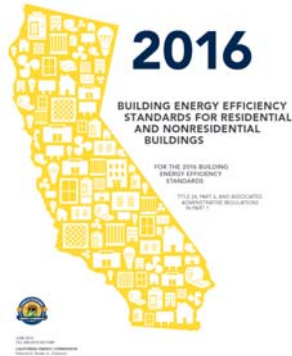


CA Title 24 Part 6 2016 Building Energy Efficiency Standards AIA WS201



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A pdf copy of the complete presentation is available at:
http://bit.ly/2016T24r1_Com

Revised: 9/15/2016

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Thank You!

Learning Objectives

1. Cover the Drivers for the Title 24 Energy Code
2. Review the Mandatory Lighting and Power Control requirements (§130.0 - .5)
3. Quickly overview changes in the Interior and Exterior Lighting Power section (§140.6 - .7)
4. Discuss significant changes in the Lighting Alteration/Addition Section (§141.0)
5. Review new Residential Lighting Requirements (§150.0(k))

3

Slide Formats

Title 24
Section Info

Changes from 2013
code are in red

§130.1(b): Multi-Level Controls

General Lighting Multi-level Controls

- If Area $\geq 100 \text{ ft}^2$ AND General Lighting $> 0.5 \text{ W/ft}^2$
 - Meet control step and uniformity criteria (T130.1-A)
 - Each dimming luminaire shall be controlled by at least one of following:
 - Manual control capable of dimming through all steps
 - Lumen maintenance
 - Tuning
 - Automatic daylighting controls, or
 - Demand responsive controls
- Exceptions
 - Classrooms with a connected general lighting load $\leq 0.7 \text{ W/ft}^2$ and public restrooms can have at least one step between 30-70% full rated power
 - Areas with a single 1- or 2-lamp luminaire
 - Areas required to be Full or Partial Off 130.1(c)(6) & 7

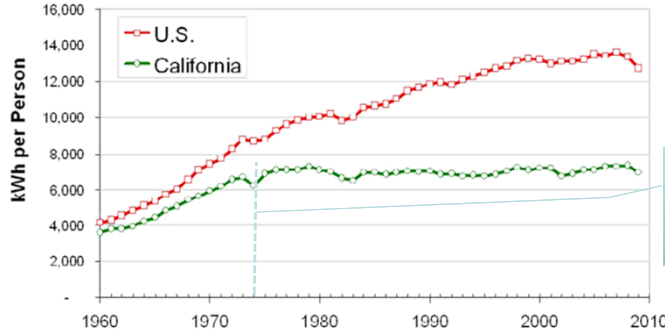
General Lighting is installed electric lighting that provides a uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect, exclusive of daylighting, and also known as ambient lighting.

42

4

2013 Title 24 (Part 6) Policy Objectives

California and US per Capita Electricity Consumption



Building & Appliance Standards have contributed to relatively flat per capita electricity consumption in California since 1974.
Source: US Energy Information Administration (EIA)

- 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 (GBSC)

8

Where is the Code?

- <http://www.energy.ca.gov/title24/2016standards/>

2016 Building Energy Efficiency Standards

California's Building Energy Efficiency Standards are updated on an approximately three-year cycle. The 2016 Standards will continue to improve upon the current 2013 Standards for new construction of new additions and alterations to residential and nonresidential buildings. The 2016 Standards will go into effect on January 1, 2017.

2016 Energy Standards

- 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings (03/16/2016) (PDF File 36 Pages 2.1 Mb)
- 2016 Reference Appendices (03/16/2016) (PDF File 36 Pages 33 Mb)

Compliance Manuals and Compliance Documents

- 2016 Residential Compliance Manual and Documents (03/16/2016) (PDF File 36 Pages 2.1 Mb)
- 2016 Nonresidential Compliance Manual and Documents (03/16/2016) (PDF File 36 Pages 33 Mb)

Worksheets

- Open and Closed Circuit Cooling Towers - Minimum Approach Cycle Calculator (03/16/2016)
- Solar Performance Index Calculator (SPI) (03/16/2016)
- Mechanical Worksheet (03/16/2016)
- 2016 Title 24 Solar Water Heating Calculator for Split-Unit System (03/16/2016)

Compliance Software & Alternative Calculation Methods

Approved Compliance Modeling Software

- 2016 Approved Computer Compliance Programs

ACM Manuals

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When?

- 2016 Building Energy Standards take effect January 1, 2017 for any site pulling a permit after that date.



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Overview of Sections

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

18



Review the definitions...

- “Shall” is mandatory, “May” is permissive
- Highlights:
 - “**Lighting**”
 - Includes definitions for all types
 - General, Permanently Installed, Portable
 - “**Lighting Controls**”
 - Occupancy Sensing Controls: Motion Detectors, Partial On, Partial Off, Vacancy
 - “**Nonresidential Function Areas**”
 - Classroom, Office, Parking Garage Building...
 - “**Outdoor Areas**”
 - Canopy, Hardscape...

“Self Contained” Control Devices to T20

- 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
- Part-Night Outdoor Lighting Controls
- Exception that users should not be able to convert manual-on to auto-on when required by code.

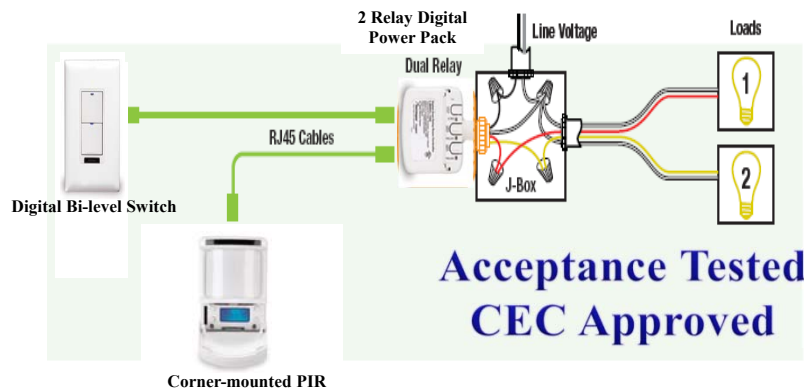
“Self Contained is a unitary lighting control module where no additional components are required for a fully functional lighting control.”



New! Occupant Sensing Controls shall turn OFF all or part of the lighting ≤ 20 minutes after vacancy (except for Hotel Rooms).

“Lighting Control System” in T24

“...a 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.”



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§130.0 (a-b): Mandatory Lighting Requirements – General

What buildings do codes apply to?

- Occupancy Group A, B, E, F, H, M, R, S, or U (§100.0)
 - Not Listed: I (Institutional) & L (Laboratories)
- Nonresidential, high-rise residential, motel/hotel, & outdoor lighting (§130.0 - §130.5)
- Dwelling space of High-rise residential units, Fire Stations, Dorms, Senior Housing and Hotel/Motel guest rooms follow §150.0(k)
 - Outdoor lighting permanently attached to a building, but separately controlled from the inside of a high-rise unit or guest room, must comply with Section 150.0(k)
 - Hotel/Motel guest rooms also follow 130.1(c)



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§130.0(c)1 Luminaire Classifications & Power

Luminaire Labeling

- Every luminaire shall have their max relamping 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 relamping wattage.
 - **Low-voltage ≤ 24 volts** (except track systems) with 50 watts maximum relamping wattage.
 - **Compact fluorescents** with an integral electronic ballast, with 42 watts maximum relamping wattage.

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§130.0(c)2 Mandatory Lighting Requirements - General

Line Voltage Luminaires

- §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

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§130.0(c)6 Mandatory Lighting Requirements - General

Ballasted Luminaires

- Wattage of luminaires with internal or remote ballasts **or drivers** is lamp/ballast combo via UL 1598
 - Per manufacture's literature or testing.
 - **Driver Input wattage per UL 8750 or LM-79**
 - ~~Replacement of lamps with linear lamps of another technology does not change the luminaire.~~

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§130.0(c)7 Mandatory Lighting Requirements - General

Line Track Luminaires

- 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.

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§130.0(c)8 Mandatory Lighting Requirements - General

Luminaires & Systems with Transformers

- 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

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§130.0(c)9 Mandatory Lighting Requirements - General

LED and LED Light Engines

- 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 **can be added** without re-wiring, use driver's max rated input wattage
- ~~Luminaires and luminaire housings equipped with screw-base sockets shall not be classified as a LED lighting system for compliance with Part 6.~~

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§130.0(c)10 – (d) Mandatory Lighting Requirements - General

Other

- 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.

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§130.1: Mandatory Indoor Lighting Controls

Mandatory Interior

- **§130.1(a) Area Controls**
 - Must have a manual switch or dimmer able to control lighting On or Off
- **§130.1(b) Multi-level lighting controls; General Lighting Only**
 - Spaces ≥ 100 ft² AND General Lighting > 0.5 W/ft² follow Table 130.1-A
 - Basically requires dimmable fixtures for Fluorescents and LEDs
- **§130.1(c) Shut Off Controls**
 - Turn Off Lights automatically via Time, Occupancy or other controls
 - No Countdown Timer Switches allowed except 2 applications
 - Some spaces require OS units
 - Some spaces require Partial On or Partial Off Occupancy Sensors
- **§130.1(d) Daylighting Controls; General Lighting Only**
 - Primary Sidelit, Secondary Sidelit, and Skylit Zone definitions
 - Automatically reduce when ≥ 120 W of General Lighting in a daylight zone
- **§130.1(e) Demand Response**
 - All buildings or projects $\geq 10,000$ ft² must be capable of reducing power from max by 15%

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§130.1(a)1-3: Area Controls

Area Controls

- All luminaries need manual On and Off Lighting Controls, and each area enclosed by ceiling height partition shall be independently controlled
 - Exception for .2 W/ft²
 - Must be designated a **means of egress** on plans
 - **Controls** only accessible to Authorized Personnel.
- Lighting Controls must be:
 - Readily accessible
 - Operated by a manual control in room
 - Malls **and atria**, Auditoriums, Retail Sales Areas, **Commercial and Industrial storage areas, general commercial and industrial work areas**, Conv/Arenas can be pilot lit
 - ~~If controlling dimmable fixtures, control must go to all mandated levels~~
 - 2 or more stall public restrooms, **stairwells and corridors, and parking areas** can use a device accessible to only Authorized Personnel
- Other devices may be installed as long the above functionality is not lost.



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§130.1(a)4: Area Controls

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.




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§130.1(b): Multi-Level Controls

General Lighting Multi-level Controls

- If Area $\geq 100 \text{ ft}^2$ AND General Lighting $> 0.5 \text{ W/ft}^2$
 - Meet control step and uniformity criteria (T130.1-A)
 - Each **dimming** luminaire shall be controlled by at least one of following:
 - Manual control capable of dimming through all steps
 - ~~Lumen maintenance,~~
 - ~~Tuning,~~
 - ~~Automatic daylighting controls, or~~
 - ~~Demand responsive controls~~
- Exceptions
 - Classrooms with a connected general lighting load $\leq 0.7 \text{ W/ft}^2$ and **public restrooms** can have at least one step between 30-70% full rated power
 - Areas with a single 1- or 2-lamp luminaire
 - **Areas required to be Full or Partial Off 130.1(c)6 & 7**






“General Lighting is installed electric lighting that provides a uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect, exclusive of daylighting, and also known as ambient lighting.”

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Table 130.1-A: Multi-Level Lighting Controls & Uniformity Reqs

General Lighting Multi-level Controls

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

Exemptions: Spaces $< 100 \text{ ft}^2$, or $\leq 0.5 \text{ W/ft}^2$
Classrooms $\leq 0.7 \text{ W/ft}^2$ & Restrooms 30-70% step OK
Spaces requiring Full and/or Partial Off - 130.1(c) 6-7
Space with just a 1- or 2-lamp fixture

Dimming = “Enabling Technology”

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§130.1(c)1: Shut-off Controls

Shut-off Requirements

- All interior lighting shall turn Off automatically when space typically unoccupied, by using:
 - Occupancy sensor,
 - Automatic time switch,
 - Other control device
- Separate Controls per floor (except Stairwells)
- Separate Controls per 5,000 ft²
 - 20,000 ft² for Malls, auditoriums, Single tenant Retail, Industrial, Convention, Arenas
- Separate Controls for General, Display, Ornamental, and Display Case lighting
- Exceptions:
 - 24/7 operational areas
 - Areas that require Occupancy Sensors, or Partial Off Sensors
 - 0.1 W/ft² (was .05 W/ft²) for means of egress areas in Office Buildings
 - Electrical Equipment Rooms - 110.26(d)
 - Illumination by emergency lighting equipment, powered by emergency power source or battery, that is ON only when normal power is absent.



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§130.1(c)2-4: Shut-off Controls

Countdown Timers and Time Clocks

- Countdown timer switches cannot be used as an Auto Off Device, except
 - Single Stall bathrooms or closets < 70 ft², 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.



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§130.1(c)5: Indoor Lighting Controls

Mandatory use of Sensors

- Occupant Sensing Controls must be installed in the following areas to shut off the lighting:
 - Offices ≤ 250 ft²
 - Multipurpose rooms ≤ 1000 ft²
 - Classrooms any size
 - Conference rooms any size
- When multilevel lighting is required per §130.1(b), OS must be:
 - Partial On of between 50-70% lighting power
 - Vacancy Sensor Mode
- When multilevel lighting IS NOT required per §130.1(b), OS must be:
 - Occupancy Sensor
 - Partial On Occupancy Sensor
 - Vacancy Sensor Mode
- Controls must allow the lights to be manually shut off in compliance with §130.1(a) regardless of the sensor's status



§110.9 Occupant Sensing Controls shall turn OFF all or part of the lighting ≤ 20 minutes after vacancy (except for Hotel Rooms).

§100.1: Definitions

“Partial On” & “Partial Off” Sensor Definitions

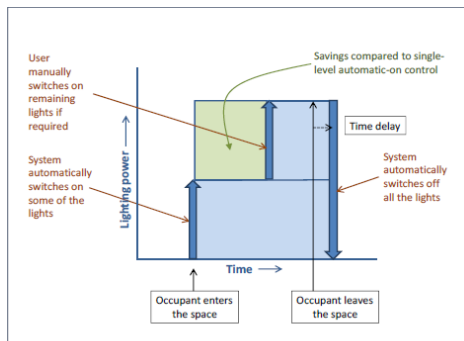


Figure 5-3 Functional Diagram for Partial-ON Occupant Sensor

Simple because Seq of Op the same
Normal Hours = 50% Auto On / Off
After Hours = 50% Auto On / Off

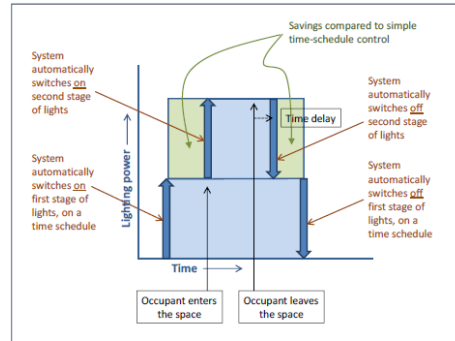





Figure 5-4 Functional Diagram for Partial-OFF Occupant Sensor

Not Simple because rules change
Normal Hours = Hi (100%) / Lo (50%)
After Hours = Hi (100%) / Off (0%)

§130.1(c)6: Indoor Lighting Controls



Full or Partial OFF Sensor WITH Auto Off

Space	Requirements
Warehouse Aisles & Open Areas 	<ul style="list-style-type: none"> • Sensor required for Hi/Lo $\geq 50\%$ during the day, turn off when vacant • If LPD $\leq 80\%$ area LPD, $\geq 40\%$ reduction • If metal halide, $\geq 40\%$ reduction
Library Stack Aisles one end ≥ 10 ft, and both ends ≥ 20 ft 	<ul style="list-style-type: none"> • Sensor required for Hi/Lo $\geq 50\%$ during the day, turn off when vacant • Independent zones for each aisle
Corridors & Stairwells 	<ul style="list-style-type: none"> • 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

Reminder: These spaces no longer have to meet Multilevel requirements.

§130.1(c)7: Indoor Lighting Controls

Partial OFF Sensor w/o Auto Off

Space	Requirements
Common Area Corridors in <ul style="list-style-type: none"> • Hotels/Motels • High rise Resi 	<ul style="list-style-type: none"> • Hi/Lo (at least 50%) during the day in each separate space and shall be automatically activated from all designed paths of egress. • If LPD is $\leq 80\%$ area method, $\geq 40\%$ reduction
Parking garages (Interior) Parking areas Loading and unloading areas 	<ul style="list-style-type: none"> • Reduce <i>general lighting watts</i> to 20-50% • One sensor per 500 Watts max. • Meet uniformity levels in 131-A • Control each separate space and shall be automatically activated from all designed paths of egress. • If HID efficacy > 75 lumens/W, 20 - 60%

Reminder: These spaces no longer have to meet Multilevel requirements.

§130.1(c)8: Indoor Lighting Controls

Guestrooms

- 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.



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§130.1(d): Daylit Areas

Daylighting Definitions

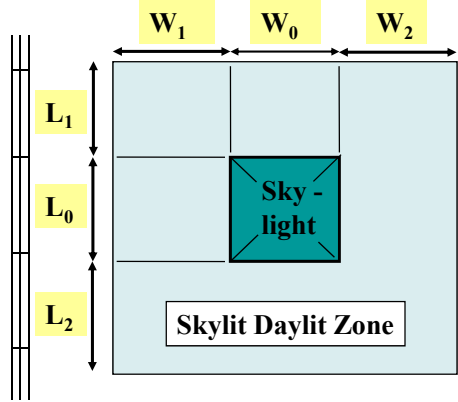
- Three different Daylight Zones
- DO NOT double count overlapping areas
 - Skylit Daylight Area
 - Primary Sidelit Daylight Area
 - Secondary Sidelit Daylight Area

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§130.1(d)IA: Daylit Areas

Skylit Area

- 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 permanent obstruction
 - Obstruction if > 50% floor to skylight bottom
- Floor shape matches skylight

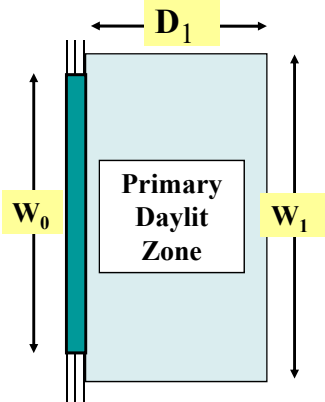
$$\text{Daylit area} = L \times W = (L_1 + L_0 + L_2) \times (W_1 + W_0 + W_2)$$

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§130.1(d)IB: Daylit Areas

Primary Sidelit Area

- Control luminaires in the Primary Sidelit area



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

- Distance to closest 60" high permanent obstruction*

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

- .5 x Window Head Height, or
- Distance to closest 60" high permanent obstruction

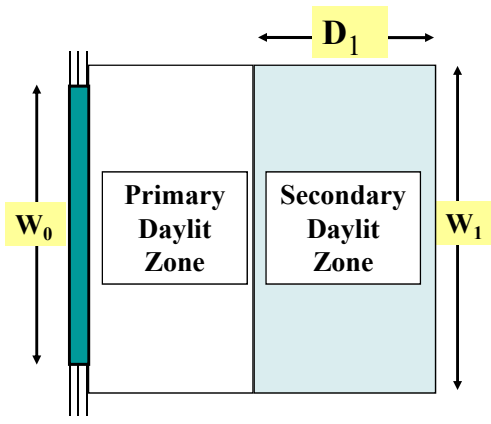
$$\text{Primary Sidelit area} = (D_1) \times (W_1)$$

* Per Code, Cubical Walls ARE NOT Permanent

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§130.1(d)1C: Daylit Areas

Secondary Sidelit Area



D_1 = **Window Head Height**, or

- Distance to closest 60" high permanent obstruction*

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

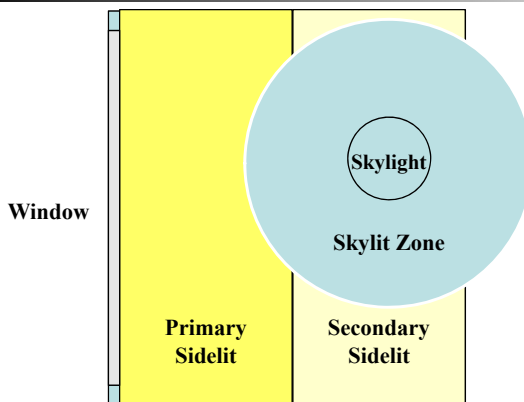
- .5 x Window Head Height or
- Distance to closest 60" high permanent obstruction

Secondary Sidelit area = (D_1) x (W_1)

* Per Code, Cubical Walls ARE NOT Permanent

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Daylight Zones



**The New Hierarchy:
Skylit beats Primary Sidelit, &
Skylit beats Secondary Sidelit**

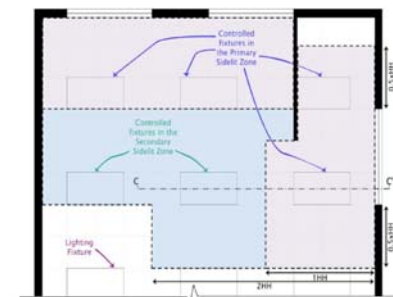


Figure 5-9 – Secondary Sidelit Daylit Zone Diagram 1

**What happened to
orientation requirement?**

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§130.1(d)2A-C: Daylight

Daylight Areas

- **General Lighting** luminaires totally or at least 50% 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 and Skylit areas separately.
 - **WARNING!!!** 140.6(d) requires control of **Secondary Sidelit fixtures for prescriptive method**

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§130.1(d)2D: Daylight

Automatic Daylighting Control Device

- **Exceptions**
 - Total General Lighting in **Skylit or Primary Sidelit zones < 120W**
 - When glazing in room is < 24 ft²
- 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/ft²
 - ~~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~~ **combined** 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

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§130.1(d)3: Daylight

Parking Garage Daylighting

- In Parking Garages with > 36 ft² of windows or openings, luminaires in **Primary & Secondary Sidelit** daylit zones shall be controlled independently from the rest of the lighting by automatic daylighting controls.
 - Show zones on plans
 - Ensure photosensors and calibrations are not accessible to unauthorized people (e.g. in locked case or require tool to open)
 - 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 >150% of controlled lighting **at the darkest point**, the general lighting in that zone shall be at 0% power



<http://www.everlastlight.com/>

i.e. DOES mandate full off

- Exception for transition luminaires, or when general lighting power in Primary Sidelit < **120W**

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§130.1(e): Indoor Lighting Controls

Demand Responsive Controls

- In buildings > 10,000 ft², Total Lighting Power shall be capable of being automatically reduced by a DR signal by at least 15%
 - Do not include spaces < 0.5W/ft² toward 10,000 ft² OR the Total Lighting Power
 - Lighting reduction shall be uniform per Table 130.1-A
 - ~~Non-habitable spaces don't count toward the 15%~~
 - Per Acceptance Test: Can't reduce below 50%
 - **Alterations Exempt** if ≤ 10,000 ft² in size
 - **Additions Exempt** if ≤ 10,000 ft² in size
- Exempt lighting not permitted to be reduced by health or life safety statute.
- DRC equipment shall be capable of receiving and automatically responding to at least one standards based messaging protocol.

"HABITABLE SPACE is space in a building for living, sleeping, eating or cooking. Bathrooms, toilets, hallways, storage areas, closets, or utility rooms and similar areas are not considered habitable spaces."



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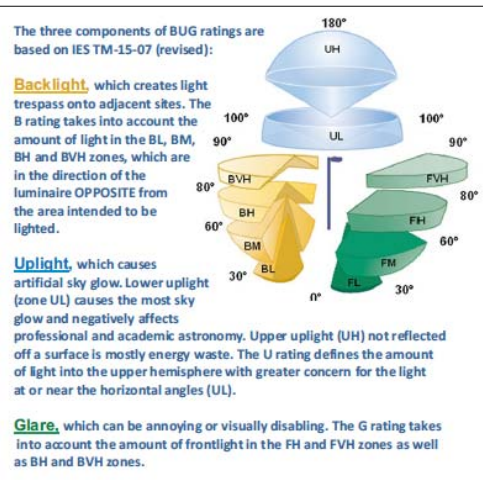
§ 130.2

Outdoor Lighting Fixtures & Controls

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

Exterior Lighting and Cutoff

- Outdoor incandescent luminaires > 100W controlled by a motion sensor
- Outdoor luminaires > 150W follow **Backlight, Uplight, & Glare (BUG)** requirements:
 - No Backlight (BL or BM) Requirements
 - Max zonal Uplight lumens: Table 130.2-A
 - Max zonal Glare lumens: Table 130.2-B
 - Note that T24 Part 11 §5.106.8 has additional BUG requirements.
 - **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.



From IDA-IES Model Lighting Ordinance

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

Revised Exterior Lighting and Cutoff

Uplight Ratings

TABLE 130.2-A Uplight Ratings (Maximum Zonal Lumens)

Secondary Solid Angle	Maximum Zonal Lumens per Outdoor Lighting Zone				
	LZO	OLZ 1	OLZ 2	OLZ 3	OLZ 4
Uplight High (UH) 100 to 180 degrees	0	10	50	500	1,000
Uplight Low (UL) 90 to <100 degrees	0	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				
	LZO	OLZ 1	OLZ 2	OLZ 3	OLZ 4
Forward Very High (FVH) 80 to 90 degrees	10	100	225	500	750
Backlight Very High (BVH) 80 to 90 degrees	10	100	225	500	750
Forward High (FH) 60 to <80 degrees	660	1,800	5,000	7,500	12,000
Backlight High (BH) 60 to <80 degrees	110	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				
	LZO	OLZ 1	OLZ 2	OLZ 3	OLZ 4
Forward Very High (FVH) 80 to 90 degrees	10	100	225	500	750
Backlight Very High (BVH) 80 to 90 degrees	10	100	225	500	750
Forward High (FH) 60 to <80 degrees	660	1,800	5,000	7,500	12,000
Backlight High (BH) 60 to <80 degrees	660	1,800	5,000	7,500	12,000

T24 Part 11 Calgreen §5.106.8

CAL Green Exterior Light Pollution

- Cal Green has additional Light Pollution Reqs:
 - Follow **Table 5.106.8** or local ordinance (if more stringent)
 - Exceptions:
 - Luminaires excepted in T24 §140.7
 - Emergency lighting
 - Building facade lighting
 - Custom lighting features per §101.8 (Alt. materials, designs & const.)

TABLE 5.106.8 (N) MAXIMUM ALLOWABLE BACKLIGHT, UPLIGHT AND GLARE (BUG) RATINGS^{1,2}

ALLOWABLE RATING	LIGHTING ZONE 1	LIGHTING ZONE 2	LIGHTING ZONE 3	LIGHTING ZONE 4
Maximum Allowable Backlight Rating³				
Luminaire greater than 2 mounting heights (MH) from property line	No Limit	No Limit	No Limit	No Limit
Luminaire back hemisphere is 1 – 2 MH from property line	B2	B3	B4	B4
Luminaire back hemisphere is 0.5 – 1 MH from property line	B1	B2	B3	B3
Luminaire back hemisphere is less than 0.5 MH from property line	B0	B0	B1	B2
Maximum Allowable Uplight Rating				
For area lighting ⁴	U0	U0	U0	U0
For all other outdoor lighting, including decorative luminaires	U1	U2	U3	U4
Maximum Allowable Glare Rating⁵				
Luminaire greater than 2 MH from property line	G1	G2	G3	G4
Luminaire front hemisphere is 1 – 2 MH from property line	G0	G1	G1	G2
Luminaire front hemisphere is 0.5 – 1 MH from property line	G0	G0	G1	G1
Luminaire back hemisphere is less than 0.5 MH from property line	G0	G0	G0	G1

1. IESNA Lighting Zones 0 and 5 are not applicable; refer to Lighting Zones as defined in the California Energy Code and Chapter 10 of the California Administrative Code.
 2. For property lines that abut public walkways, bikeways, plazas and parking lots, the property line may be considered to be 5 feet beyond the actual property line for purpose of determining compliance with this section. For property lines that abut public roadways and public transit corridors, the property line may be considered to be the centerline of the public roadway or public transit corridor for the purpose of determining compliance with this section.
 3. If the nearest property line is less than or equal to two mounting heights from the back hemisphere of the luminaire distribution, the applicable reduced Backlight rating shall be met.
 4. General lighting luminaires in areas such as outdoor parking, sales or storage lots shall meet these reduced ratings. Decorative luminaires located in these areas shall meet U-value limits for "all other outdoor lighting."
 5. If the nearest property line is less than or equal to two mounting heights from the front hemisphere of the luminaire distribution, the applicable reduced Glare rating shall be met.

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

Outdoor Controls

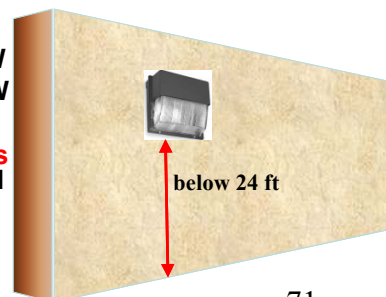
- All installed outdoor lighting shall:
 - Have Auto-OFF by a photo control, astronomical time switch, **or other control when daylight is available.**
 - ~~Circuited and~~ Controlled to turn off independently from other electrical loads by an automatic scheduling control.
- Exceptions:
 - Lights that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

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§130.2(c)3: Outdoor Lighting Controls

Controls for Outdoor Lighting

- Outdoor luminaires with bottoms $\leq 24'$ 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
 - Pole mtd luminaires w/max power $\leq 75W$
 - Non-pole luminaires w/max power $\leq 30W$
 - Linear lighting with max $\leq 4W/ft$
 - **4 (was 6) specific lighting applications allow a "Part Night" device to be used**
 - Exterior Lighting exempted in §140.7(a)



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§130.2(c)4: Outdoor Lighting Controls

#1 Ext. Sales Frontage, ~~Lots & Canopies~~

- Install automatic lighting controls to meet:
 - Motion sensors capable of automatically reducing lighting power by at 40-90%, and which have auto-on functionality, or
 - A distributed “part-night” device.

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

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§130.2(c)5: Outdoor Lighting Controls

#2-4 Façade, Ornamental Hardscape & Dining

- Install automatic lighting controls that meet the following:
 - Motion sensors capable of automatically reducing lighting power by at least 40-90%, and which have auto-on functionality, or
 - A centralized time-based zone switching capable of automatically reducing lighting power by at least 50%, or
 - A distributed “part-night” device, or
- Does not include Wall Packs

Ornamental Exterior Lighting is: Luminaires installed outdoor which are rated for ≤ 100 W that are post-top luminaires, lanterns, pendant luminaires, chandeliers, and marquee lighting.

Hardscape is defined as: the area of an improvement to a site that is paved or has other structural features such as curbs, plazas, entries, parking lots, site roadways, driveways, walkways, sidewalks, bikeways, water features and pools, storage or service yards, loading docks, amphitheaters, outdoor sales lots, and private monuments and statuary.

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§130.2(c)3: Outdoor Lighting Controls

Exterior Lighting Exempted in §140.7(a)

When more than 50 percent of the light from a luminaire falls within one or more of the following applications

1. Temporary outdoor lighting.
2. FAA and Coast Guard required and regulated lighting.
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, ie: rail yards, maritime shipyards and docks, piers and marinas, chemical and petroleum processing plants, and aviation facilities.
6. Lighting specifically for ATMs.
7. Lighting of signs complying with the requirements of Sections 130.3 and 140.8.
8. **ADA Lighting of tunnels, bridges, stairs, wheelchair elevator lifts, and ramps that are other than parking garage ramps.**
9. **Landscape lighting.**
10. In theme parks: outdoor lighting only for themes and special effects.
11. Lighting for outdoor theatrical and other outdoor live performances (provided there is other Area Lighting, and it's controlled by a theatrical system).
12. Some Outdoor lighting systems for qualified historic buildings, if they consist solely of historic lighting components or replicas of historic lighting components. Other lighting components are not exempt.

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§130.4: Lighting Control Acceptance

Acceptance and Certificate Requirements

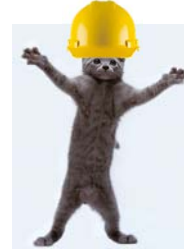
- Mandates certification of lighting controls before occupancy permit granted. Compliance with Part 6 requirements for plans, specifications, installation certificates, operating and maintenance info
- Applicable Procedures for Acceptance testing performed by CLCATT on:
 - Automatic daylighting controls: §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
- Installation Certificate by someone by Div 3. (C-10, Architect, GC) 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
- The acceptance testing shall be performed by a Certified Lighting Controls Acceptance Test Technician (CLCATT).

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§10-103.1: Lighting Control Acceptance Test Technician

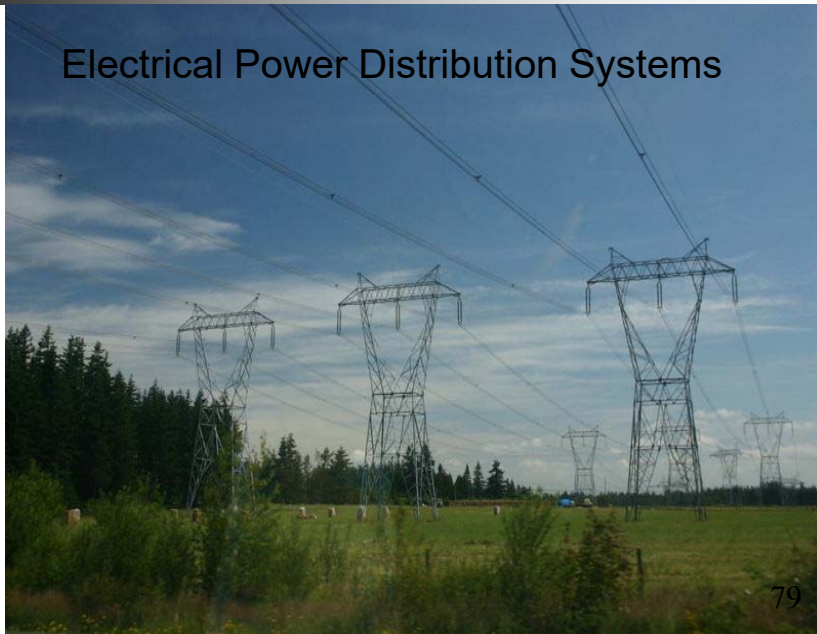
CLCATT = "Cool Cat"

- 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



§130.5(a): Electrical Distribution Systems

Electrical Distribution Systems

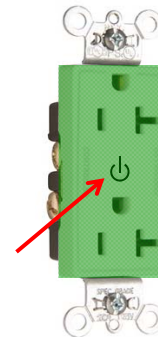
- **§130.5(a) Metering**
 - Each electrical service or feeder shall have a permanently installed metering system which measures of electrical energy use in accordance with TABLE 130.5-A.
 - EXCEPTION: When utility provides a metering system that indicates instantaneous kW demand and kWh for a utility-defined period
 - Specific info about recording intervals and length of history, and separate tenant spaces deleted
- **§130.5(b) Disaggregation Separation of Electrical Circuits**
 - Shall be designed so that measurement devices can monitor the electrical energy usage of load types according to TABLE 130.5-B
 - For each separate load type, up to 10 percent of the connected load may be of any type.
 - Exception if utility provides meter for occupant use with resettable kW & kWh
 - Alteration exemption when specific existing equipment remains in place.
- **§130.5(c) Voltage Drop**
 - Maximum combined voltage drop for feeders and branch circuits to the farthest connected load or outlet, shall not exceed 5%.
 - EXCEPTION: Voltage drop permitted by California Electrical Code Sections 647.4, 695.6 and 695.7
 - EXCEPTION for Emergency Circuits
- **§130.5(d) Plug Load Control**
- **§130.5(e) Demand Response**
 - All DRC hardware, where installed, to be enabled to receive and act upon demand response signals
- ~~§130.5(f) EMCS~~
 - Sets rules from when EMCS can be used

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§130.5(d): Plug Loads

Controlled Receptacles

- Provide Controlled Receptacles (CR) and UnControlled Receptacles (UCR) in the following spaces:
 - Occ. Sensor Only**
 - Private offices
 - Conference rooms
 - Occ. Sensor or Time Clock**
 - Open Office Spaces
 - Reception Lobbies
 - Copy rooms
 - Kitchenettes (in office spaces)
- Install automatic shut-off controls so when space is shut off when unoccupied at the receptacle or receptacle circuit
 - per Lighting §130.1(e)1-5 (note Mandatory OS locations);
 - If a Time Switch, must have a max 2 hr After Hour Time Delay
 - Can't use Countdown Timer Switches
- Rules
 - At least one CR within 6' foot from each UCR, or a split wired duplex receptacle
 - Where receptacles are installed in modular furniture in open office areas, at least one controlled receptacle shall be installed at each workstation
 - CR shall have a permanent and durable marking to differentiate them from UCR
 - In Open Offices, controlled circuits shall be installed to support office furniture with future CRs.



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§130.5(d): Plug Loads

Controlled Receptacles

- In Hotel and motel guest rooms, at least 50% of receptacles shall be controlled off via sensors, captive card key controls or automatic controls so they are off within 30 minutes of vacancy
- NOTE: A hardwired power strip controlled by an occupant sensing control may be used.
 - Deleted language about permanently installed OS
 - Plug-in strips and other plug-in devices shall not be used to comply with the requirements of this Section.
- Exceptions for fridges, water dispensers, clocks, copy room machinery, above 20Amp, and marked receptacles connected to a 24/7 UPS.



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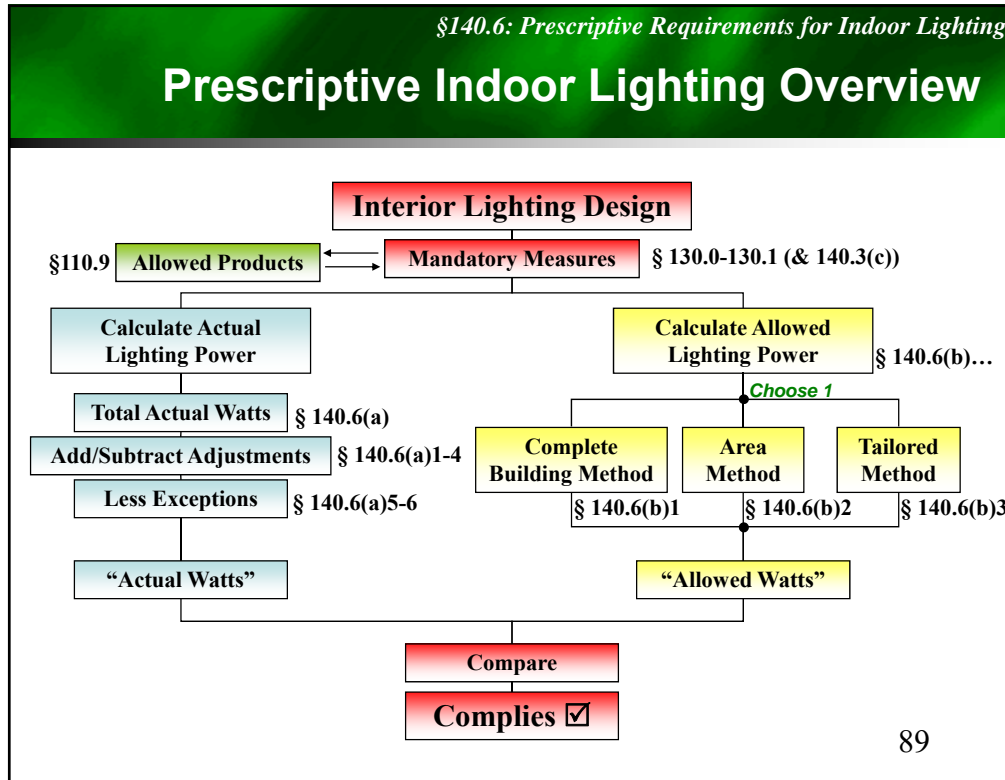
§140.3(c): Minimum Daylighting

Large Spaces

- Conditioned or Unconditioned spaces $\geq 5,000 \text{ ft}^2$ (was 8,000 ft^2) directly under roof, with ceilings $> 15 \text{ ft}$ need $\geq 75\%$ (was 50%) of floor area (plan view) in Primary Sidelit, and/or $0.7 \times$ ceiling height from Skylights
 - Skylight to skylit area ratio $\geq 3.3\%$, or Min Eff. Aperture $\geq 1.1\%$
 - Primary sidelit daylit areas Eff. Aperture $\geq 10\%$
- 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 General Lighting LPD $< .5 \text{ W/ft}^2$
 - Spaces where permanent Architectural features, structures or natural objects block direct sunlight on $\frac{1}{2}$ the roof more than 1500 hrs per year between 8am – 4pm.
- The total skylight area is at least 3% of the total floor area in the space within a horizontal distance of $0.7 \times$ the average ceiling height from the edge of rough opening of skylights; or the product of the total skylight area and the average skylight visible transmittance is no less than 1.5 % of the total floor area in the space within a horizontal distance of $0.7 \times$ the average ceiling height from the edge of rough opening of skylights

Applications: Warehouses & most Retail

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- §140.6(a): Prescriptive Requirements for Indoor Lighting*
- ## Actual Lighting Power Density (LPD)
- Actual must be less than Allowed
 - Include Permanent and Portable Lighting
 - Exception: Up to **0.3 watts/ft²** 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
- 90

§140.6(a)1: Prescriptive Requirements for Indoor Lighting

Interlocked 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

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



Reduction of Wattage through Controls

- Controlled watts of permanently installed general lighting may be reduced by watts x PAF Table 140.6-A
- 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 Table 140.6-A
 - Rules for PAFs for furniture mounted luminaires (installed, indirect lighting, etc.)
 - ~~Partial On (was Multilevel) Sensors and Dimming Systems are gone~~
 - New Daylight Dimming with OFF, and institutional Tuning PAFs






Table 140.6-A: Lighting Power Adjustment Factors

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			
b. Only one PAF may be used for each qualifying luminaire unless combined below.			
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 \leq 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, conference or waiting room.	0.20
1. Daylight Dimming plus OFF Control		Luminaires in skylit daylight zone or primary sidelit daylight zone	0.10
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
			From 126 to 250 square feet
			From 251 to 500 square feet
3. Dimming System	Manual Dimming	Hotels/motels, restaurants, auditoriums, theaters	0.10
	Multiscene Programmable		0.20
3. Institutional Tuning		Luminaires in non-daylit areas; Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.	0.10
		Luminaires in daylight areas; Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.	0.05
4. Demand Responsive Control		All building types less than 10,000 square feet. 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 \leq 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, conference or waiting room	0.25

§140.6(c)1 : Prescriptive Requirements for Indoor Lighting

Calc Allowed Indoor Lighting Power Density

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

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Table 146-E

Complete Bldg. – Lighting Power Density

TABLE 140.6-B COMPLETE BUILDING METHOD LIGHTING POWER DENSITY VALUES

TYPE OF BUILDING	ALLOWED LIGHTING POWER DENSITY (WATTS PER SQUARE FOOT)
Auditorium Building	1.51.4
Classroom Building	1.1
Commercial and Industrial Storage Building	0.60
Convention Center Building	1.21.0
Financial Institution Building	1.11.0
General Commercial Building/Industrial Work Building	1.00
Grocery Store Building	1.50
Library Building	1.31.2
Medical Building/Clinic Building	1.11.0
Office Building	0.80
Parking Garage Building	0.20
Religious Facility Building	1.61.5
Restaurant Building	1.21.1
School Building	1.00.95
Theater Building	1.3
All others buildings	0.60.50

§140.6(c)2 : Prescriptive Requirements for Indoor Lighting

Calc Allowed Indoor Lighting Power Density

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/ft² 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

Table 140.6-C

Area Method – Lighting Power Density

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

PRIMARY FUNCTION AREA	ALLOWED LIGHTING POWER DENSITY (W/ft ²)	PRIMARY FUNCTION AREA	ALLOWED LIGHTING POWER DENSITY (W/ft ²)
Auditorium Area	4-51.40 ¹	Reading areas	4-21.1 ¹
Auto Repair Area	0.90 ²	Stack areas	1.5 ³
Beauty Salon Area	1.7	Hotel lobby	4-40.00 ¹
Civic Meeting Place Area	1.3 ³	Main entry lobby	4-40.00 ¹
Classroom, Lecture, Training, Vocational Areas	1.2 ³	Locker/Dressing Room	4-40.00
Commercial and Industrial Storage Areas (conditioned and unconditioned)	0.60	Lounge Area	1-10.00 ³
Commercial and Industrial Storage Areas (refrigerated)	0.7	Malls and Atrium	4-30.00 ¹
Convention, Conference, Multipurpose and Meeting Center Areas	4-41.1 ³	Medical and Clinical Care Area	1.2
Corridor, Restroom, Stair, and Support Areas	0.60	Office Area	≥ 250 square feet 0.75 ≤ 250 square feet 1.0
Dining Area	4-41.0 ¹	Parking Area**	0.14
Electrical, Mechanical, Telephone Rooms	0.20-0.55 ²	Parking Garage Area	Dedicated Ramps 0.50 Daylight Adaptation Zones [†] 0.60
Exercise Center, Gymnasium Areas	1.0	Religious Worship Area	1.5 ³
Exhibit, Museum Areas	2-01.8	Retail Merchandise Sales, Wholesale Showroom Areas	1.2 +max ¹
Financial Transaction Area	4-21.0 ³	Theater Area	Motion picture 0.90 ³ Performance 1.4 ³
General Commercial and Industrial Work Areas	Low bay 0.9 ² High bay 1.0 ³ Precision 1.2 ⁴	Transportation-Function Area	Concourse & Baggage 0.50 Ticketing 1.0
Grocery Sales Area	1.2 +max ¹	Videoconferencing Studio	1.2 ³
Hotel-Function Areas	1.5 ³	Waiting Area	4-40.00 ¹
Hotel Function Area	1.4 ³	All other areas	4-40.00
Kitchen, Food Preparation Areas	4-61.2		
Laboratory Area, Scientific	1.4 ³		
Laundry Area	4-40.00		

Footnotes for this table are listed below.
FOOTNOTES FOR TABLE 140.6-C:

Table 140.6-C Footnotes

Area Method – Lighting Power Density

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 density (W/ft ² of task area unless otherwise noted)
1	Specialized task work	0.20 W/ft ²
2	Specialized task work	0.50 W/ft ²
3	Ornamental lighting as defined in Section 100.1 and in accordance with Section 140.6(c)2.	0.50 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	0.30 W/ft ²
7	Decorative lighting - primary function shall be decorative and shall be in addition to general illumination.	0.20 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	
10	Additional allowance for ATM locations in Parking Garages. Allowance per ATM.	200 watts for first ATM location. 50 watt for each additional ATM location in a group.
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	

§140.6(c)3 : Prescriptive Requirements for Indoor Lighting

Calc Allowed Indoor Lighting Power Density

Choose between 3 methods

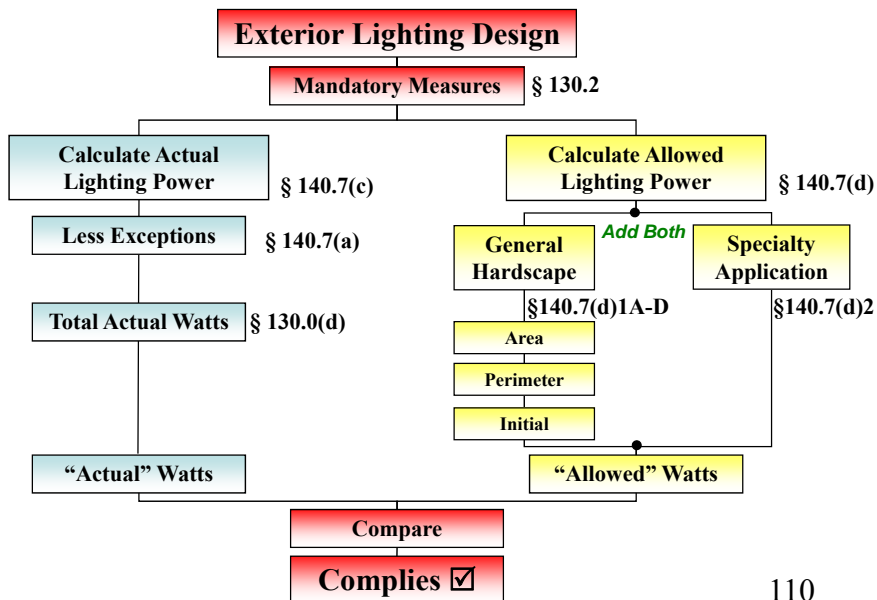
3) Tailored Method

- Based on Lux
- 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

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§140.7: Prescriptive Requirements for Outdoor Lighting

Prescriptive Outdoor Lighting Overview



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§140.7: Requirements for Outdoor Lighting

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, **tunnels**, stairs, some ramps, landscape lighting, some historic lighting elements, etc...

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§140.7(d): Requirements for Outdoor Lighting

Allowed Lighting Power

- **Allowed Lighting is total of:**
 - **General Hardscape Lighting** includes: parking lots, roadways, sidewalks, walkways, bikeways, plazas, **bridges, tunnels**
 - **Specific Applications** includes items from Table 147-B
 - Building Entrance/Exit, Drive-up window, etc...

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§10-114-A: Outdoor Lighting Zones

Determination of Outdoor Lighting Zones

Zone	Ambient Illumination	State wide Default Location	Moving Up to Higher Zone	Moving Down to Lower Zones
LZ0	Very Low	Undeveloped areas of government designated parks, recreation areas, and wildlife preserves	Undeveloped areas of government designated parks, recreation areas, and wildlife preserves can be designated as LZ1 or LZ2 if they are contained within such a zone.	Not applicable
LZ1	Low	Developed portion of government designated parks, recreation areas, and wildlife preserves. Those that are wholly contained within a higher lighting zone may be considered by the local government as part of that lighting zone.	Developed portion of a government designated park, recreation area, or wildlife preserve, can be designated as LZ2 or LZ3 if they are contained within such a zone.	Not applicable.
LZ2	Moderate	Rural areas, as defined by the 2010 U.S. Census.	Special districts within a default LZ2 zone may be designated as LZ3 or LZ4 by a local jurisdiction. Examples include special commercial districts or areas with special security considerations located within a rural area.	Special districts and government designated parks within a default LZ2 zone may be designated as LZ1 by the local jurisdiction for lower illumination standards, without any size limits.
LZ3	Moderately High	Urban areas, as defined by the 2010 U.S. Census.	Special districts within a default LZ3 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 within a default LZ3 zone may be designated as LZ1 or LZ2 by the local jurisdiction, without any size limits.
LZ4	High	None	Not applicable.	Not applicable.

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§140.7(d): Requirements for Outdoor Lighting

Table Only Changes

General Hardscape is a Total of:

- **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 0	Lighting Zone 1	Lighting Zone 2 ¹	Lighting Zone 3 ²	Lighting Zone 4
Area Wattage Allowance (AWA)		0.0350_020 W/ft ²	0.0450_030 W/ft ²	0.0900_040 W/ft ²	0.1150_050 W/ft ²
Linear Wattage Allowance (LWA)	No allowance ¹	0.250_15 W/lf	0.450_25 W/lf	0.600_35 W/lf	0.850_45 W/lf
Initial Wattage Allowance (IWA)		340 W	510_450 W	770_520 W	1030_640 W

¹Continuous lighting is explicitly prohibited in Lighting Zone 0. A single luminaire of 15 Watts or less may be installed at an entrance to a parking area, trail head, fee payment kiosk, outhouse, or toilet facility, as required to provide safe navigation of the site infrastructure. Luminaires installed in Lighting Zone 0 shall meet the maximum zonal lumen limits for Uplight and Glare specified in Table 130.2-A and 130.2-B.

²For Lighting Zone 2 and 3, where greater than 50% of the paved surface of a parking lot is finished with concrete, the AWA for that area shall be 0.035 W/ft² for Lighting Zone 2 and 0.040 W/ft² for Lighting Zone 3, and the LWA for both lighting zones shall be 0.70 W/lf. This does not extend beyond the parking lot, and does not include any other General Hardscape areas.

Table Only Changes §147(c)2A-D: Allowed Application Specific Outdoor Lighting Power

Specific Application – “Use it or Lose it”

- 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 0	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.	Not applicable	40-15 watts	60-25 watts	90-15 watts	90-45 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.	Not applicable	45 watts	80 watts	120 watts	170 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.	Not applicable	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.	Not applicable	120 watts	175 watts	185 watts	330 watts
ATM Machine Lighting. Allowance per ATM machine. Luminaires qualifying for this allowance shall be within 30 feet of the dispenser.	Not applicable	250 watts for first ATM machine, 70 watts for each additional ATM machine.			
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.	Not applicable	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					

Completely Re-written §141.0(a)

Additions

- Additions shall use either Prescriptive or Performance Approach
 - **Prescriptive Approach.** The envelope and **lighting of the addition**; any newly installed space-conditioning system, electrical power distribution system, or water-heating system; any addition to an outdoor lighting system; and any new sign shall meet the applicable requirements of **§110.0 - 130.5** and **§140.2 - 140.9**.
 - **Performance Approach.**
 - The envelope and **indoor lighting** in the conditioned space of the addition, and any newly installed space-conditioning system, electrical power distribution system, or water-heating system, shall meet the applicable requirements of **§110.0 -130.5**; and either below shall comply with **§140.1**:
 - The addition; or
 - Existing plus addition plus alteration

§141.0(b)



Alterations

- **Alterations** to existing nonresidential, high-rise residential, or hotel/motel buildings, relocatable public school buildings or alterations in conjunction with a change in building occupancy to a nonresidential, high-rise residential, or hotel/motel occupancy shall meet item **Mandatory Insulation Requirements** for Roofs, Walls and Floors, and either the **Prescriptive** or **Performance Approach**
 - **Prescriptive Approach.**
The altered components of the envelope, or space conditioning, **lighting**, electrical power distribution and water heating systems, and any newly installed equipment serving the alteration, shall meet **the applicable requirements** of §110.0 - 110.9, §120.0 -120.6, and §120.9 -130.5


Per §141.0(f) Spaces with lighting systems installed **for the first time** shall meet the requirements of §110.9, 130.0, 130.1, 130.2, 130.4, 140.3(c), 140.6, and 140.7

Per §141.0(g) When **adding skylights** to an existing building and the lighting system is not re-circuited, the daylighting control need not meet the multi-level requirements in §130.1(d)
 - **Performance Approach.**
The altered envelope, space-conditioning system, **lighting** and water heating components, and any newly installed equipment serving the alteration, shall meet the applicable requirements of §110.0 - 110.9, §120.0 - 120.6, and §120.9 - 130.5

Remember:
 130.0 = Power Calculations 130.4 = Acceptance Testing
 130.1 = Interior Requirements 130.1(d) = Daylighting
 130.2 = Exterior Requirements

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§141.0(b)21



Entire Luminaire Alterations

- **Tenant Improvement**
 - For each enclosed space, alterations that consist of either
 - (a) removing and reinstalling a total of 10 percent or more of the existing luminaires; or
 - (b) replacing or adding entire luminaires; or
 - (c) adding, removing, or replacing walls or ceilings along with any redesign of the lighting system, shall meet the lighting power allowance in §140.6, and the altered luminaires shall meet the applicable requirements in Table 141.0-E; or
- **Luminaire Replacement (Modification-in-Place)**
 - For alterations where existing luminaires are replaced with new luminaires, and that do not include adding, removing, or replacing walls or ceilings along with redesign of the lighting system, the replacement luminaires in each **office, retail, and hotel occupancy shall have at least 50 percent**, and in all other occupancies **at least 35 percent**, lower rated power at full light output compared to the existing luminaires being replaced, and shall meet the requirements of §130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B
- **EXCEPTIONS**
 - **Alteration of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded as specified in Section 140.6(a)3.**
 - **In an enclosed space where two or fewer luminaires are replaced or reinstalled.**
 - **Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.**
 - **Acceptance testing requirements of Section 130.4 are not required for alterations where lighting controls are added to control 20 or fewer luminaires.**

130.1(a)1-3 = Area Device (not separate) 130.1(c)1A-C = Auto Shut Off (not separate) 130.1(c)2 = No Countdown Timers 130.1(c)3 & 4 = Timeclock specifics	130.1(c)5 = Mandatory OS 130.1(c)6A = Full/Partial Off OS (Warehouse) 130.1(c)7B = Partial Off OS (Garage) *Note this was 40 previously
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Table §141.0-E

Completely Re-written

Entire Luminaire Alterations

TABLE 141.0-E CONTROL REQUIREMENTS FOR ENTIRE LUMINAIRE ALTERATIONS

Control requirements that shall be met when 10% or more of existing luminaires in an enclosed space are altered	Resulting lighting power, compared to the lighting power allowance specified in Section 140.6(c)2, Area Category Method	
	Lighting power is ≤ 85% of allowance	Lighting power is > 85% to 100% of allowance
Section 130.1(a)1, 2, and 3 Area Controls	Yes	Yes
Section 130.1(b) Multi-Level Lighting Controls – only for alterations to general lighting of enclosed spaces 100 square feet or larger with a connected lighting load that exceeds 0.5 watts per square foot	For each enclosed space, minimum one step between 30-70 percent of lighting power regardless of luminaire type, or meet Section 130.1(b)	Yes
Section 130.1(c) Shut-Off Controls	Yes	Yes
Section 130.1(d) Automatic Daylight Controls	Not Required	Yes
Section 130.1(e) Demand Responsive Controls – only for alterations > 10,000 ft ² in a single building, where the alteration also changes the area of the space, or changes the occupancy type of the space, or increases the lighting power	Not Required	Yes

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Clarification from the CEC

From: [REDACTED] <[REDACTED]@energy.ca.gov>
Sent: Monday, May 16, 2016 2:22:02 PM
To: Charles A Knuffke
Subject: RE: Alterations Examples

Hello Charles,

I can bring an update about Exemption 2 to Section 141.0(b)2I.


Following is to clarify Exemption 2.

Exception 2 is not a complete exception for alterations where there is more than one space with lighting alterations; Exception 2 is specified for small alterations where there are only two or fewer luminaires being replaced or reinstalled for the entire project scope.

I will look into your emailed question from today.

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§141.0(b)2J



Luminaire Component Modifications


Luminaire Upgrade

- Luminaire component modifications in place that include replacing the ballasts or drivers and the associated lamps in the luminaire, permanently changing the light source of the luminaire, or changing the optical system of the luminaire, where 70* or more existing luminaires are modified either on any single floor of a building or, where multiple tenants inhabit the same floor, in any single tenant space, in any single year, shall not prevent or disable the operation of any multi-level, shut-off, or daylighting controls, and shall:
 - i. Meet the lighting power allowance in §140.6 and comply with Table 141.0-E; or
 - ii. **In office, retail, and hotel occupancies have at least 50 percent**, and in all other occupancies have at least 35 percent, lower rated power at full light output as compared to the original luminaires prior to being modified, and meet the requirements of §130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B.
- **Lamp replacements alone and ballast replacements alone** shall not be considered a modification of the luminaire provided that the replacement lamps or ballasts are installed and powered without modifying the luminaire.
- EXCEPTIONS
 - **Modification of portable luminaires, luminaires affixed to** moveable partitions, or lighting excluded by Section 140.6(a)3.
 - **In an enclosed space where two or fewer luminaires** are modified.
 - **Modifications that would directly cause the disturbance of asbestos**, unless the modifications are made in conjunction with asbestos abatement.
 - **Acceptance testing requirements of §130.4 are not** required for modifications where lighting controls are added to control 20 or fewer luminaires.

130.1(a)1-3 = Area Device (not separate)	130.1(c)5 = Mandatory OS
130.1(c)1A-C = Auto Shut Off (not separate)	130.1(c)6A = Full/Partial Off OS (Warehouse)
130.1(c)2 = No Countdown Timers	130.1(c)7B = Partial Off OS (Garage)
130.1(c)3 & 4 = Timeclock specifics	*Note this was 40 previously

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§141.0(b)2K



Lighting Wiring Alterations

- For each enclosed space, wiring alterations that add a circuit feeding luminaires; that replace, modify, or relocate wiring between a switch or panelboard and luminaires; or that replace lighting control panels, panelboards, or branch circuit wiring; shall:
 - i. meet the lighting power allowance in §140.6;
 - ii. meet the requirements in §130.1(a)1, 2, and 3, 130.1(c)1A - C, 130.1(c)3, and 130.1(c)4;
 - iii. for each enclosed space, be wired to create a minimum of one step between 30-70 percent of lighting power or meet Section 130.1(b); and for each enclosed space where wiring alterations include 10 or more luminaires that provide general lighting within the primary sidelit daylight zone or the skylit daylight zone, meet the requirements of 130.1(d)
- NOTE: As specified in Section 141.0(b)2I, alterations that include adding, removing, or replacing walls or ceilings resulting in redesign of the lighting system shall meet the requirements of Table 141.0-E.
- EXCEPTIONS
 - Alterations strictly limited to addition of lighting controls.
 - **In an enclosed space where wiring alterations** involve two or fewer luminaires.
 - Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.
 - Acceptance testing requirements of §130.4 are not required for wiring alterations where lighting controls are added to control 20 or fewer luminaires.

130.1(a) = Area Device	130.1(c)3 & 4 = Timeclock specifics
130.1(c)1 = Automatic Shut Off	

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§141.0(b)2L

Completely Re-written

Outdoor Lighting Alterations

- Alterations to existing outdoor lighting systems in a lighting application listed in TABLE 140.7-A or 140.7-B shall meet the applicable requirements of §130.0, 130.2(a), 130.2(b), and 130.4, and:
 - i. In alterations that increase the connected lighting load, the added or altered luminaires shall meet the applicable requirements of Section 130.2(c) and the requirements of Section 140.7 for general hardscape lighting or for the specific lighting applications containing the alterations; and
 - ii. In alterations that do not increase the connected lighting load, **where the greater of 5 luminaires or 10 percent of the existing luminaires are replaced** in a general hardscape or a specific lighting application, the alterations shall meet the following requirements:
 - a. In parking lots and outdoor sales lots where the bottom of the luminaire is mounted 24 feet or less above the ground, the replacement luminaires shall comply with Section 130.2(c)1 AND Section 130.2(c)3;
 - b. For all other lighting applications and where the bottom of the luminaire is mounted greater than 24 feet above the ground, the replacement luminaires shall comply with Section 130.2(c)1 AND EITHER comply with Section 130.2(c)2 or be controlled by lighting control systems, including motion sensors, that automatically reduces lighting power by at least 40 percent in response to the area being vacated of occupants; and
 - iii. In alterations that do not increase the connected lighting load, **where the greater of 5 luminaires or 50 percent of the existing luminaires are replaced** in general hardscape or a specific application, the replacement luminaires shall meet the requirements of subsection ii above and the requirements of Section 140.7 for general hardscape lighting or specific lighting applications containing the alterations.
 - **EXCEPTION** Alterations where the replacement luminaires have at least 40 percent lower power consumption compared to the original luminaires are not required to comply with the lighting power allowances of Section 140.7.
- **EXCEPTION** Acceptance testing not required when controls are added to 20 or fewer luminaires.

130.0 = Power Calculations	130.2c = Mandatory Controls
130.2a&b = No Incand. and BUG	130.4 = Acceptance Testing

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§141.0(b)2P

Completely Re-written

Electrical Power Alterations

- Alterations to electrical power distribution systems shall meet the applicable requirements of Section 130.5 as follows:
 - **i. Service Electrical Metering.**
New or replacement electrical service equipment shall meet the requirements of §130.5(a) applicable to the electrical power distribution system altered.
 - **ii. Separation Of Electrical Circuits For Electrical Energy Monitoring.**
For entirely new or complete replacement of electrical power distribution systems, the entire system shall meet the applicable requirements of §130.5(b).
 - **iii. Voltage Drop.** Alterations of feeders and branch circuits where the alteration includes addition, modification, or replacement of both feeders and branch circuits, the altered circuits shall meet the requirements of §130.5(c).
 - **EXCEPTION:** Voltage drop permitted by California Electrical Code §647.4, 695.6 and 695.7.
 - **iv. Circuit Controls for 120-Volt Receptacles and Controlled Receptacles.**
For entirely new or complete replacement of electrical power distribution systems, the entire system shall meet the applicable requirements of §130.5(d).

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Summary of Commissioning Requirements

Commissioning shall include:

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.

* For Buildings < 10,000 ft², these are the only required items.

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Design Phase Design Review

1. Design Reviewer Requirements. ~~Based on Building Size:~~

- a) The design reviewer shall be the documentation author of the Design Review Kickoff Certificate(s) of Compliance and Construction Document Design Review Checklist Certificate(s) of Compliance as specified in Part 1 Section 10-103(a)1
- ~~b) <10,000 ft²: Design phase design review may be completed by the design engineer.~~
- ~~c) 10,000 to 50,000 ft² require completion of the design review checklist by an engineer in-house to the design firm not associated with the building project.~~
- ~~d) >50,000 ft² or for buildings with complex mechanical systems, an independent, third-party review of these documents is required.~~

2. Design Review Kickoff.

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 Kickoff Certificate of compliance form in the Certificate of Compliance documentation

3. Construction Documents Design Review.

The Construction Documents Design Review Checklist Certificate of Compliance shall list the items 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 form in the Certificate of Compliance documentation (§10-103).

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§120.8(e): Building Commissioning

Show Commissioning measures CDs.

- Complete descriptions of all measures or requirements necessary for commissioning shall be included 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.~~

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§120.1(c)5: Mechanical Controls

HVAC Occupant Sensors

- HVAC systems are required to have Demand Control Ventilation to insure Air Quality.
 - One way of meeting the requirement is CO₂ Sensors.
 - Another way for spaces <1,500 ft² is Occupancy Sensors which reduce airflow when space is unoccupied.

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§120.2(e)1: Mechanical Controls

Shut-off/Reset for Space Conditioning

- 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.

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§120.2(e)3: Mechanical Controls

HVAC Occupancy Controls

- Following **spaces must have occupancy sensors**
 - Multipurpose room < 1000 ft²,
 - Classrooms > 750 ft,2 and
 - Conference, Convention, Auditorium and Meeting Center rooms > 750 ft²
- 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

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Title 24 Resources



- <http://www.energy.ca.gov/title24>
 - Energy Efficiency Standards
 - Compliance Manual
- Hotline: 800-772-3300
- Blueprint
 - <http://www.energy.ca.gov/efficiency/blueprint/>
- CLTC
 - [Commercial Guide](#)
 - [Resi Guide](#)

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



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Questions???

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Thank you

What are your questions?

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