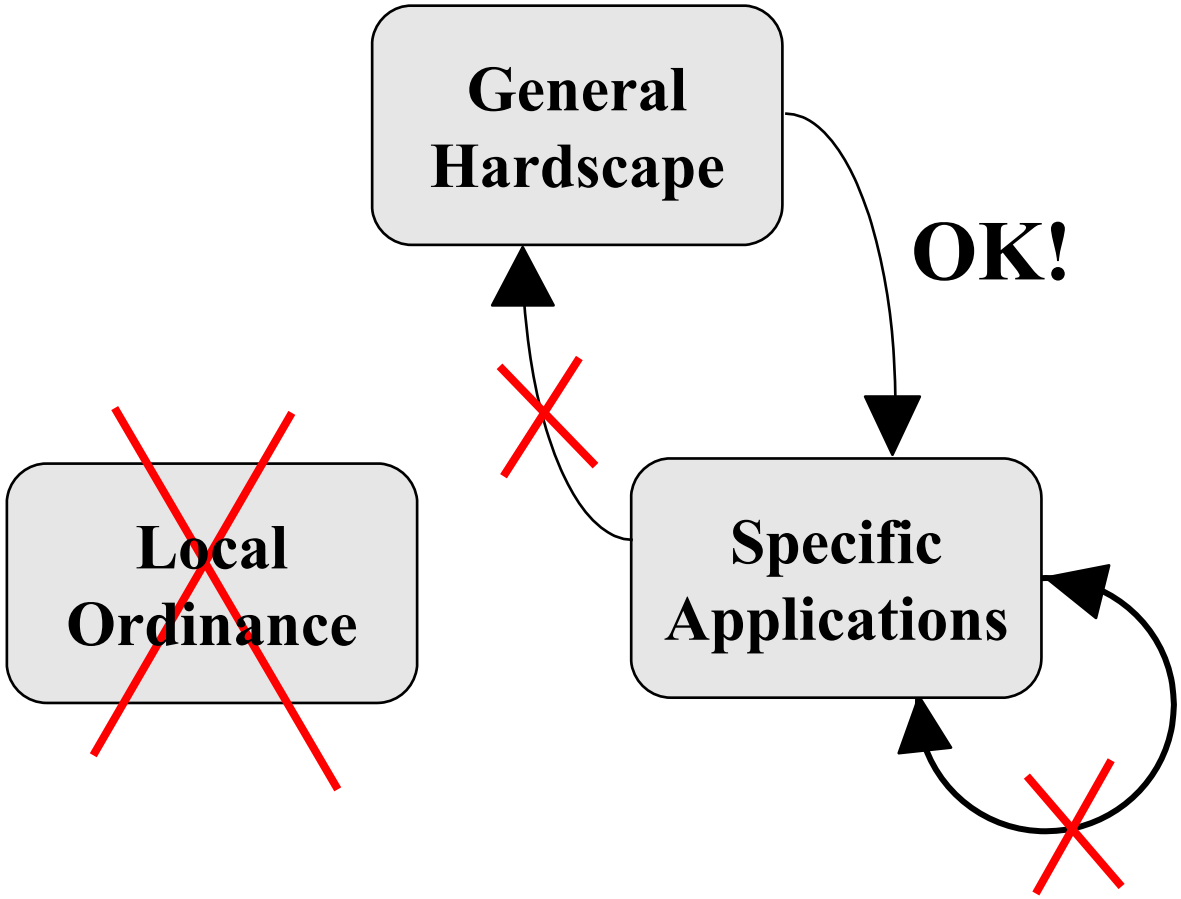
# Allowed Lighting Power

*§140.7(d): Requirements for Outdoor Lighting*

- **Allowed Lighting is total of:**
  - **General Hardscape Lighting** includes: parking lots, roadways, sidewalks, walkways, bikeways, plazas
  - **Specific Applications** includes items from Table 147-B
    - Building Entrance/Exit, Drive-up window, etc…
  - ~~**Local Ordinance** includes items from Table 147-C~~ **Gone**

# Lighting Power Trade-offs

*§140.7(b): Requirements for Outdoor Lighting*



# General Hardscape is a Total of: *§140.7(d): Requirements for Outdoor Lighting*

**Area Based**

Total all “Illuminated Areas”, which is a Square with sides **= 10 x mounting height**, centered each luminaire or pole

Multiply “Illuminated Area” x Area Allowance in Table 140.7-A

**Perimeter Based**

Perimeter of Illuminated Hardscape, less small landscape areas and permanent planters

Multiply Illuminated Perimeter x Linear Allowance Table 140.7-A

**Initial Wattage**

One time allowance of power per site per Table 140.7-A

*TABLE 140.7-A GENERAL HARDSCAPE LIGHTING POWER ALLOWANCE*

| Type of Power Allowance | Lighting Zone 1 | Lighting Zone 2 | Lighting Zone 3 | Lighting Zone 4 |
|---|---|---|---|---|
| Area Wattage Allowance (AWA) | ~~0.036~~ 0.035 W/ft² | 0.045 W/ft² | ~~0.092~~ 0.090 W/ft² | 0.115 W/ft² |
| Linear Wattage Allowance (LWA) | ~~0.36~~ 0.25 W/lf | 0.45 W/lf | ~~0.92~~ 0.60 W/lf | ~~1.15~~ 0.85 W/lf |
| Initial Wattage Allowance (IWA) | 340 W | 510 W | 770 W | 1030 W |

# Determination of Outdoor Lighting Zones

*§10-114: Outdoor Lighting Zones*

| Zone | Ambient Illumination | State wide Default Location | Moving Up to Higher Zone | Moving Down to Lower Zones |
|---|---|---|---|---|
| **LZ1** | **Dark** | **Government designated parks, recreation areas, and Wildlife preserves.** | Designated park, recreation area, wildlife preserve can be designated as LZ2 or LZ3 if they are contained within such a zone. | NA |
| **LZ2** | **Low** | **Rural areas,** as defined by the 2000 U.S. Census. | Districts may designated as LZ3 by a local jurisdiction. Examples include special commercial or industrial districts or areas with special security considerations located within a rural area. | Special districts and government designated parks may be designated as LZ1 by the local jurisdiction for lower illumination standards, without any size limits. |
| **LZ3** | **Medium** | **Urban areas,** as defined by the 2000 U.S. Census. | Districts may be designated as a LZ4 by local jurisdiction for high intensity nighttime use, such as entertainment or commercial districts or areas with special security considerations requiring very high light levels. | Special districts and government designated parks may be designated as LZ1 or LZ2 by the local jurisdiction, without any size limits. |
| **LZ4** | **High** | **None** | NA | NA |

# Specific Application –"Use it or Lose it"

*§147(c)2A-D: Allowed Application Specific Outdoor Lighting Power*

- Similar to Indoor Lighting for Specific Applications, but for Outdoor Applications. Review Table 140.7-B to see if allowed for specific Lighting Zones
  - Building Façade Lighting
  - Outdoor Sales Frontage Lighting
  - Outdoor Ornamental Lighting
  - Lighting under Canopies
  - Vehicle Service Station
    - Without Canopies
    - Hardscape Areas
  - Drive-up Windows
  - Guarded Facilities
  - Outdoor Dining

*TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS*

*All area and distance measurements in plan view unless otherwise noted.*

| | Lighting Application | Lighting Zone 1 | Lighting Zone 2 | Lighting Zone 3 | Lighting Zone 4 |
|---|---|---|---|---|---|
| **WATTAGE ALLOWANCE PER APPLICATION. Use all that apply as appropriate.** | | | | | |
| | **Building Entrances or Exits.** Allowance per door. Luminaires qualifying for this allowance shall be within 20 feet of the door. | 30 watts | ~~75~~ 60 watts | ~~100~~ 90 watts | ~~120~~ 90 watts |
| | **Primary Entrances to Senior Care Facilities, Police Stations, Hospitals, Fire Stations, and Emergency Vehicle Facilities.** Allowance per primary entrance(s) only. Primary entrances shall provide access for the general public and shall not be used exclusively for staff or service personnel. This allowance shall be in addition to the building entrance or exit allowance above. Luminaires qualifying for this allowance shall be within 100 feet of the primary entrance. | 45 watts | 80 watts | 120 watts | 130 watts |
| | **Drive Up Windows.** Allowance per customer service location. Luminaires qualifying for this allowance shall be within 2 mounting heights of the sill of the window. | 40 watts | 75 watts | 125 watts | 200 watts |
| | **Vehicle Service Station Uncovered Fuel Dispenser.** Allowance per fueling dispenser. Luminaires qualifying for this allowance shall be within 2 mounting heights of the dispenser. | 120 watts | 175 watts | 185 watts | 330 watts |
| **WATTAGE ALLOWANCE PER UNIT LENGTH (w/linear ft). May be used for one or two frontage side(s) per site.** | | | | | |
| | **Outdoor Sales Frontage.** Allowance for frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. Luminaires qualifying for this allowance shall be located between the principal viewing location and the frontage outdoor sales area. | No Allowance | 22.5 W/linear ft | 36 W/linear ft | 45 W/linear ft |
| **WATTAGE ALLOWANCE PER HARDSCAPE AREA (W/ft²). May be used for any illuminated hardscape area on the site.** | | | | | |

# Alteration vs. Modification-in-Place

*§141.0(I): Lighting System Modifications*

(n) Reduction of threshold when lighting alterations must comply with the Standards, (from when 50% of the luminaires are replaced), to when only 10% of the luminaires are replaced. Consistent with proposed changes to ASHRAE 90.1-2010. **(Section 141.0(b)I & J)**

(o) Added threshold requirements for when luminaire-modifications-in-place (sometimes referred to as lighting retrofits – i.e.: lamp/ballast change-outs) must comply with the Standards. **(Section 141.0(b)I)**

# Renovations or Alterations

Note that the minimum energy code requirements apply to both new construction and renovations or alterations of building lighting.In CA Title 24 2008 and IECC 2012, at least 50% of the luminaires have to be replaced in order to qualify as an alteration.If you replace less than 50% of the luminaires and don't increase the LPD (Lighting Power Density or watts per square foot of lighting power) in the altered Space, then you don't need to comply with the minimum energy code requirements for lighting.Note that alterations do not include routine maintenance or repair situations.

ASHRAE 90.1-2010 has pushed the bar higher. This standard requires that if more than 10% of the lighting load is altered (i.e. at least both the lamps and ballasts are changed) in a space, then all the lighting in the space must comply with automatic shut-off and LPD requirements for the space. Title 24 2013 (effective Jan. 2014) is looking at adding similar requirements.

- **Lighting System Alterations**

  Where an existing lighting system is modified, luminaires are replaced, or luminaires are disconnected from the circuit, removed and reinstalled, whether in the same location or installed elsewhere.

  –

  – <u>Does not include:</u>

- **Luminaire Modification-in-Place**

  Replacing lamps and ballasts with like type or quantity in a manner that preserves the original luminaire listing.

  Changing the number or type of light source in a luminaire including: socket renewal, removal or relocation of sockets or lampholders, and/or related wiring internal to the luminaire including the addition of safety disconnecting devices.

  Changing the optical system of a luminaire in part or in whole.

  Replacement of whole luminaires 1 for 1 in which the only electrical modification involves disconnecting the existing luminaire and reconnecting the replacement luminaire.

# Alteration vs. Modification-in-Place

*§141.0(I): Lighting System Modifications*

Luminaire Modification-in-Place

- Can’t be part of any general remodeling or renovation of their enclosed space
- Can’t cause, be the result of, or involve any changes to the panel board or branch circuit wiring
- Including line voltage switches, relays, contactors, dimmers and other control devices, providing power to the lighting system.
- Exemption for Circuit modifications strictly limited to the addition of Occupancy or vacancy sensors and class two lighting controls

# Luminaire Alterations *Table 141.0-E: Additions, Alterations Repairs*

## Over 10% Rule!

*TABLE 141.0-E Requirements for Luminaire Alterations*

| Quantity of existing affected luminaires per Enclosed Space [1] | Resulting Lighting Power for Each Enclosed Space | Applicable Mandatory Control Provisions for Each Enclosed Space | Multi-level Lighting Control Requirements for Each Altered Luminaire |
|---|---|---|---|
| **Alterations that do not change the area of the enclosed space or the space type** | | | |
| Sum total < 10% of existing luminaires | Existing lighting power is permitted | Existing provisions are permitted | Existing controls are permitted |
| Sum total ≥ 10% of existing luminaires | ≤ 85% of allowed lighting power per Section 140.6 Area Category Method | §130.1(a), (c) | Two level lighting control [2] or §130.1(b) |
| | > 85% of allowed lighting power per Section 140.6 Area Category Method | §130.1(a), (c), (d) [3] | §130.1(b) |
| **Alterations that change the area of the enclosed space or the space type or increase the lighting power in the enclosed space** | | | |
| Any number | Comply with Section 140.6 | §130.0(d) [3] §130.1(a), (c), (d) [3], (e) | §130.1(b) |

1. Affected luminaires include any luminaire that is changed, replaced, removed, relocated; or, connected to, altered or revised wiring, except as permitted by EXCEPTIONS 1 and 2 to Section 141.0(b)**2Iii:**
2. Two level lighting control shall have at least one control step between 30 and 70% of design lighting power in a manner providing reasonably uniform illuminations
3. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are altered.

**Remember:**

**130.1(a) = Area Device**
**130.1(b) = Multilevel Off**
**130.1(c) = Automatic Shut**
**130.1(d) = Daylighting**
**130.1(e) = Demand Response**
**130.0(d) = Mfg. Instructions**

# Modification-in-Place *Table 141.0-F: Additions, Alterations Repairs*

## ≥ 40 FIXTURES Rule!

*TABLE 141.0-F=Requirements for Luminaire Modifications-in-Place*

For compliance with this Table, building space is defined as any of the following:

1. A complete single story building
2. A complete floor of a multi floor building
3. The entire space in a building of a single tenant under a single lease
4. All of the common, not leasable space in single building

| **Quantity of affected luminaires per Building Space per annum** | **Resulting Lighting Power per Each Enclosed Space Where ≥ 10% of Existing Luminaires are Luminaire Modifications-in-Place** | **Applicable mandatory control provisions for each enclosed space [1]** | **Applicable multi-level lighting control requirements for each modified luminaire [2]** |
|---|---|---|---|
| Sum total < 40 Luminaire Modifications-in-Place | Existing lighting power is permitted | Existing provisions are permitted | Existing controls are permitted |
| Sum total ≥ 40 Luminaire Modifications-in-Place | ≤ 85% of allowed lighting power per Section 140.6 Area Category Method | §130.1(a), (c) | Two level lighting control [3] Or §130.1(b) |
| | > 85% of allowed lighting power per Section 140.6 Area Category Method | §130.0(d) [4] §130.1(a), (c), (d) [4] | §130.1(b) |

1. Control requirements only apply to enclosed spaces for which there are Luminaire Modifications-in-Place.
2. Multi-level controls are required only for luminaires for which there are Luminaire Modifications-in-Place.
3. Two level lighting control shall have at least one control step between 30% and 70% of design lighting power in a manner providing reasonably uniform illuminations
4. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are modified-in-place.

# Building Commissioning



- Building commissioning to be included in the design and construction of the building project to verify that the energy systems and components meet the owner's or owner representative's project requirements.
- Commissioning shall be performed in accordance with this section by trained personnel with experience on projects of comparable size and complexity.
- All building systems and components covered by Sections 110.0, 120.0, 130.0, and 140.0 shall be included in the scope of the commissioning requirements in this Section, excluding covered processes.
- For buildings less than 10,000 $ft^2$, only the design review requirements in Section 120.8(d) and 120.8(e) shall be completed.

# Summary of Commissioning Requirements

*§120.8(a): Building Commissioning*

The following items shall be completed:

1. Owner's or owner representative's project requirements;
2. Basis of design;
3. Design phase design review;
4. Commissioning measures shown in the construction documents
5. Commissioning plan;
6. Functional performance testing;
7. Documentation and training; and
8. Commissioning report.

## Commissioning

(f) Moved Part 11 commissioning requirements to Part 6 for energy-related building components.

**(Section 120.8)**

(g) Added mandatory requirements for design-phase commissioning, which includes an early review of design intent documents and highlighting efficiency specifications in both construction documents and Standards compliance forms. **(Section 120.8(d))**

(h) Added performance standard compliance requirement to produce whole building performance

rating twice: once during design permit stage ("design rating") then after construction acceptance testing ("as-built rating"). **(Section 120.8(g))**

# Owner's Project Requirements (OPR)

*§120.8(b): Building Commissioning*

The energy-related expectations and requirements of the building shall be documented before the design phase of the project begins. This documentation shall include the following:

1. Energy efficiency goals;
2. Ventilation requirements;
3. Project program, including facility functions and hours of operation, and need for after-hours operation; and
4. Equipment and systems expectations.
   EXCEPTION: Buildings less than 10,000 ft2.

# Basis of Design *§120.8(c): Building Commissioning*

A written explanation of how the design of the building systems meets the OPR shall be completed at the design phase of the building project, and updated as necessary during the design and construction phases. The Basis of Design document shall cover the following systems:

1. Heating, ventilation, air conditioning (HVAC) systems and controls;
2. Indoor lighting system and controls; and
3. Water heating system.

EXCEPTION: Buildings less than 10,000 $ft^2$.

# Design Phase Design Review *§120.8(d): Building Commissioning*

1. **Design Reviewer Requirements.** Based on Building Size:

   a) <10,000 $ft^2$: Design phase design review may be completed by the design engineer.

   b) 10,000 to 50,000 $ft^2$ require completion of the design review checklist by an engineer in-house to the design firm not associated with the building project.

   c) >50,000 $ft^2$ or for buildings with complex mechanical systems, an independent, third party review of these documents is required.

2. **Design Review.**

   During schematic design, the owner/representative, design team and design reviewer to discuss the project scope, schedule and how design reviewer will coordinate with project team. The building owner / representative shall include the Design Review Checklist compliance form in the Certificate of Compliance documentation (see Section 10-103).

3. **Construction Documents Design Review.**

   The Construction Documents Design Review compliance form lists the items that shall be checked by the design reviewer during the construction document review. The completed form shall be returned to the owner and design team for review and sign-off. The building owner/representative shall include this Construction Documents Design Review compliance form in the Certificate of Compliance documentation (§10-103).

# Commissioning measures shown in the construction documents

- Include commissioning measures or requirements in the construction documents (plans and specifications). Be clear, detailed and complete. Include:
  - Systems and assemblies commissioned,
  - Testing scope
  - Roles and responsibilities of contractors
  - Requirements for meetings
  - Management of issues
  - The commissioning schedule,
  - Operations and maintenance manual development and of training
  - Checklist and test form development
  - Execution and documentation.

- Include, for information only, roles of non-contractor parties.

# Commissioning Plan *§120.8(f): Building Commissioning*

- Commissioning Plan. Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started during the design phase of the building project. The Commissioning Plan shall include the following:
  - 1. General project information;
  - 2. Commissioning goals;
  - 3. Systems to be commissioned.
  - 4. Plans to test systems and components shall include:
    - A. An explanation of the original design intent;
    - B. Equipment and systems to be tested, including the extent of tests;
    - C. Functions to be tested;
    - D. Conditions under which the test shall be performed;
    - E. Measurable criteria for acceptable performance;
    - F. Commissioning team information; and
    - G. Commissioning process activities, schedules and responsibilities. Plans for the completion of commissioning requirements listed in Sections 120.8(g) through 120.8(i) shall be included.

- EXCEPTION for buildings less than 10,000 $ft^2$ .

# Functional Performance Testing

*§120.8(g): Building Commissioning*

- Functional performance tests shall demonstrate the correct installation and operation of each component, system and system-to-system interface in accordance with the Construction Documents.
- Functional performance testing reports to contain:
  - Information on each of the building components tested,
  - Testing methods utilized, and any readings and adjustments made.
  - All Acceptance Requirements for Code Compliance shall be completed as part of this functional performance testing.
- EXCEPTION: Buildings less than 10,000 $ft^2$.

# Documentation and Training *§120.8(h): Building Commissioning*

1. Systems manual. Documentation of the operational aspects of the building shall be completed within the Systems Manual and delivered to the building owner or representative and facilities operator. The Systems Manual shall include the following:
   A. Site information, including facility description, history and current requirements;
   B. Site contact information;
   C. Basic operations and maintenance, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, site events log;
   D. Major systems;
   E. Site equipment inventory and maintenance notes;
   F. A copy of all special inspection verifications required by the enforcing agency or this code; and
   G. Other resources and documentation.

2. Systems operations training. The training of the appropriate maintenance staff for each equipment type and/or system shall be documented in the commissioning report and shall include the following:
   A. System/equipment overview (what it is, what it does and with what other systems and/or equipment it interfaces)
   B. Review and demonstration of operation, servicing and preventive maintenance
   C. Review of the information in the Systems Manual
   D. Review of the record drawings on the system/equipment

EXCEPTION to Section 120.8(h): Buildings less than 10,000 $ft^2$ .

# Permit, Certificate, …

*§10-103: Construction Documentation*

All registration of nonresidential compliance documents with a HERS provider.

An electronic storage mechanism to archive all residential HERS and Nonresidential Compliance.

# HVAC Occupant Sensors *§120.1(c)5: Mechanical Controls*

- HVAC systems are required to have Demand Control Ventilation to insure Air Quality.
  - One way of meeting the requirement is $CO_2$ Sensors.
  - Another way for spaces <1,500 $ft^2$ is Occupancy Sensors which reduce airflow when space is unoccupied.

# Shut-off/Reset for Space Conditioning *§120.2(e)1:*

*Mechanical Controls*

- Each space-conditioning have controls that automatically shut off the system during periods of nonuse using:

  - An automatic time switch control device complying with Section 110.9, with an accessible manual override that allows operation of the system for up to 4 hours; or
  - An occupancy sensor; or
  - A 4-hour timer that can be manually operated.

- Exception

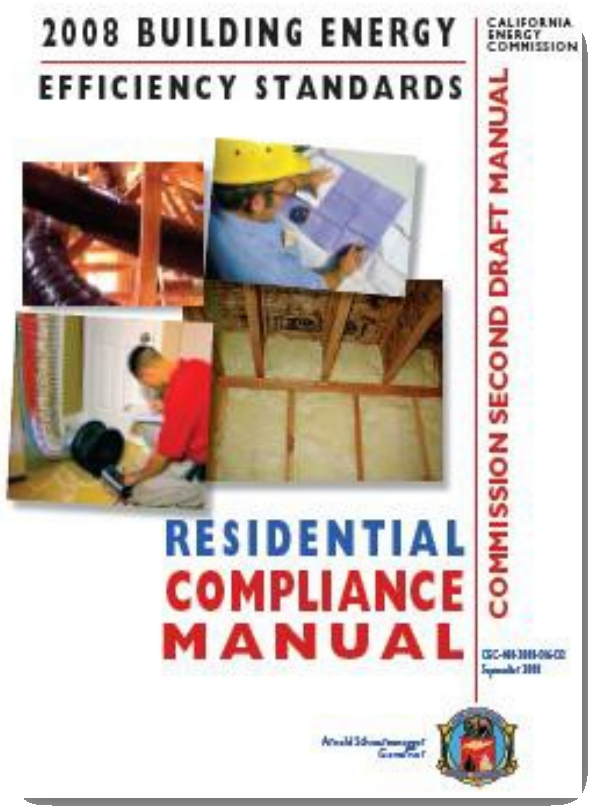
  Mechanical systems serving retail stores and associated malls, restaurants, grocery stores, churches, and theaters equipped with 7- day programmable timers.

# HVAC Occupancy Controls *§120.2(e)3: Mechanical Controls*

- Following spaces **must have occupancy sensors**
  - Multipurpose room < 1000 $ft^2$,
  - Classrooms > 750 $ft^2$ and
  - Conference, Convention, Auditorium and Meeting Center rooms > 750 $ft^2$

- During unoccupied periods:
  - Automatically setup the operating cooling temperature set point by 2°F or more and setback the operating heating temperature set point by 2°F or more; and
  - Automatically reset the minimum required ventilation rate with an occupant sensor ventilation control device according to Section 120.1(c)5.
  - Exemption for spaces with processes or operations that generate dusts, fumes, vapors or gasses

# Residential Requirements




**Under T24 <u>Commercial</u> Rules, CEC dictates power requirements, but doesn't care about the fixtures used.**

**Under T24 <u>Residential</u> Rules, CEC doesn't limit power used, but wants High Efficacy Fixtures.**

# Residential Lighting *§150.0 (k)1-2: Low-rise Residential Buildings*

- Per Tables 150.0-A and 150.0–B, Luminaires are either
  - High Efficiency
  - Low Efficiency

- If it's a hybrid Luminaire with both High and Low Efficiency systems, each separately complies with 150.0(k) requirements

# LEDs in Residential Applications *§110.9 (e): Mandatory Requirements for Lighting Control Devices*

- To be High Efficacy, Residential LED Luminaries and Light Engines shall be certified to CEC per JA-8.
  - If not certified, considered Low Efficacy
  - Non-residential LED lighting not required to be certified
  - JA-8 mandates a minimum **LED CRI of 90!**

# Residential Lighting *§150 (k)1-2: Low-rise Residential Buildings*

*TABLE 150.0-~~C~~A CLASSIFICATION OF HIGH EFFICACY AND LOW EFFICACY LIGHT SOURCES*

| **High Efficacy Light Sources**<br>Luminaires manufactured, designed and rated for use with only lighting technologies in this column shall be classified as high efficacy: | **Low Efficacy Light Sources**<br>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 Section 150(k)1D.<br>2. Pulse-start metal halide lamps.<br>3. High pressure sodium lamps.<br>4. GU-24 sockets rated for LED lamps.<br>5. GU-24 sockets rated for compact fluorescent lamps~~, and which are not recessed luminaires~~.<br>6. Luminaires using LED light sources which have been certified to the Commission as high efficacy in accordance with Reference Joint Appendix JA-8.<br>7. Luminaire housings rated by the manufacturer for use with only LED light engines.<br>8. Induction lamps.<br>**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.<br>2. Low-voltage lamp holders capable of operating incandescent lamps of any type.<br>3. High efficacy lamps installed in low-efficacy luminaires, including screw base compact fluorescent and screw base LED lamps.<br>3. Mercury vapor lamps.<br>4. Track lighting or other flexible lighting system which allows the addition or relocation of luminaires without altering the wiring of the system.<br>6. Luminaires using LED light sources which have not been certified to the Commission as high efficacy.<br>7. Lighting systems which have modular components that allow conversion between high-efficacy and low-efficacy lighting without changing the luminaires' housing or wiring.<br>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. |

# Low-Rise Residentia

*TABLE 150-B: Low Rise Residential Mandatory Features - Lighting*

| Lamp Power Rating | Minimum Lamp Efficacy |
|---|---|
| 5 watts or less | 30 lumens per watt |
| Over 5 - 15 watts | 45 lumens per watt (was 40) |
| Over 15 watts to 40 Watts | 60 lumens per watt (was 50) |
| Over 40 watts | 90 lumens per watt (was 60) |

Note: Determine minimum luminaire efficacy using the system initial rated lumens divided by the luminaire total rated system input power.

# Luminaire wattage *§150(k)3, 5, 6 : Low-rise Residential Buildings*

- Luminaire Wattage
  - Permanently installed luminaries wattage per Section 130.0(c)
  - In kitchens electrical boxes with a blank cover or where no electrical equipment is installed is **180 watts of low efficacy lighting** per electrical box

- Electronic Ballasts
  - For all Fluorescent lamps over 13W

- Nightlights Alone and in Exhaust Fans
  - ~~Contain only high efficacy lamps~~
  - Rated to consume no more than 5 watts of power per Luminaire or Fan
  - Not required to be controlled by a vacancy sensor

- Exhaust Fan Lighting
  - In all rooms ~~except kitchens~~ must comply to Section 150 (k)
  - Except for Lighting installed by manufacturer in Kitchen Exhaust Hoods

# Switching Devices & Controls

*§150(k)7 : Low-rise Residential Buildings*

- Switch High & Low Efficacy luminaires **separately**
- Switch **Exhaust fans** separately from **lighting**
  - **Exception** Lighting integral to an exhaust fan may be on the same switch as the fan provided the lighting can be switched OFF in accordance with the applicable provisions in Section 150(k)2 while allowing the fan to continue to operate for an extended period of time.
- Controls must be **readily accessible** and installed in accordance with the manufacturer's instructions
- **Cannot** have controls that **bypass** any required dimmer or vacancy sensor
- An Energy Management Control System and/or multi-scene programmable controller may be used if it complies with Dimming or Vacancy Sensor requirements.

# Lighting Specific to rooms

*§150(k)8 : Low-rise Residential Buildings*

**Kitchens**: ≥ 50% of permanently installed lighting must be high efficacy (by Watts)

Exemption for:

50W for dwelling units ≤ 2,500 $ft^2$, or

100W for dwelling units > 2,500 $ft^2$ if:

Meet 150.0(k)2 and ~~low efficacy~~ **All kitchen luminaires** are controlled by a vacancy sensor or dimmer, ~~EMCS, or~~ ~~programmable control system,~~ ~~**AND**~~

~~All permanently installed lights in garages, laundry rooms, closets > 70 $ft^2$, and utility rooms are high efficacy~~ ~~**AND**~~ ~~controlled by a vacancy sensor~~
~~(Note bathrooms are not included in list).~~

# Lighting Specific to rooms

*§150(k)9-11 : Low-rise Residential Buildings*

- **Internal Cabinet Lighting:** ≤ 20 W/ linear ft.
  Regardless of the number of shelves or the number of doors per cabinet section, the length of an illuminated cabinet shall be determined by:
  - One horizontal length of illuminated cabinet; or
  - One vertical length, per illuminated cabinet section; or
  - No more than one vertical length per every 40 horizontal inches of illuminated cabinet.

- **Bathrooms:** Must have 1 High efficacy light, and all other should be high efficacy lighting unless it's controlled by a vacancy sensor

- **Garages, Laundry Rooms, Utility Rooms**: Use high efficacy lighting AND must be controlled by a vacancy sensor

- **Other rooms**: High efficacy lighting or controlled by a dimmer or vacancy sensor
  - Closets < 70 $ft^2$ exempted
  - Doesn't include small detached storage buildings

# Title 24 Resources


- http://www.energy.ca.gov/title24
  - Energy Efficiency Standards
  - Compliance Manual
    - Hotline: 800-772-3300

# California Energy Commission
# Energy Standards Hotline

**(916) 654-5106**
**or toll free in California**
**(800) 772-3300**

**HOURS:**
**Monday through Friday**
**8 a.m. to 12 p.m. and 1 p.m. to 4:30 p.m.**

E-mail: title24@energy.state.ca.us

# Complete Bldg. – Lighting Power Density

*Table 146-E*

*TABLE 140.6-B COMPLETE BUILDING METHOD LIGHTING POWER DENSITY VALUES ~~(WATTS/FT²)~~*

| TYPE OF BUILDING | ALLOWED LIGHTING POWER DENSITY (WATTS PER SQUARE FOOT) |
|---|---|
| Auditorium Building | 1.5 |
| Classroom Building | 1.1 |
| Commercial and Industrial Storage Building | 0.6 |
| Convention Center Building | 1.2 |
| Financial Institution Building | 1.1 |
| General Commercial Building/Industrial Work Building | 1.0 |
| Grocery Store Building | 1.5 |
| Library Building | 1.3 |
| Medical Building/Clinic Building | 1.1 |
| Office Building | 0.8 |
| Parking Garage Building | 0.2 |
| Religious Facility Building | 1.6 |
| Restaurant Building | 1.2 |
| School Building | 1.0 |
| Theater Building | 1.3 |
| All others buildings | 0.6 |

# Calculations of Allowed Indoor Lighting Power Density

*§140.6(c)2 : Prescriptive Requirements for Indoor Lighting*

Choose between 3 methods

2) Area Category Method

- Total allowed lighting power is the sum of the allowed lighting powers for all individual areas
- Multi-tenant areas with an unknown tenant, use 0.6W/$ft^2$ for lighting (Unleased Tenant Area)
- Allowance in Table's footnote for specialized tasks, ornamental, precision, accent, display, decorative, video conferencing, white and chalk boards under specific conditions

# Area Method – Lighting Power Density

*Table 140.6-C*

*TABLE 140.6-C AREA CATEGORY METHOD - LIGHTING POWER DENSITY VALUES (WATTS/FT²)*

| PRIMARY FUNCTION AREA | | ALLOWED LIGHTING POWER (W/ft²) | PRIMARY FUNCTION AREA | | ALLOWED LIGHTING POWER (W/ft²) |
|---|---|---|---|---|---|
| Auditorium Area | | 1.5 [3] | Library Area | Reading areas | 1.2 [3] |
| Auto Repair Area | | 0.9 [2] | | Stack areas | 1.5 [3] |
| Beauty Salon Area | | 1.7 | Lobby Area | Hotel lobby | 1.1 [3] |
| Civic Meeting Place Area | | 1.3 [3] | | Main entry lobby | 1.5 [3] |
| Classroom, Lecture, Training, Vocational Areas | | 1.2 [5] | Locker/Dressing Room | | 0.8 |
| Commercial and Industrial Storage Areas (conditioned and unconditioned) | | 0.6 | Lounge/~~Recreation~~ Area | | 1.1 [3] |
| Commercial and Industrial Storage Areas (refrigerated) | | 0.7 | Malls and Atria | | 1.2 [3] |
| Convention, Conference, Multipurpose and Meeting Center Areas | | 1.4 [3] | Medical and Clinical Care Area | | 1.2 |
| Corridor, Restroom, Stair, and Support Areas | | 0.6 | Office Area | ≥ 250 square feet | 0.75 |
| Dining Area | | 1.1 [3] | | ≤ 250 square feet | 1.0 |
| Electrical, Mechanical, Telephone Rooms | | 0.7 [2] | Parking Garage Area | Parking Area | 0.14 |
| Exercise Center, Gymnasium Areas | | 1.0 | | Dedicated Ramps | 0.3 |
| Exhibit, Museum Areas | | 2.0 | | Daylight Adaptation Zones [9] | 0.6 |
| Financial Transaction Area | | 1.2 [3] | Religious Worship Area | | 1.5 [3] |
| General Commercial and Industrial Work Areas | Low bay | 0.9 [2] | Retail Merchandise Sales, Wholesale Showroom Areas | | 1.2 [6 and 7] |
| | High bay | 1.0 [2] | ~~Tenant Lease Space~~ | | ~~0.75~~ |
| | Precision | 1.2 [4] | Theater Area | Motion picture | 0.9 [3] |
| Grocery Sales Area | | 1.2 [6 and 7] | | Performance | 1.4 [3] |
| Hotel Function Area | | 1.5 [3] | Transportation Function Area | | 1.2 |
| Kitchen, Food Preparation Areas | | 1.6 | Videoconferencing Studio | | 1.2 [8] |
| Laboratory Area, Scientific | | 1.4 [1] | Waiting Area | | 1.1 [3] |
| Laundry Area | | 0.9 | All other areas | | 0.6 |
| Footnotes for this table are listed below. | | | | | |

# Area Method –Lighting Power Density

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*Table 140.6-C Footnotes*

FOOTNOTES FOR TABLE 140.6-C:
See Section 140.6(c)2 for an explanation of additional lighting power available for specialized task work, ornamental, precision, accent, display, decorative, and white boards and chalk boards, in accordance with the footnotes in this table. The smallest of the added lighting power listed in each footnote below, or the actual design wattage, may be added to the allowed lighting power only when using the Area Category Method of compliance.

| Footnote number | Type of lighting system allowed | Maximum allowed added lighting power, ($W/ft^2$ –of task area unless otherwise noted) |
|---|---|---|
| 1 | Specialized task work | 0.2 $W/ft^2$ |
| 2 | Specialized task work | 0.5 $W/ft^2$ |
| 3 | Ornamental lighting as defined in Section 100.1 and in accordance with Section 140.6.(c)2. | 0.5 $W/ft^2$ |
| 4 | Precision commercial and industrial work | 1.0 $W/ft^2$ |
| 5 | Per linear foot of white board or chalk board. | 5.5 W per linear foot |
| 6 | Accent, display and feature lighting - luminaires shall be adjustable or directional | 0.3 $W/ft^2$ |
| 7 | Decorative lighting - primary function shall be decorative and shall be in addition to general illumination. | 0.2 $W/ft^2$ |
| 8 | Additional Videoconferencing Studio lighting complying with all of the requirements in Section 140.6(c)2Gvii. | 1.5 $W/ft^2$ |
| 9 | Daylight Adaptation Zones shall be no longer than 66 feet from the entrance to the parking garage | |

# Calc of Allowed Indoor Lighting Power Density

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*§140.6(c)3 : Prescriptive Requirements for Indoor Lighting*

Choose between 3 methods

3) Tailored Method

- Re-worked based on Lux vs. IES Type
- Use on projects with primary function areas that do not use the Area Category Method
- General Lighting can't be
- Narrow beam, wall washer, valence, direct cove, perimeter linear slot
- Voluminous clarifications for most specific applications have been added to the code
- Wall, Floor, Ornamental/Special Effect, Valuable Case

# Tailored Method



- Start by determining spaces general lighting allowance (Column 2) from Table 146-G.
- If not listened, refer to IESNA Handbook's Design Guide for Horizontal Illuminance.
- Tasks less than 2 hours, or poor quality tasks, can't be used to justify types E, F, or G.

*TABLE 146-G ~~D~~ TAILORED METHOD SPECIAL LIGHTING POWER ALLOWANCES*

| 1 | 2 | 3 | 4 | 5 | ~~6~~ |
|---|---|---|---|---|---|
| Primary Function | Illumination Category | Wall Display Power (W/ft) | Allowed Floor Display Power (W/ft²) | Allowed Ornamental/ Special Effect Lighting | ~~Allowed Very Valuable Display Power (W/ft²)~~ |
| Auditorium | D | ~~2.5~~ 2.25 | 0.3 | 0.5 | ~~0~~ |
| Civic Meeting Place | D | ~~3.5~~ 3.15 | 0.2 | 0.5 | – |
| ~~Classrooms, lecture, training, vocational room~~ | ~~D~~ | ~~7~~ | ~~0~~ | ~~0~~ | ~~0~~ |
| Commercial and industrial storage<br>Inactive<br>Active: bulky items; large labels<br>Active: small items; small labels | ~~IESNA HB~~<br>B<br>C<br>D | ~~0~~ | ~~0~~ | ~~0~~ | ~~0~~ |
| Convention, conference, multipurpose and ing centers | D | 2.5 | 0.4 | 0.5 | ~~0~~ |
| ~~Corridors, restrooms, stairs and support~~ | ~~IESNA~~ | ~~0~~ | | ~~0~~ | ~~0~~ |
| Correction Facility cells and day rooms | D | 0 | | | |
| Dining | | .5 | | 0.6 | ~~0~~ |
| Dressing room | D | 0 | | | |
| Education facilities<br>Classrooms, lecture, training, vocational room | D | 5.5 | 0 | 0 | |

Gone

# Tailored Method – Lighting Power Density

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*Table 140.6-D*

*TABLE 140.6-D TAILORED METHOD ~~SPECIAL~~ LIGHTING POWER ALLOWANCES ~~(THIS IS A REFORMATED VERSION OF THE TABLE ABOVE)~~*

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Primary Function Area | General Illumination Level (Lux) | Wall Display Power (W/ft) | Allowed Combined Floor Display Power and Task Lighting Power (W/ft²) | Allowed Ornamental/ Special Effect Lighting |
| Auditorium Area | 300 | 2.25 | 0.3 | 0.5 |
| Civic Meeting Place | 300 | 3.15 | 0.2 | 0.5 |
| Convention, Conference, Multipurpose, and Meeting Center Areas | 300 | 2.50 | 0.4 | 0.5 |
| Dining Areas | 200 | 1.50 | 0.6 | 0.5 |
| Exhibit, Museum Areas | 150 | 15.0 | 1.2 | 0.5 |
| Financial Transaction Area | 300 | 3.15 | 0.2 | 0.5 |
| Grocery Store Area | 500 | 8.00 | 0.9 | 0.5 |
| Hotel Function Area | 400 | 2.25 | 0.2 | 0.5 |
| Lobby Area: | | | | |
| Hotel lobby | 200 | 3.15 | 0.2 | 0.5 |
| Main entry lobby | 200 | 0 | 0.2 | 0 |
| Lounge/~~Recreation~~ Area | 200 | 7.00 | 0 | 0.5 |
| Malls and Atria | 300 | 3.50 | 0.5 | 0.5 |
| Religious Worship Area | 300 | 1.50 | 0.5 | 0.5 |
| Retail Merchandise Sales, and Showroom Areas | 400 | 14.00 | 1.0 | 0.5 |
| Theater Area: | | | | |
| Motion picture | 200 | 3.00 | 0 | 0.5 |
| Performance | 200 | 6.00 | 0 | 0.5 |
| Transportation Function Area | 300 | 3.15 | 0.3 | 0.5 |
| Waiting Area | 300 | 3.15 | 0.2 | 0.5 |

# Tailored Method - RCR

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*Table 140.6-F*

- Determine Room Cavity Ratio of each space.

*TABLE 140.6-F ROOM CAVITY RATIO (RCR) EQUATIONS*

| |
|---|
| Determine the Room Cavity Ratio for ~~Table~~TABLE 140.6-G using one of the following equations. |
| Room cavity ratio for rectangular rooms $$RCR = \frac{5 \times H \times (L + W)}{L \times W}$$ |
| Room cavity ratio for irregular-shaped rooms $$RCR = \frac{2.5 \times H \times P}{A}$$ |
| Where: L =Length of room; W = Width of room; H =Vertical distance from the work plane to the centerline of the lighting fixture; P = Perimeter of room, and A = Area of room |
| |

# Tailored Method - Task Areas

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*§146(c) 3A iv: Task Areas*

- Based on Lux and RCR, look up allowed LPD
- Multiply by Area $Ft^2$

*TABLE 140.6-G ILLUMINANCE LEVEL (LUX) POWER DENSITY VALUES (WATTS/FT²)*

| Illuminance Level (Lux) | RCR ≤ 2.0 | RCR > 2.0 and ≤ 3.5 | RCR > 3.5 and ≤ 7.0 | RCR > 7.0 |
|---|---|---|---|---|
| 50 | 0.2 | 0.3 | 0.4 | 0.6 |
| 100 | 0.4 | 0.6 | 0.8 | 1.2 |
| 200 | 0.6 | 0.8 | 1.3 | 1.9 |
| 300 | 0.8 | 1.0 | 1.4 | 2.0 |
| 400 | 0.9 | 1.1 | 1.5 | 2.2 |
| 500 | 1.0 | 1.2 | 1.6 | 2.4 |
| 600 | 1.2 | 1.4 | 2.0 | 2.9 |
| 700 | 1.4 | 1.7 | 2.3 | 3.3 |
| 800 | 1.6 | 1.9 | 2.6 | 3.8 |
| 900 | 1.8 | 2.2 | 3.0 | 4.3 |
| 1000 | 1.9 | 2.4 | 3.3 | 4.8 |

RCR

# Tailored Method - "UseitorLoseit"

*Table 140.6-D: Additional Allowed Power*

- For primary functions listed in Table 140.6-D, there may be Additional Allowed Power.
- If these additional powers aren't used, they're lost.

**Use It Or Lose It!**

**Wall Displays**

**Floor Displays**

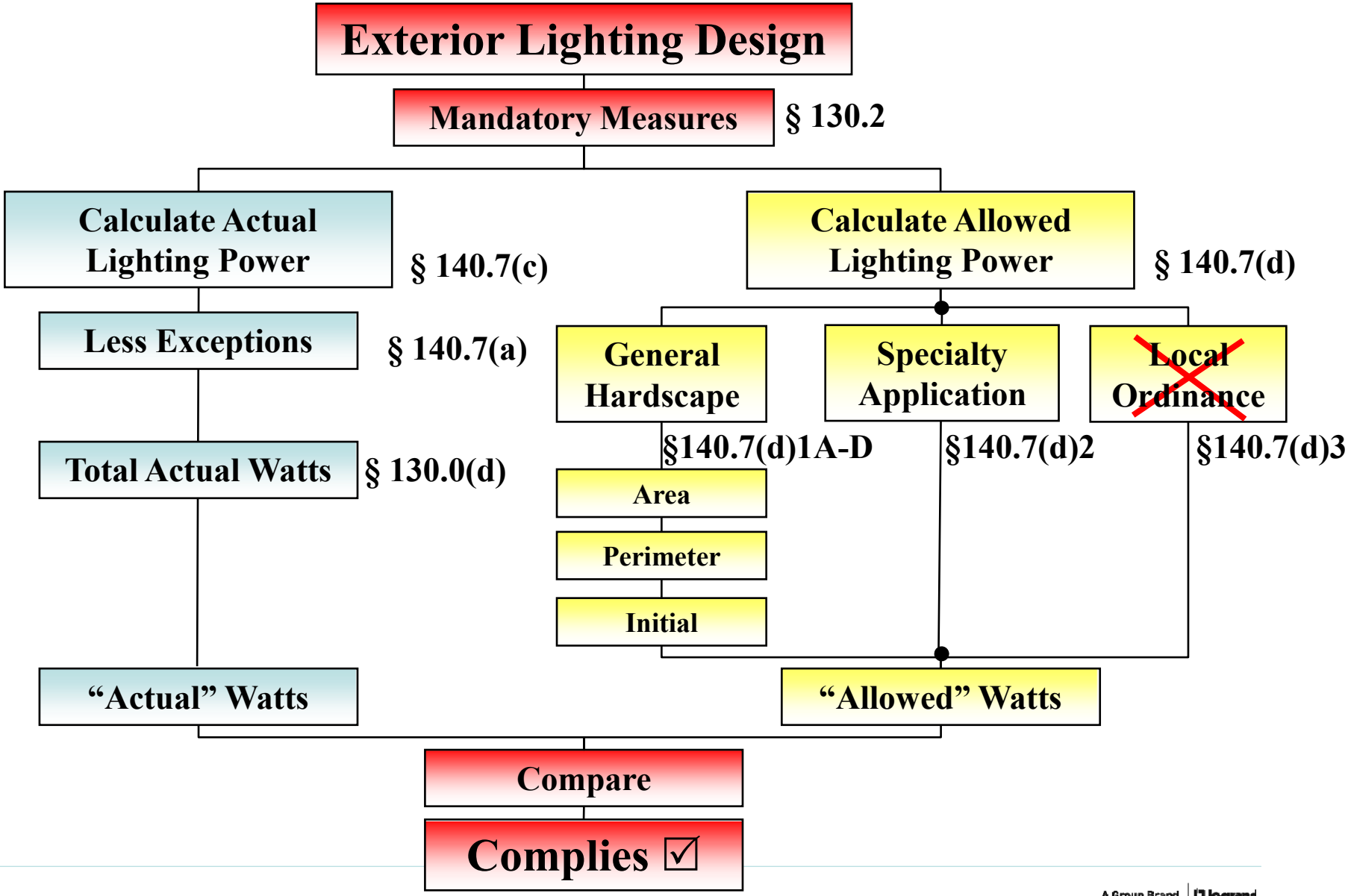
**Ornamental/Special**

*TABLE 140.6-D TAILORED METHOD ~~SPECIAL~~ LIGHTING POWER ALLOWANCES ~~(THIS IS A REFORM VERSION OF THE TABLE ABOVE)~~*

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Primary Function Area | General Illumination Level (Lux) | Wall Display Power (W/ft) | Allowed Combined Floor Display Power and Task Lighting Power (W/ft²) | Allowed Ornamental/ Special Effect Lighting |
| Auditorium Area | 300 | 2.25 | 0.3 | 0.5 |
| Civic Meeting Place | 300 | 3.15 | 0.2 | 0.5 |
| Convention, Conference, Multipurpose, and Meeting Center Areas | 300 | 2.50 | 0.4 | 0.5 |
| Dining Areas | 200 | 1.50 | 0.6 | 0.5 |
| Exhibit, Museum Areas | 150 | 15.0 | 1.2 | 0.5 |
| Financial Transaction Area | 300 | 3.15 | 0.2 | 0.5 |

# Prescriptive Outdoor Lighting Overview

*§140.7: Prescriptive Requirements for Outdoor Lighting*



# Outdoor Lighting

WattStopper

*§140.7: Requirements for Outdoor Lighting*

- Compliance requires Actual LPD to be less than Allowed LPD
- Long list of exceptions when 50% light falls within following applications
  - Temporary, FAA required, roadway, sports fields, children's playgrounds, industrial site lighting, ATMs, public monuments, signs, ~~pools and water features,~~ tunnels, stairs, some ramps, landscape lighting, some historic lighting elements, etc...

# Allowed Lighting Power

WattStopper

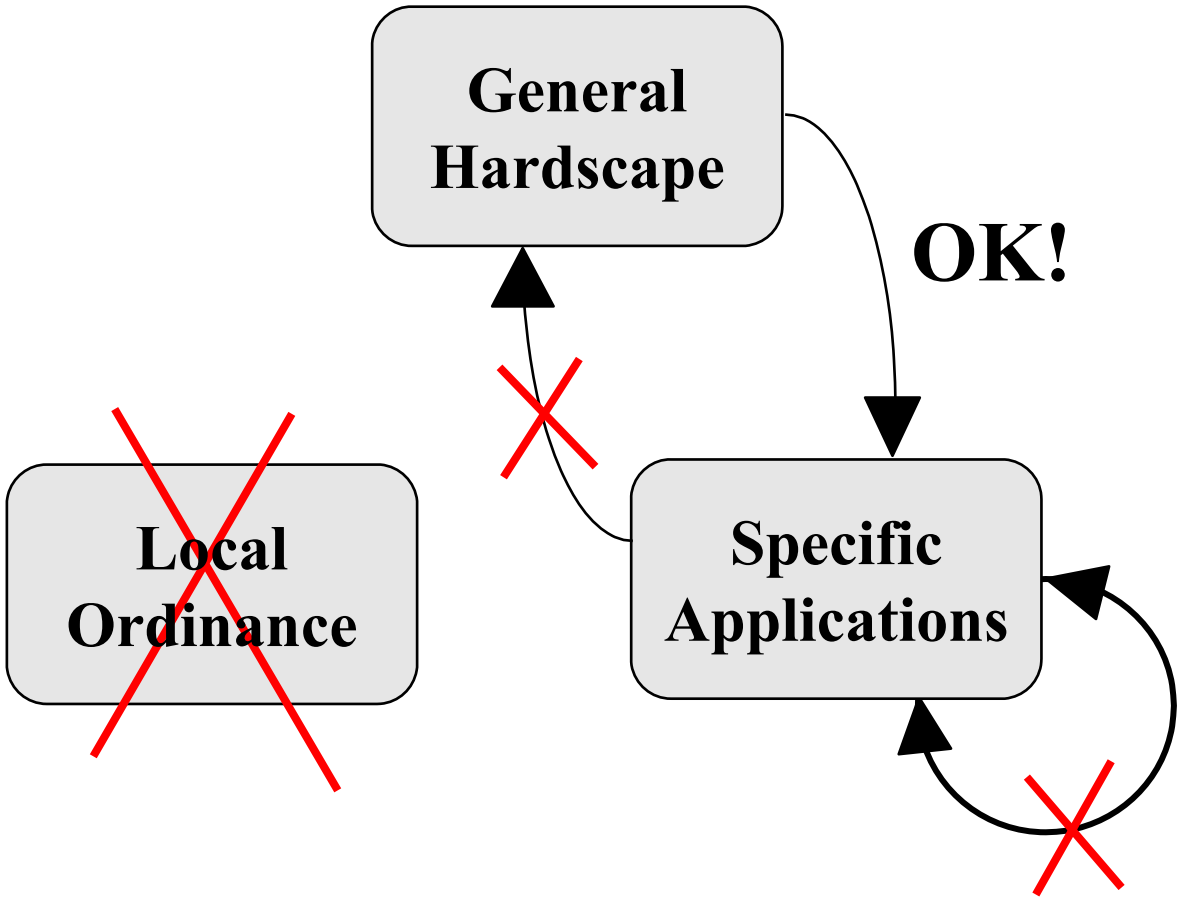
*§140.7(d): Requirements for Outdoor Lighting*

- **Allowed Lighting is total of:**
  - **General Hardscape Lighting** includes: parking lots, roadways, sidewalks, walkways, bikeways, plazas
  - **Specific Applications** includes items from Table 147-B
    - Building Entrance/Exit, Drive-up window, etc…
  - ~~**Local Ordinance** includes items from Table 147-C~~ **Gone**

# Lighting Power Trade-offs

WattStopper

*§140.7(b): Requirements for Outdoor Lighting*



# General Hardscape is a Total of:

*§140.7(d): Requirements for Outdoor Lighting*

**Area Based**

Total all “Illuminated Areas”, which is a Square with sides **= 10 x mounting height**, centered each luminaire or pole

Multiply “Illuminated Area” x Area Allowance in Table 140.7-A

**Perimeter Based**

Perimeter of Illuminated Hardscape, less small landscape areas and permanent planters

Multiply Illuminated Perimeter x Linear Allowance Table 140.7-A

**Initial Wattage**

One time allowance of power per site per Table 140.7-A

*TABLE 140.7-A GENERAL HARDSCAPE LIGHTING POWER ALLOWANCE*

| Type of Power Allowance | Lighting Zone 1 | Lighting Zone 2 | Lighting Zone 3 | Lighting Zone 4 |
|---|---|---|---|---|
| Area Wattage Allowance (AWA) | ~~0.036~~ 0.035 W/ft² | 0.045 W/ft² | ~~0.092~~ 0.090 W/ft² | 0.115 W/ft² |
| Linear Wattage Allowance (LWA) | ~~0.36~~ 0.25 W/lf | 0.45 W/lf | ~~0.92~~ 0.60 W/lf | ~~1.15~~ 0.85 W/lf |
| Initial Wattage Allowance (IWA) | 340 W | 510 W | 770 W | 1030 W |

# Determination of Outdoor Lighting Zones

*§10-114: Outdoor Lighting Zones*

| Zone | Ambient Illumination | State wide Default Location | Moving Up to Higher Zone | Moving Down to Lower Zones |
|---|---|---|---|---|
| **LZ1** | **Dark** | **Government designated parks, recreation areas, and Wildlife preserves.** | Designated park, recreation area, wildlife preserve can be designated as LZ2 or LZ3 if they are contained within such a zone. | NA |
| **LZ2** | **Low** | **Rural areas,** as defined by the 2000 U.S. Census. | Districts may designated as LZ3 by a local jurisdiction. Examples include special commercial or industrial districts or areas with special security considerations located within a rural area. | Special districts and government designated parks may be designated as LZ1 by the local jurisdiction for lower illumination standards, without any size limits. |
| **LZ3** | **Medium** | **Urban areas,** as defined by the 2000 U.S. Census. | Districts may be designated as a LZ4 by local jurisdiction for high intensity nighttime use, such as entertainment or commercial districts or areas with special security considerations requiring very high light levels. | Special districts and government designated parks may be designated as LZ1 or LZ2 by the local jurisdiction, without any size limits. |
| **LZ4** | **High** | **None** | NA | NA |

# Specific Application –"Use it or Lose it"

*§147(c)2A-D: Allowed Application Specific Outdoor Lighting Power*

- Similar to Indoor Lighting for Specific Applications, but for Outdoor Applications. Review Table 140.7-B to see if allowed for specific Lighting Zones
  - Building Façade Lighting
  - Outdoor Sales Frontage Lighting
  - Outdoor Ornamental Lighting
  - Lighting under Canopies
  - Vehicle Service Station
    - Without Canopies
    - Hardscape Areas
  - Drive-up Windows
  - Guarded Facilities
  - Outdoor Dining

*TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS*

*All area and distance measurements in plan view unless otherwise noted.*

| | Lighting Application | Lighting Zone 1 | Lighting Zone 2 | Lighting Zone 3 | Lighting Zone 4 |
|---|---|---|---|---|---|
| **WATTAGE ALLOWANCE PER APPLICATION. Use all that apply as appropriate.** | | | | | |
| | **Building Entrances or Exits.** Allowance per door. Luminaires qualifying for this allowance shall be within 20 feet of the door. | 30 watts | ~~75~~ 60 watts | ~~100~~ 90 watts | ~~120~~ 90 watts |
| | **Primary Entrances to Senior Care Facilities, Police Stations, Hospitals, Fire Stations, and Emergency Vehicle Facilities.** Allowance per primary entrance(s) only. Primary entrances shall provide access for the general public and shall not be used exclusively for staff or service personnel. This allowance shall be in addition to the building entrance or exit allowance above. Luminaires qualifying for this allowance shall be within 100 feet of the primary entrance. | 45 watts | 80 watts | 120 watts | 130 watts |
| | **Drive Up Windows.** Allowance per customer service location. Luminaires qualifying for this allowance shall be within 2 mounting heights of the sill of the window. | 40 watts | 75 watts | 125 watts | 200 watts |
| | **Vehicle Service Station Uncovered Fuel Dispenser.** Allowance per fueling dispenser. Luminaires qualifying for this allowance shall be within 2 mounting heights of the dispenser. | 120 watts | 175 watts | 185 watts | 330 watts |
| **WATTAGE ALLOWANCE PER UNIT LENGTH (w/linear ft). May be used for one or two frontage side(s) per site.** | | | | | |
| | **Outdoor Sales Frontage.** Allowance for frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. Luminaires qualifying for this allowance shall be located between the principal viewing location and the frontage outdoor sales area. | No Allowance | 22.5 W/linear ft | 36 W/linear ft | 45 W/linear ft |
| **WATTAGE ALLOWANCE PER HARDSCAPE AREA (W/ft²). May be used for any illuminated hardscape area on the site.** | | | | | |

# Alteration vs. Modification-in-Place

*§141.0(I): Lighting System Modifications*

- **Lighting System Alterations**
  - Where an existing lighting system is modified, luminaires are replaced, or luminaires are disconnected from the circuit, removed and reinstalled, whether in the same location or installed elsewhere. Does not include:

- **Luminaire Modification-in-Place**
  - Replacing lamps and ballasts with like type or quantity in a manner that preserves the original luminaire listing.
  - Changing the number or type of light source in a luminaire including: socket renewal, removal or relocation of sockets or lampholders, and/or related wiring internal to the luminaire including the addition of safety disconnecting devices.
  - Changing the optical system of a luminaire in part or in whole.
  - Replacement of whole luminaires 1 for 1 in which the only electrical modification involves disconnecting the existing luminaire and reconnecting the replacement luminaire.

# Alteration vs. Modification-in-Place

*§141.0(I): Lighting System Modifications*

- Luminaire Modification-in-Place
  - Can't be part of any general remodeling or renovation of their enclosed space
  - Can't cause, be the result of, or involve any changes to the panelboard or branch circuit wiring
    - Including line voltage switches, relays, contactors, dimmers and other control devices, providing power to the lighting system.
    - Exemption for Circuit modifications strictly limited to the addition of occupancy or vacancy sensors and class two lighting controls

# Luminaire Alterations

*Table 141.0-E: Additions, Alterations Repairs*

Over 10% Rule!

*TABLE 141.0-E Requirements for Luminaire Alterations*

| Quantity of existing affected luminaires per Enclosed Space [1] | Resulting Lighting Power for Each Enclosed Space | Applicable Mandatory Control Provisions for Each Enclosed Space | Multi-level Lighting Control Requirements for Each Altered Luminaire |
|---|---|---|---|
| **Alterations that do not change the area of the enclosed space or the space type** | | | |
| Sum total < 10% of existing luminaires | Existing lighting power is permitted | Existing provisions are permitted | Existing controls are permitted |
| Sum total ≥ 10% of existing luminaires | ≤ 85% of allowed lighting power per Section 140.6 Area Category Method | §130.1(a), (c) | Two level lighting control [2] or §130.1(b) |
| | > 85% of allowed lighting power per Section 140.6 Area Category Method | §130.1(a), (c), (d) [3] | §130.1(b) |
| **Alterations that change the area of the enclosed space or the space type or increase the lighting power in the enclosed space** | | | |
| Any number | Comply with Section 140.6 | §130.0(d) [3] §130.1(a), (c), (d) [3], (e) | §130.1(b) |

1. Affected luminaires include any luminaire that is changed, replaced, removed, relocated; or, connected to, altered or revised wiring, except as permitted by EXCEPTIONS 1 and 2 to Section 141.0(b)**2Iii:**
2. Two level lighting control shall have at least one control step between 30 and 70% of design lighting power in a manner providing reasonably uniform illuminations
3. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are altered.

**Remember:**

**130.1(a) = Area Device**
**130.1(b) = Multilevel Off**
**130.1(c) = Automatic Shut**
**130.1(d) = Daylighting**
**130.1(e) = Demand Response**
**130.0(d) = Mfg. Instructions**

# Modification-in-Place

*Table 141.0-F: Additions, Alterations Repairs*

≥ 40 Rule!

*TABLE 141.0-F=Requirements for Luminaire Modifications-in-Place*

For compliance with this Table, building space is defined as any of the following:

1. A complete single story building
2. A complete floor of a multi floor building
3. The entire space in a building of a single tenant under a single lease
4. All of the common, not leasable space in single building

| **Quantity of affected luminaires per Building Space per annum** | **Resulting Lighting Power per Each Enclosed Space Where ≥ 10% of Existing Luminaires are Luminaire Modifications-in-Place** | **Applicable mandatory control provisions for each enclosed space [1]** | **Applicable multi-level lighting control requirements for each modified luminaire [2]** |
|---|---|---|---|
| Sum total < 40 Luminaire Modifications-in-Place | Existing lighting power is permitted | Existing provisions are permitted | Existing controls are permitted |
| Sum total ≥ 40 Luminaire Modifications-in-Place | ≤ 85% of allowed lighting power per Section 140.6 Area Category Method | §130.1(a), (c) | Two level lighting control [3] Or §130.1(b) |
| | > 85% of allowed lighting power per Section 140.6 Area Category Method | §130.0(d) [4] §130.1(a), (c), (d) [4] | §130.1(b) |

1. Control requirements only apply to enclosed spaces for which there are Luminaire Modifications-in-Place.
2. Multi-level controls are required only for luminaires for which there are Luminaire Modifications-in-Place.
3. Two level lighting control shall have at least one control step between 30% and 70% of design lighting power in a manner providing reasonably uniform illuminations
4. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are modified-in-place.

# Building Commissioning



- Building commissioning to be included in the design and construction of the building project to verify that the energy systems and components meet the owner's or owner representative's project requirements.
- Commissioning shall be performed in accordance with this section by trained personnel with experience on projects of comparable size and complexity.
- All building systems and components covered by Sections 110.0, 120.0, 130.0, and 140.0 shall be included in the scope of the commissioning requirements in this Section, excluding covered processes.
- For buildings less than 10,000 $ft^2$, only the design review requirements in Section 120.8(d) and 120.8(e) shall be completed.

# Summary of Commissioning Requirements

*§120.8(a): Building Commissioning*

The following items shall be completed:

9. Owner's or owner representative's project requirements;
10. Basis of design;
11. Design phase design review;
12. Commissioning measures shown in the construction documents
13. Commissioning plan;
14. Functional performance testing;
15. Documentation and training; and
16. Commissioning report.

# Owner's Project Requirements (OPR)

*§120.8(b): Building Commissioning*

The energy-related expectations and requirements of the building shall be documented before the design phase of the project begins. This documentation shall include the following:

5. Energy efficiency goals;
6. Ventilation requirements;
7. Project program, including facility functions and hours of operation, and need for after hours operation; and
8. Equipment and systems expectations.

EXCEPTION: Buildings less than 10,000 ft2.

# Basis of Design

*§120.8(c): Building Commissioning*

A written explanation of how the design of the building systems meets the OPR shall be completed at the design phase of the building project, and updated as necessary during the design and construction phases. The Basis of Design document shall cover the following systems:

4. Heating, ventilation, air conditioning (HVAC) systems and controls;
5. Indoor lighting system and controls; and
6. Water heating system.

EXCEPTION: Buildings less than 10,000 $ft^2$.

# Design Phase Design Review

*§120.8(d): Building Commissioning*

4. **Design Reviewer Requirements.** Based on Building Size:

a) <10,000 $ft^2$: Design phase design review may be completed by the design engineer.

b) 10,000 to 50,000 $ft^2$ require completion of the design review checklist by an engineer in-house to the design firm not associated with the building project.

c) >50,000 $ft^2$ or for buildings with complex mechanical systems, an independent, third party review of these documents is required.

5. **Design Review.**

During schematic design, the owner/representative, design team and design reviewer to discuss the project scope, schedule and how design reviewer will coordinate with project team. The building owner / representative shall include the Design Review Checklist compliance form in the Certificate of Compliance documentation (see Section 10-103).

6. **Construction Documents Design Review.**

The Construction Documents Design Review compliance form lists the items that shall be checked by the design reviewer during the construction document review. The completed form shall be returned to the owner and design team for review and sign-off. The building owner/representative shall include this Construction Documents Design Review compliance form in the Certificate of Compliance documentation (§10-103).

# Commissioning measures shown in the construction documents

- Include commissioning measures or requirements in the construction documents (plans and specifications). Be clear, detailed and complete. Include:
  - Systems and assemblies commissioned,
  - Testing scope
  - Roles and responsibilities of contractors
  - Requirements for meetings
  - Management of issues
  - The commissioning schedule,
  - Operations and maintenance manual development and of training
  - Checklist and test form development
  - Execution and documentation.

- Include, for information only, roles of non-contractor parties.

# Commissioning Plan

*§120.8(f): Building Commissioning*

- Commissioning Plan. Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started during the design phase of the building project. The Commissioning Plan shall include the following:
  - 1. General project information;
  - 2. Commissioning goals;
  - 3. Systems to be commissioned.
  - 4. Plans to test systems and components shall include:
    - A. An explanation of the original design intent;
    - B. Equipment and systems to be tested, including the extent of tests;
    - C. Functions to be tested;
    - D. Conditions under which the test shall be performed;
    - E. Measurable criteria for acceptable performance;
    - F. Commissioning team information; and
    - G. Commissioning process activities, schedules and responsibilities. Plans for the completion of commissioning requirements listed in Sections 120.8(g) through 120.8(i) shall be included.

- EXCEPTION for buildings less than 10,000 $ft^2$ .

# Functional Performance Testing

*§120.8(g): Building Commissioning*

F

- Functional performance tests shall demonstrate the correct installation and operation of each component, system and system-to-system interface in accordance with the Construction Documents.
- Functional performance testing reports to contain:
  - Information on each of the building components tested,
  - Testing methods utilized, and any readings and adjustments made.
  - All Acceptance Requirements for Code Compliance shall be completed as part of this functional performance testing.
- EXCEPTION: Buildings less than 10,000 $ft^2$.

# Documentation and Training

*§120.8(h): Building Commissioning*

3. Systems manual. Documentation of the operational aspects of the building shall be completed within the Systems Manual and delivered to the building owner or representative and facilities operator. The Systems Manual shall include the following:

A. Site information, including facility description, history and current requirements;
B. Site contact information;
C. Basic operations and maintenance, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, site events log;
D. Major systems;
E. Site equipment inventory and maintenance notes;
F. A copy of all special inspection verifications required by the enforcing agency or this code; and
G. Other resources and documentation.

4. Systems operations training. The training of the appropriate maintenance staff for each equipment type and/or system shall be documented in the commissioning report and shall include the following:

A. System/equipment overview (what it is, what it does and with what other systems and/or equipment it interfaces)
B. Review and demonstration of operation, servicing and preventive maintenance
C. Review of the information in the Systems Manual
D. Review of the record drawings on the system/equipment

EXCEPTION to Section 120.8(h): Buildings less than 10,000 $ft^2$ .

# Permit, Certificate, …

*§10-103: Construction Documentation*

All registration of nonresidential compliance documents with a HERS provider.

An electronic storage mechanism to archive all residential HERS and Nonresidential Compliance.

# HVAC Occupant Sensors

*§120.1(c)5: Mechanical Controls*

- HVAC systems are required to have Demand Control Ventilation to insure Air Quality.
  - One way of meeting the requirement is $CO_2$ Sensors.
  - Another way for spaces <1,500 $ft^2$ is Occupancy Sensors which reduce airflow when space is unoccupied.

# Shut-off/Reset for Space Conditioning

*§120.2(e)1: Mechanical Controls*

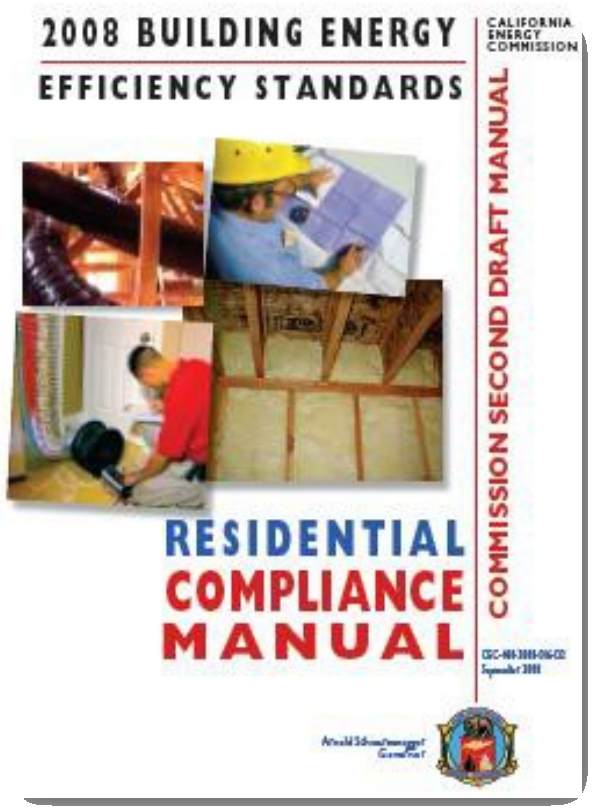
- Each space-conditioning have controls that automatically shut off the system during periods of nonuse using:
  - An automatic time switch control device complying with Section 110.9, with an accessible manual override that allows operation of the system for up to 4 hours; or
  - An occupancy sensor; or
  - A 4-hour timer that can be manually operated.
- Exception
  - Mechanical systems serving retail stores and associated malls, restaurants, grocery stores, churches, and theaters equipped with 7- day programmable timers.

# HVAC Occupancy Controls

*§120.2(e)3: Mechanical Controls*

- Following spaces **must have occupancy sensors**
  - Multipurpose room < 1000 $ft^2$,
  - Classrooms > 750 $ft^2$ and
  - Conference, Convention, Auditorium and Meeting Center rooms > 750 $ft^2$
- During unoccupied periods:
  - Automatically setup the operating cooling temperature set point by 2°F or more and setback the operating heating temperature set point by 2°F or more; and
  - Automatically reset the minimum required ventilation rate with an occupant sensor ventilation control device according to Section 120.1(c)5.
  - Exemption for spaces with processes or operations that generate dusts, fumes, vapors or gasses

# Residential Requirements




**Under T24 <u>Commercial</u> Rules, CEC dictates power requirements, but doesn't care about the fixtures used.**

**Under T24 <u>Residential</u> Rules, CEC doesn't limit power used, but wants High Efficacy Fixtures.**

# Residential Lighting

*§150.0 (k)1-2: Low-rise Residential Buildings*

- Per Tables 150.0-A and 150.0–B, Luminaires are either
  - High Efficiency
  - Low Efficiency

- If it's a hybrid Luminaire with both High and Low Efficiency systems, each separately complies with 150.0(k) requirements

# LEDs in Residential Applications

WattStopper

*§110.9 (e): Mandatory Requirements for Lighting Control Devices*

- To be High Efficacy, Resi LED Luminaries and Light Engines shall be Certified to CEC per JA-8.
  - If not certified, considered Low Efficacy
  - Non-resi LED lighting not required to be certified
  - JA-8 mandates a minimum **LED CRI of 90!**

# Residential Lighting *§150 (k)1-2: Low-rise Residential Buildings*

*TABLE 150.0-~~C~~A CLASSIFICATION OF HIGH EFFICACY AND LOW EFFICACY LIGHT SOURCES*

| **High Efficacy Light Sources**<br>Luminaires manufactured, designed and rated for use with only lighting technologies in this column shall be classified as high efficacy: | **Low Efficacy Light Sources**<br>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 Section 150(k)1D.<br>2. Pulse-start metal halide lamps.<br>3. High pressure sodium lamps.<br>4. GU-24 sockets rated for LED lamps.<br>5. GU-24 sockets rated for compact fluorescent lamps~~, and which are not recessed luminaires~~.<br>6. Luminaires using LED light sources which have been certified to the Commission as high efficacy in accordance with Reference Joint Appendix JA-8.<br>7. Luminaire housings rated by the manufacturer for use with only LED light engines.<br>8. Induction lamps.<br>**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.<br>2. Low-voltage lamp holders capable of operating incandescent lamps of any type.<br>3. High efficacy lamps installed in low-efficacy luminaires, including screw base compact fluorescent and screw base LED lamps.<br>3. Mercury vapor lamps.<br>4. Track lighting or other flexible lighting system which allows the addition or relocation of luminaires without altering the wiring of the system.<br>6. Luminaires using LED light sources which have not been certified to the Commission as high efficacy.<br>7. Lighting systems which have modular components that allow conversion between high-efficacy and low-efficacy lighting without changing the luminaires' housing or wiring.<br>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. |

# Low-Rise Residential

*TABLE 150-B: Low Rise Residential Mandatory Features - Lighting*

| Lamp Power Rating | Minimum Lamp Efficacy |
|---|---|
| 5 watts or less | 30 lumens per watt |
| Over 5 - 15 watts | 45 lumens per watt (was 40) |
| Over 15 watts to 40 Watts | 60 lumens per watt (was 50) |
| Over 40 watts | 90 lumens per watt (was 60) |

Note: Determine minimum luminaire efficacy using the system initial rated lumens divided by the luminaire total rated system input power.

# Luminaire wattage *§150(k)3, 5, 6 : Low-rise Residential Buildings*

- Luminaire Wattage
  - Permanently installed luminaries wattage per Section 130.0(c)
  - In kitchens electrical boxes with a blank cover or where no electrical equipment is installed is **180 watts of low efficacy lighting** per electrical box

- Electronic Ballasts
  - For all Fluorescent lamps over 13W

- Nightlights Alone and in Exhaust Fans
  - ~~Contain only high efficacy lamps~~
  - Rated to consume no more than 5 watts of power per Luminaire or Fan
  - Not required to be controlled by a vacancy sensor

- Exhaust Fan Lighting
  - In all rooms ~~except kitchens~~ must comply to Section 150 (k)
  - Except for Lighting installed by manufacturer in Kitchen Exhaust Hoods

# Switching Devices & Controls *§150(k)7 : Low-rise Residential Buildings*

- Switch High & Low Efficacy luminaires **separately**
- Switch **Exhaust fans** separately from **lighting**
  - **Exception** Lighting integral to an exhaust fan may be on the same switch as the fan provided the lighting can be switched OFF in accordance with the applicable provisions in Section 150(k)2 while allowing the fan to continue to operate for an extended period of time.
- Controls must be **readily accessible** and installed in accordance with the manufacturer's instructions
- **Cannot** have controls that **bypass** any required dimmer or vacancy sensor
- An Energy Management Control System and/or multi-scene programmable controller may be used if it complies with Dimming or Vacancy Sensor requirements.

# Lighting Specific to rooms

*§150(k)8 : Low-rise Residential Buildings*

**Kitchens**: ≥ 50% of permanently installed lighting must be high efficacy (by Watts)

Exemption for:

50W for dwelling units ≤ 2,500 $ft^2$, or

100W for dwelling units > 2,500 $ft^2$ if:

Meet 150.0(k)2 and ~~low efficacy~~ **All kitchen luminaires** are controlled by a vacancy sensor or dimmer, ~~EMCS, or~~ ~~programmable control system,~~ ~~**AND**~~

~~All permanently installed lights in garages, laundry rooms, closets > 70 $ft^2$, and utility rooms are high efficacy~~ ~~**AND**~~ ~~controlled by a vacancy sensor~~
~~(Note bathrooms are not included in list).~~

# Lighting Specific to room *§150(k)9-11 : Low-rise Residential Buildings*

- **Internal Cabinet Lighting:** ≤ 20 W/ linear ft.
  Regardless of the number of shelves or the number of doors per cabinet section, the length of an illuminated cabinet shall be determined by:
  - One horizontal length of illuminated cabinet; or
  - One vertical length, per illuminated cabinet section; or
  - No more than one vertical length per every 40 horizontal inches of illuminated cabinet.

- **Bathrooms:** Must have 1 High efficacy light, and all other should be high efficacy lighting unless it's controlled by a vacancy sensor

- **Garages, Laundry Rooms, Utility Rooms**: Use high efficacy lighting AND must be controlled by a vacancy sensor

- **Other rooms**: High efficacy lighting or controlled by a dimmer or vacancy sensor
  - Closets < 70 $ft^2$ exempted
  - Doesn't include small detached storage buildings

# Title 24 Resources

# Multi-Level Control Requirements (Table 130.1-A)

| Luminaire Type | Minimum Required Control Steps ( percent of full rated power[1] ) | | | | Uniform level of illuminance shall be achieved by: |
|---|---|---|---|---|---|
| Line-voltage sockets except GU-24 | Continuous dimming 10-100 percent | | | | |
| Low-voltage incandescent systems | | | | | |
| LED luminaires and LED source systems | | | | | |
| GU-24 rated for LED | | | | | |
| GU-24 sockets rated for fluorescent > 20 watts | Continuous dimming 20-100 percent | | | | |
| Pin-based compact fluorescent > 20 watts | | | | | |
| GU-24 sockets rated for fluorescent ≤ 20 watts | Minimum one step between 30-70 percent | | | | Stepped dimming; or continuous dimming; or switching alternate lamps in a luminaire |
| Pin-based compact fluorescent ≤ 20 watts[2] | | | | | |
| Linear fluorescent and U-bent fluorescent ≤ 13 watts | | | | | |
| Linear fluorescent and U-bent fluorescent > 13 watts | Minimum one step in each range: | | | | Stepped dimming; or continuous dimming; or switching alternate lamps in each luminaire, having a minimum of 4 lamps per luminaire, illuminating the same area and in the same manner |
| | 20-40 % | 50-70 % | 80-85 % | 100 % | |
| Track Lighting | Minimum one step between 30 – 70 percent | | | | Step dimming; or continuous dimming; or Separately switching circuits in multi-circuit track with a minimum of two circuits. |
| HID > 20 watts | Minimum one step between 50 - 70 percent | | | | Stepped dimming; or continuous dimming; or switching alternate lamps in each luminaire, having a minimum of 2 lamps per luminaire, illuminating the same area and in the same manner. |
| Induction > 25 watts | | | | | |
| Other light sources | | | | | |

A **GU24** connector is fitting for compact fluorescent light bulbs (CFL) that uses a bayonet mount bi-pin connector instead of the Edison screw fitting used on many incandescent light bulbs. The GU24 fitting allows the overall length of the bulb to be shorter since the threaded base is eliminated.

# How is the Multi-level Lighting requirement achieved? What does it mean?

You have to put a wall switch/interface in the space to access the levels of control.

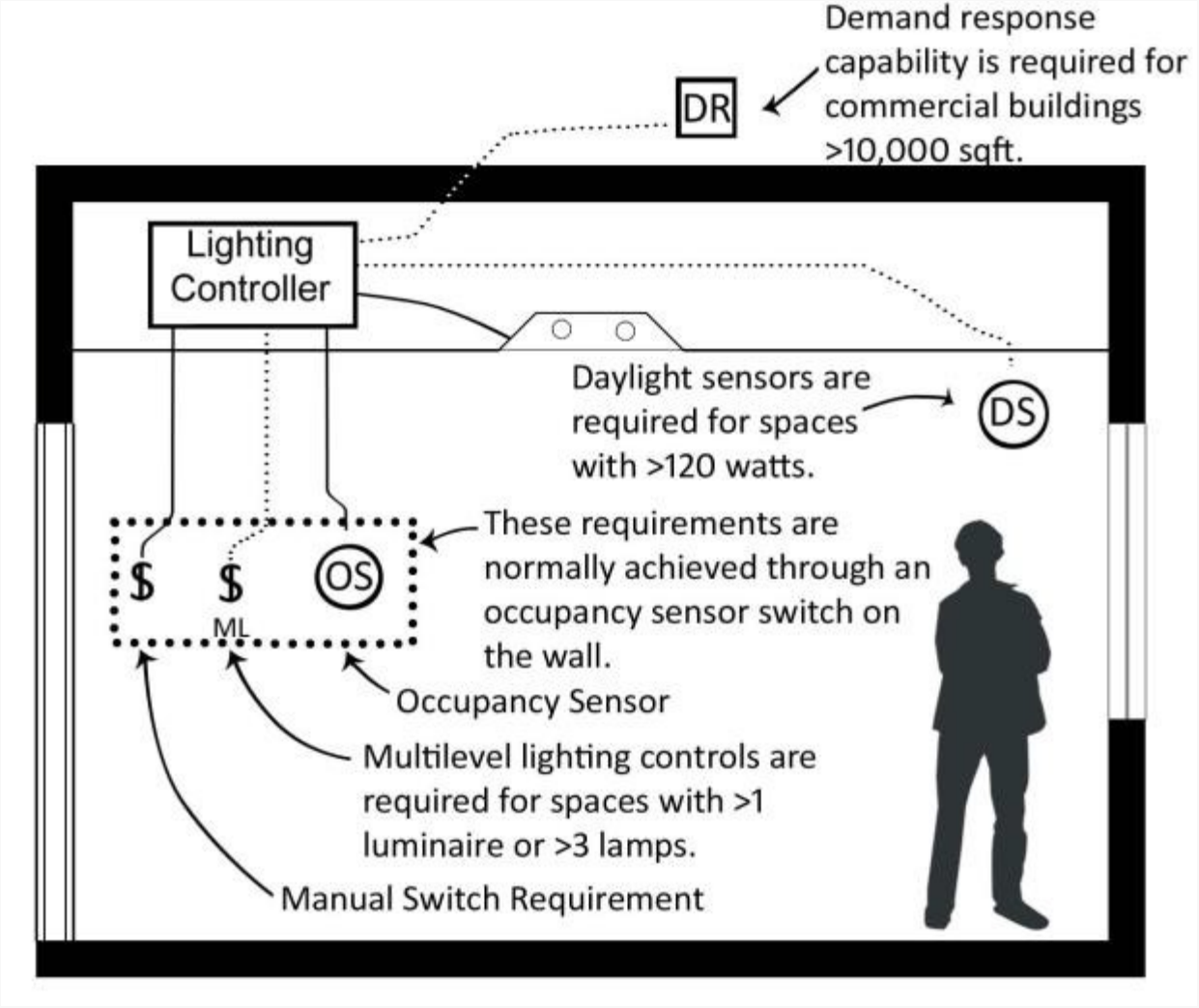
You have to employ at least one of the multi-level strategies

- Manual Dimming
- Lumen Maintenance
- Task Tuning
- Daylight Controls
- Demand Response

You need to employ occupancy and daylight sensors depending on the individual space requirements.

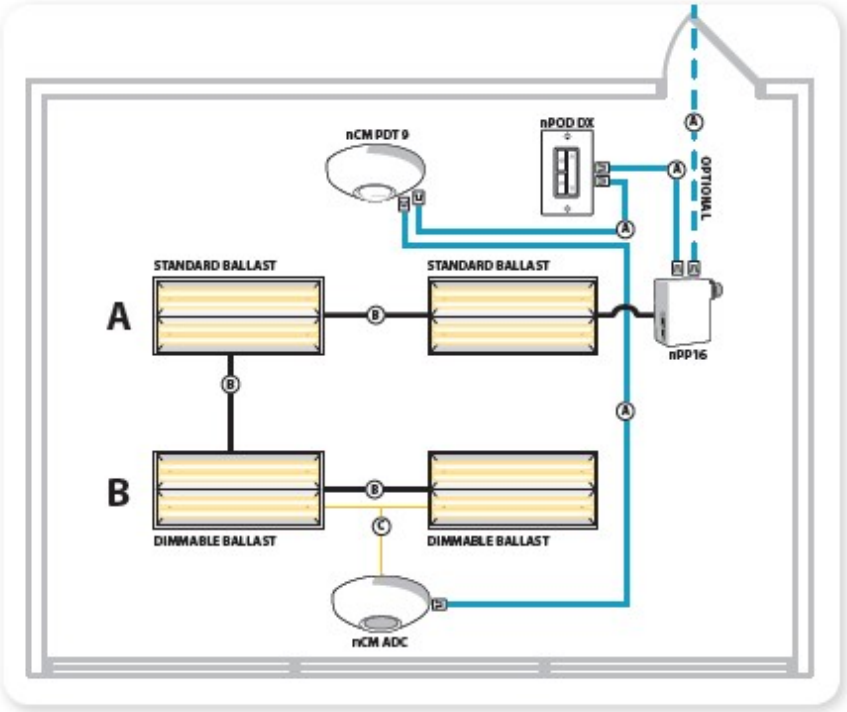
**Once you have the control system, you might as well employ every strategy that makes sense for the space!**

# Daylighting and multi-level controls in a private office example




E. Manual switch
F. Multi-level lighting control
G. Occupancy Sensor
H. Daylight Sensor
I. Demand Response

# Design approach to meet these requirements might include…




## EXAMPLE 3

**Single Level Control with One Daylight Harvesting Zone**

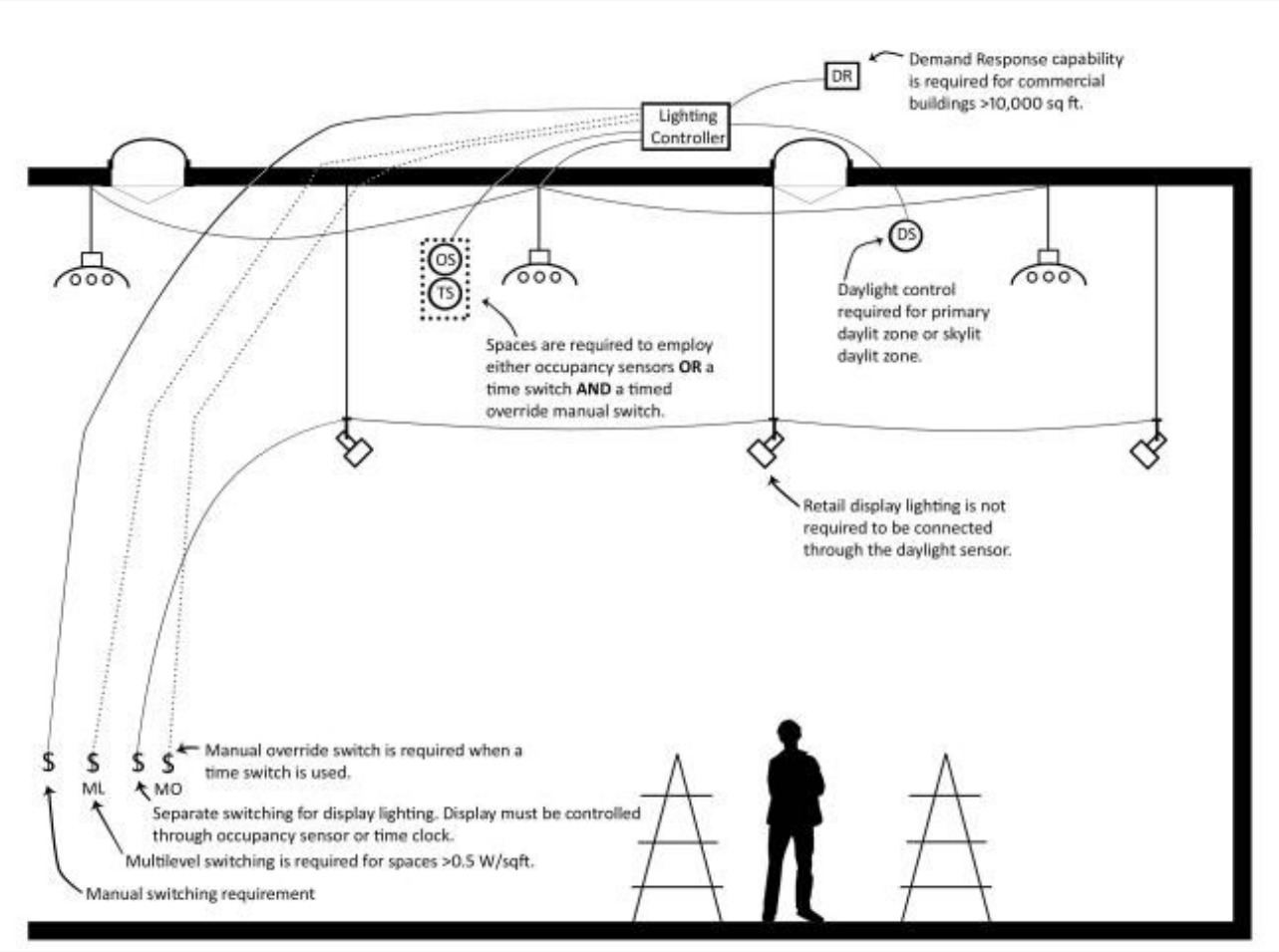
**Devices Installed:**

- **nPP16** Power Pack
- **nPOD DX** On/Off/Dim Touch WallPod®
- **nCM PDT 9** Ceiling Mount Dual Tech Occupancy Sensor
- **nCM ADC** Daylight Sensor with Automatic Dimming Control

**Description:** This design makes use of available daylight in the space by incorporating a standalone photocell device to automatically dim the lights in row **B**. Both rows of lights are turned on and off together by a single relay (in the power pack) and occupancy sensor. An On/Off/Dim Touch WallPod enables users to raise and lower row **B** as required.

Example shown from Sensor Switch Light literature.

# Daylighting and multi-level controls in a retail Example




i. Manual switch
ii. Multi-level lighting control
iii. Occupancy Sensor
iv. Daylight Sensor
v. Demand Response
vi. Separate switching for display lighting.
vii. Time switch and override for display lighting, or occupancy sensor

## Egress Lighting Control Requirements (130.1(b))

- Allowance for 24/7 lighting for building 'security' has been removed (§130.1(a) and §130.1(c)).
- Allowances for 24/7 egress and emergency lighting have mostly been removed.
  - 0.2 W/sf is excepted from the Area Control requirements, to provide egress illumination along designated routes during occupied hours (§130.1(a)).
    This was reduced from 0.3W/sf in 2008 code.
    This lighting must be shut off at unoccupied times, per §130.1(c)
  - 0.05 W/sf is excepted from the Shut-Off Control requirements, along designated egress routes <u>in offices only</u>.
    Other building types have no allowance. (§130.1(c))
    This was reduced from 0.3W/sf in 2008 code.
  - New excepted LPD is based on one controlled lamp per fixture. Emergency lighting, egress lighting and security lighting can still turn on if required via motion sensor. Relevant Fire Code sections are IBC, Section 1006.1 and 1006.2

## What is Egress Lighting?

Egress Lighting is not Emergency Lighting!

**Egress lighting** is designed to provide people who may not have control of the lighting system enough light to safely egress a space **under normal building operating circumstances**.

**Emergency lighting** is designed to provide a minimal amount of light for egress **when the normal lighting system has failed**.

Rule of thumb:

Emergency lighting is what you experience when the power fails.
Egress lighting is what you experience when someone turns the lights out in a multiple –occupant space.

So, why the distinction?

They have different requirements!

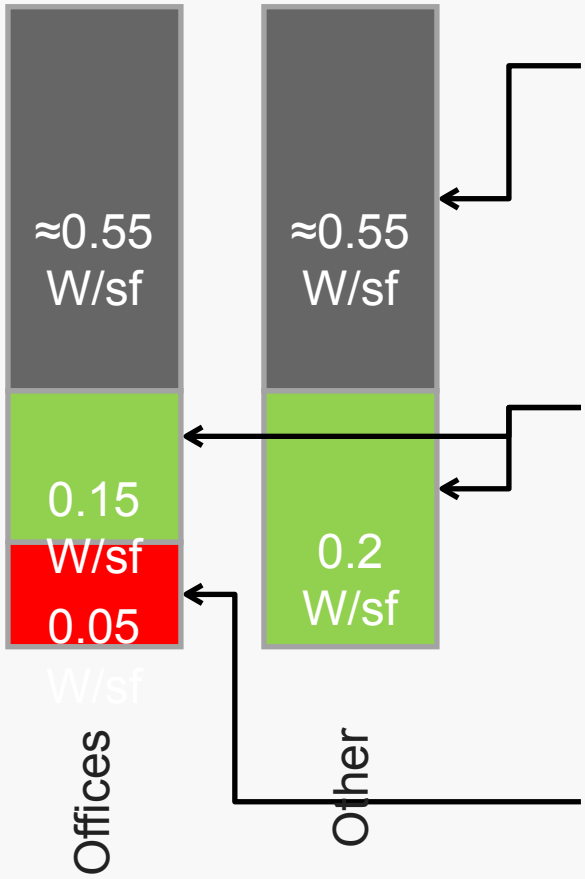
Egress lighting is designated as **1 fc min** anywhere in the path of egress.

Emergency lighting is designated as **1 fc avg, .1 fc min** Anywhere in the path of egress.

Often, the emergency and egress system uses the same luminaires and lamps.

However, when in emergency mode, the lamps are typically run by batteries, or in large buildings, via generator.

**What are the new allowances?**




Switched on and off by occupants or by automatic controls

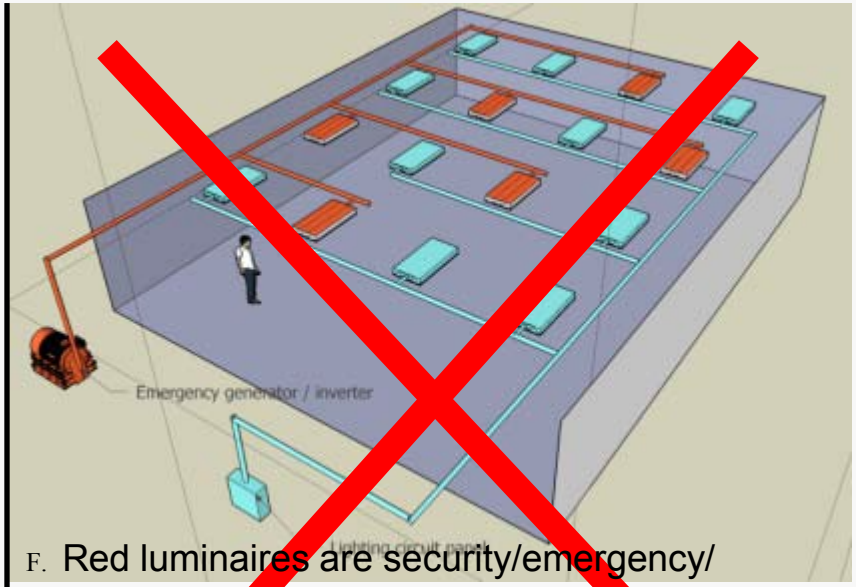
Egress allowance, held on during occupied hours, i.e. controlled only by the §130.1(c) shut-off system

Egress allowance, held on 24/7 in offices only. This is NOT necessarily emergency lighting.

When unoccupied (defined as normally unoccupied via the use schedule), these lighting must be OFF, but can come on via occupancy sensors.

During regular business hours, the egress lights may remain ON even if unoccupied, but the remainder should be OFF following occ. sensor control.

**How does this work?**




F. Red luminaires are security/emergency/ egress

The Old Way…

# Title 24, Part 6, 2008

# Outdoor Lighting Requirements (  140.7)

(p) New mandatory occupancy sensor and daylighting controls in parking garage spaces. **(Section 130.1(d)3)**

(q) Increased requirements for multi-level lighting controls for nonresidential outdoor  lighting. (Section 130.2(c)3B)

(r) Existing outdoor lighting cutoff (shielding) requirements, changed to the new IES standard: Backlight, Uplight, Glare (BUG) requirements. **(Section 130.2(b))**

Removed from the Code:

§140.7(a)  Exception for swimming pools (Article 680 of the CEC) has been removed.

§140.7(b)3  Allowance for additional lighting power allowance due to local ordinance (Table 140.7 – C)

Minor adjustments to the LPA allowances in select circumstances.

## Outdoor Lighting Controls - **big changes!** (§130.2)

**Outdoor Lighting Controls ( 130.2)**

Alignment of Code with new BUG classifications (removal of ‘cutoff, ‘semi-cutoff”, etc.) §130.2(b)

There are no ‘B’ (Backlight) requirements…
Maximum ‘U’ and ‘G’ Zonal Lumens limited by Tables 130.2-A&B
These are the same values as the IES TM-15 values.

Outdoor lighting must be circuited separately from other loads (§130.2(c)2).

All lighting mounted 24’ or less to bottom of luminaire must be controlled to meet all the following (§130.2(c)3):

Motion sensor or other auto control.
Shall reduce lighting power of each luminaire from 40 – 80%.
Shall have Auto-ON capability.
No more than 1500 watts shall be controlled together.

**Exceptions to Outdoor 24' Controls Requirement (130.2(c)3)**

Sales Frontage, Sales Lots and Outdoor Sales Canopies (These have a different set of requirements, including part-night controls, but do not require motion sensors).

Lighting for Building Facades, Ornamental Hardscape, and Outdoor Dining.

Outdoor lighting equipment where the rated wattage is below:

75 W for pole mounted.
30 W for other luminaires.
Linear products under 4 W per linear foot.

Products that are exceptions to 140.7(a).

Outdoor Ornamental Hardscape, Façade and Dining is excluded from this requirement

# Lighting Alterations

First off… Routine maintenance is not an alteration! (§141.0(b)2vii)

"… Replacement in kind of parts of an existing luminaire that include only new lamps, lamp holders, or lenses…"

There are three types of "alterations":

"Lighting system alterations" (§141.0(b)2ii)

"*an existing lighting system is modified, luminaires are replaced, or luminaires are disconnected from the circuit, removed and reinstalled, whether in the same location or installed elsewhere*."

"Luminaire modifications in place" (§141.0(b)2iii)

Includes ballast changeouts, change in light source (except some LEDs), one-for-one luminaire replacements

Does not include gut-rehab projects, or line voltage wiring changes

"Wiring alterations" (§141.0(b)2iv)

Adding circuits that feed luminaires

Replacing, modifying or relocating line voltage wiring

Replacing or installing a new panelboard feeding lighting systems

**What is a luminaire modification?**

New definition: “Luminaire modifications in place” (141.0(b)2)

## Luminaires shall only be modified by the following methods

- Replacing lamps and ballasts with “like type or quantity”.
- Changing the number or type of light source in a luminaire including: socket renewal, removal or relocation of sockets or lampholders, and/or related wiring internal to the luminaire.
- Changing the optical system of a luminaire in part or in whole.

4.Replacement of whole luminaires one-for-one

## Lumunaire Modifications-In-Place shall meet the following

1.Luminaire Modifications-in-Place shall not be part of or the result of any general remodeling or renovation of the enclosed space in which they are located.

2.Luminaire Modifications-in-Place shall not cause, be the result of, or involve any changes to the panelboard or branch circuit wiring.

EXCEPTION - Circuit modifications strictly limited to the addition of occupancy or vacancy sensors and class two lighting controls are permitted for Luminaire Modifications-in-Place.

**When do lighting alterations trigger the code?**

| Quantity of existing affected luminaires per Enclosed Space [1] | Resulting Lighting Power for Each Enclosed Space | Applicable Mandatory Control Provisions for Each Enclosed Space | Multi-level Lighting Control Requirements for Each Altered Luminaire |
|---|---|---|---|
| **Alterations that do not change the area of the enclosed space or the space type** | | | |
| Sum total < 10% of existing luminaires | Existing lighting power is permitted | Existing provisions are permitted | Existing controls are permitted |
| Sum total ≥ 10% of existing luminaires | **≤ 85%** of allowed lighting power per §140.6 Area Category Method | Area control & shutoff control; §130.1(a), (c) | Two level lighting control[2] or multi-level control §130.1(b) |
| | **> 85%** of allowed lighting power per §140.6 Area Category Method | Area control, shutoff control & daylighting; §130.1(a), (c), (d)[3] | §130.1(b) |
| **Alterations that change the area of the enclosed space or the space type or increase the lighting power in the enclosed space** | | | |
| Any number | Comply with §140.6 | Area control, shutoff control & daylighting; §130.1(a), (c), (d)[3], (e) | Multi-level control; §130.1(b) |

14 Affected luminaires include any luminaire that is changed, replaced, removed, relocated, or connected to altered or revised wiring, except as permitted by EXCEPTIONS 1 and 2 to §141.0(b)2Iii.

15 Two level lighting control shall have at least one control step between 30 and 70 percent of design lighting power in a manner providing reasonably uniform illumination.

16 Daylight controls in accordance with §130.0(d) are required only for luminaires that are altered.

**When do luminaire mod's trigger the code?**

| Quantity of affected luminaires per Building Space per annum | Resulting Lighting Power per Each Enclosed Space Where ≥ 10% of Existing Luminaires are Luminaire Modifications-in-Place | Applicable mandatory control provisions for each enclosed space [1] | Applicable multi-level lighting control requirements for each modified luminaire [2] |
|---|---|---|---|
| Sum total **< 40 Luminaire Modifications-in-Place** | Existing lighting power is permitted | Existing provisions are permitted | Existing controls are permitted |
| Sum total **≥ 40 Luminaire Modifications-in-Place** | **≤ 85%** of allowed lighting power per §140.6 Area Category Method | Area control & shutoff control; §130.1(a), (c) | Two level lighting Control[3] or multi-level control §130.1(b) |
| | **> 85%** of allowed lighting power per §140.6 Area Category Method | Area control, shutoff control & daylighting; §130.1(a), (c), (d) [4] | Multi-level control; §130.1(b) |

(s) Control requirements only apply to enclosed spaces for which there are Luminaire Modifications-in-Place.

(t) Multi-level controls are required only for luminaires for which there are Luminaire Modifications-in-Place.

(u) Two-level lighting control shall have at least one control step between 30 percent and 70 percent of design lighting power in a manner providing reasonably uniform illumination.

(v) Daylight controls in accordance with §130.0(d) are required only for those luminaires that are modified-in-place.

**A few other changes to be aware of…**

Daylighting Requirements

- New skylighting requirements in the envelope section.
- Threshold for mandatory photocontrols in primary daylit zone **reduced from 2,500 sf to 120 Watts** (§130.1(d)2D).
- Prescriptive photocontrols in secondary daylit zone.
- Automatic daylighting controls must provide multi-level lighting, having at least the number of control steps specified in TABLE 130.1-A
- Exception for small/tinted windows removed (the effective aperture calculation).

Plug Load Controls

Controlled and uncontrolled 120 volt receptacles **shall be provided in each private office, open office area, reception lobby, conference room, kitchenette in office spaces, and copy room** (130.5(d)) .
Controlled receptacles shall follow the automatic shut-off requirements for lighting (130.1(c)(1 through 5)).
At least one controlled receptacle shall be installed within 6 feet of each uncontrolled receptacle.
Controlled receptacles shall have a permanent marking to differentiate them from uncontrolled receptacles.

**The Future of Title 24**

The next round of revisions has begun…

There will be considerable focus on residential in the next round. No large-scale infrastructure changes to the nonresidential indoor sections in the next round anticipated.

# However, LEDs are taking over the lighting industry… what does that mean for T-24?

**(xvi)** With LEDs, lighting is becoming more efficient, so LPDs are anticipated to creep lower with viable LED products becoming cost effective.


- http://www.energy.ca.gov/title24
  - Energy Efficiency Standards
  - Compliance Manual
    - Hotline: 800-772-3300

**California Energy Commission**
**Energy Standards Hotline**

**(916) 654-5106**
**or toll free in California**
**(800) 772-3300**

**HOURS:**
**Monday through Friday**
**8 a.m. to 12 p.m. and 1 p.m. to 4:30 p.m.**

E-mail: title24@energy.state.ca.us