

2016 Energy Standards Overview – Lighting and Electrical

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Goals of this Presentation

- Identify and clarify the major changes in the 2016 Energy Standards for:
 - Indoor lighting
 - Outdoor lighting
 - Electrical power distribution systems
 - Sign lighting



QUESTIONS...

- Please feel free to ask at anytime:
 - During presentation, or after

Enhance today's session





A Little CEC History

- Section 25402 of the Public Resources Code (known as the Warren Alquist Act)
- The act created the Energy Commission in 1974 and gave it authority to develop and maintain Building Energy Efficiency Standards
- Requires the Standards and new requirements to be cost effective over the economic life of the structure
- Requires the Energy Commission to update the Standards periodically (about every 3 years)



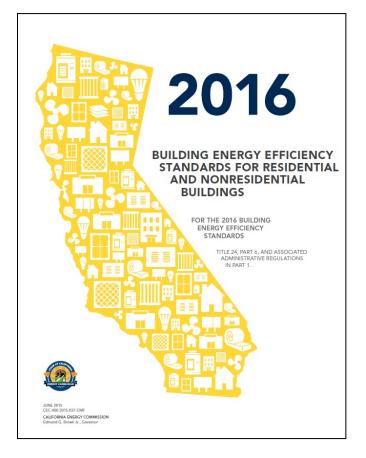
2016 BUILDING ENERGY STANDARDS



2016 Building Energy Efficiency Standards

- Effective on January 1, 2017
 - Building permit applications submitted on or after this date

- For larger projects in design phase:
 - Need to resubmit if permits pulled on/after effective date





2016 Nonresidential Energy Savings



- Overall, 5% more efficient than 2013 Standards
 - ≻ Electric Savings = 192 GWHs
 - ≻ Demand Reduction = 80 MW
 - > Gas Savings = (0.9) Mtherms



Summary of Major Changes

- Nonresidential
 - Clean-up changes to clarify Standards and resolve compliance concerns
 - Emphasis on nonresidential lighting alterations
 - Overall goal to keep current with ASHRAE 90.1 national consensus standards



NONRESIDENTIAL MANDATORY LIGHTING MEASURES



Area Controls §130.1(a)



- Must have manual ON/OFF control for all indoor lighting. Each enclosed space must be controlled separately.
- Controls must be readily accessible
 - The manual control must be located within the same room of the controlled lighting
- General lighting must be separately controlled from other lighting types:
 - Floor, display, ornamental, track, and special effects lighting must be separately controlled on circuits that are 20 amps or less



Multi-level Controls §130.1(b)

- General lighting for enclosed spaces ≥ 100 ft² with LPD > 0.5 W/ft² must have multi-level lighting controls
- The number of control steps is based on luminaire type per **TABLE 130.1-A**. Some examples:
 - LEDs: continuous dimming
 - Linear fluorescent: stepped dimming or continuous dimming

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 Low-voltage incandescent systems LED luminaires and LED source systems GU-24 rated for LED	Continuous dimming 10-100 percent				
GU-24 sockets rated for fluorescent > 20 watts Pin-based compact fluorescent > 20 watts ²	Continuous dimming 20-100 percent				
GU-24 sockets rated for fluorescent ≤ 20 watts Pin-based compact fluorescent ≤ 20 watts ² Linear fluorescent and U-bent fluorescent ≤ 13 watts	Minimum one step between 30-70 percent			Stepped dimming; or Continuous dimming; or Switching alternate lamps in a luminaire	
Linear fluorescent and U-bent fluorescent > 13 watts	Min 20-40 %	50-70 %	p in each ran 75-85 %	ge: 100 %	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
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 Induction > 25 watts	Minimum one step between 50 - 70 percent			Stepped dimming; or Continuous dimming; or	
Other light sources				Switching alternate lamps in each luminaire, having a minimum of 2 lamps per luminaire, illuminating the same area and in the same manner.	

1. Full rated input power of ballast and lamp, corresponding to maximum ballast factor

2. Includes only pin based lamps: twin tube, multiple twin tube, and spiral lamps



Multi-level controls cont. §130.1(b)

- Dimmable luminaires must be controlled by a dimmer control capable of controlling through all required lighting steps
- Multi-level lighting controls exceptions:
 - ➤ Classrooms with connected load ≤ 0.7 w/ft², and public restrooms require at least one control step between 30-70%
 - Enclosed spaces with one luminaire and no more than two lamps
 - Areas required to have full or partial off occupancy sensors: open areas and aisle ways in warehouses, library book stack aisles, corridors and stairwells, parking garages/areas



Shut-OFF Controls §130.1(c)1, 3, 4

- All indoor lighting must have an automatic shut-OFF control
 > Occupant sensing or automatic time-switch
 - Automatic time-switch must have 2 hour override and holiday shutoff feature
 - Separate controls for each floor other than stairwells
 - > Separate controls for up to 5,000 ft² in an enclosed space



Shut-OFF Controls §130.1(c)5

- Occupant sensors are required for:
 - ▶ Offices $\leq 250 \text{ ft}^2$
 - ➢ Multipurpose rooms < 1,000 ft²
 - Classrooms, conference rooms
 - If multi-level lighting controls are required by 130.1(b), the control must be a partial-ON or vacancy sensor. Partial-ON must activate 50 to 70% of lighting power
 - If multi-level lighting controls are not required by 130.1(b), the control can be a normal occupancy sensor.



Shut-OFF Controls cont. §130.1(c)6

- Full OFF or partial OFF occupant sensing controls required in certain areas. Lighting power must reduce by at least **50%** for:
 - Aisle ways and open areas in warehouses
 - Library book stack aisles depending on length
 - Corridors and stairwells
- If a partial OFF control is used, must also have an automatic shut-off control to turn the lighting off when the space is typically unoccupied (i.e. at night or outside of business hours)



Shut-OFF Controls cont. §130.1(c)7, 8

- Partial-OFF occupant sensing controls required in these areas:
 - Stairwells and common area corridors in high-rise res., and hotel and motel buildings. Lighting must automatically reduce by at least 50%
 - Parking garages, parking areas, loading areas. General lighting must have at least one control step between 20% - 50%
- Hotel and motel guest rooms must have an automatic control to turn lighting off after 30 minutes of the room being vacated (captive key card, occupancy sensor)

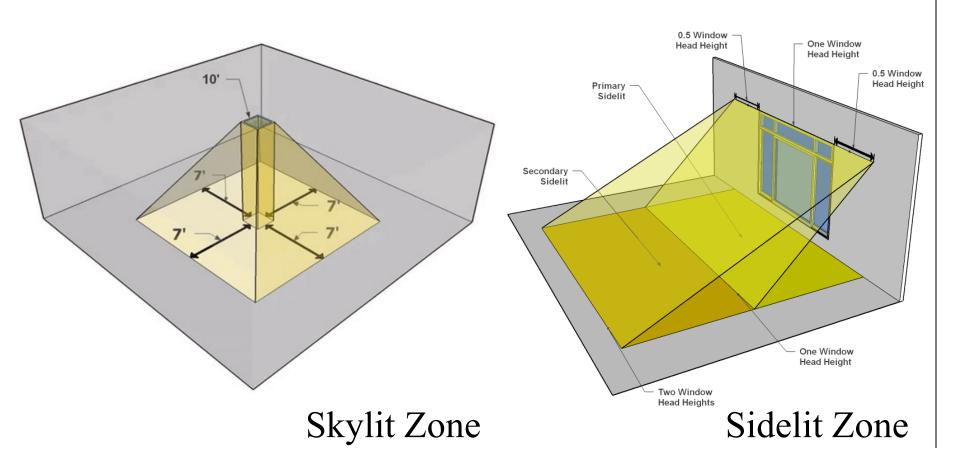


Automatic Daylighting Controls §130.1(d)

- Automatic daylighting controls are required for spaces:
 - $\geq 24 \text{ ft}^2 \text{ of glazing; and}$
 - ≥ 120 W lighting in combined skylit, primary sidelit daylit zone per enclosed space
- Daylighting controls must:
 - Automatically reduce general lighting within the daylit zone
 - > Primary sidelit and skylit zone must be controlled separately.
 - Provide lighting control steps per TABLE 130.1-A
 - Combined electric lighting and daylighting must be within 100% to 150% of design illuminance
 - Daylit zones must be shown on plans



Automatic Daylighting Controls cont. §130.1(d)



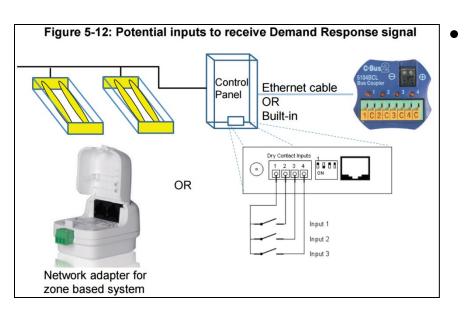


Automatic Daylighting Controls cont. §130.1(d)

- Daylight controls in parking garages are required when:
 - \geq 60 watts of lighting in primary sidelit zone; and
 - \geq 36 ft² of glazing or opening
- Daylighting controls must:
 - Automatically reduce general lighting within the combined primary and secondary sidelit daylit zone
 - Provide multi-level, continuous dimming or ON/OFF lighting control steps



Demand Responsive Controls §130.1(e)



- Demand responsive (DR) Controls are required for buildings over 10,000 ft²
 - DR control must be capable of receiving a DR signal (OpenADR, SEP, etc.)
 - Automatically reduce total lighting power by minimum 15%
 - Spaces with LPD ≤ 0.5 W/ft² are excluded from the 10,000 ft² threshold



Acceptance Testing §130.4

- Acceptance testing required for:
 - Automatic shut-OFF
 - Automatic daylighting
 - Demand responsive
 - Institutional tuning
 - Outdoor lighting controls



- Must use certified ATTs from an approved Acceptance Test Technician Certification Provider (ATTCP)
- http://www.energy.ca.gov/title24/attcp/

NONRESIDENTIAL PRESCRIPTIVE LIGHTING MEASURES



CALIFORNIA ENERGY COMMISSION



Power Adjustment Factors §140.6(a)2

• Power Adjustment Factor (PAF): Additional lighting power allowance for installing controls beyond mandatory requirements

 TABLE 140.6-A
 LIGHTING POWER ADJUSTMENT FACTORS (PAF)

TABLE 140.6-A LIGHTING POWER ADJUSTMENT FACTORS (PAF)						
TYPE OF CONTROL	TYPI	FACTOR				
a. To qualify for any of the Power Adjustment Section 140.6(a)2	Factors in this table, the installat	ion shall comply with the applicable requ	irements in			
b. Only one PAF may be used for each qualify	ing luminaire unless combined be	elow.				
c. Lighting controls that are required for comp	liance with Part 6 shall not be elig	gible for a PAF				
1. Daylight Dimming plus OFF Control	Luminaires in skylit daylit zone	0.10				
 Occupant Sensing Controls in Large Open Plan Offices 	In open plan offices > 250 square feet: One sensor	No larger than 125 square feet	0.40			
		From 126 to 250 square feet	0.30			
	controlling an area that is:	From 251 to 500 square feet	0.20			
2. Institutional Turing	Luminaires in non-daylit areas: Luminaires that qualify for othe for this tuning PAF.	0.10				
3. Institutional Tuning	Luminaires in daylit areas: Luminaires that qualify for othe for this tuning PAF.	0.05				
4. Demand Responsive Control	All building types less than 10, Luminaires that qualify for othe for this demand responsive com	0.05				



- There are three methods to calculate lighting power allowance:
 - Complete Building (TABLE 140.6-B)
 - ➤ Area Category (TABLE 140.6-C)
 - ➤ Tailored (TABLE 140.6-D through TABLE 140.6-G)
- Lighting power density (LPD, W/ft²) are assigned to buildings or space types.
- ~50% of function areas saw reduction in LPD. Indoor LPDs based on HPT8 linear fluorescent.



- Complete Building
 Method
 - TABLE 140.6-B lists building types and corresponding LPD
 - Single LPD for entire building

 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



- Area Category Method
 - TABLE 140.6-C lists function areas and corresponding LPD
 - Each area calculated separately
 - Sum allowed lighting power for all areas combined

PRIMARY I	FUNCTION AREA	ALLOWED LIGHTING POWER (W/ft²)		PRIMARY FUNCTION AREA		ALLOWED LIGHTING POWER (W/ft²)
Auditorium Are	a	1.5 3		Liberry Area	Reading areas	1.2 3
Auto Repair Are	ea	0.9 2		Library Area	Stack areas	1.5 3
Beauty Salon A	rea	1.7		Lobby Area Hotel lobby Main entry lobby		1.1 3
Civic Meeting P	lace Area	1.3 3				1.5 3
Classroom, Lect Vocational Area		1.2 5		Locker/Dressing Room		0.8
	Industrial Storage ned and unconditioned)	0.6		Lounge Area	Lounge Area	
Commercial and Areas (refrigerat	I Industrial Storage ted)	0.7		Malls and Atria		1.2 3
Convention, Con and Meeting Cer	nference, Multipurpose nter Areas	1.4 3		Medical and Clinical Care Area		1.2
Corridor, Restro Areas	om, Stair, and Support	0.6		> 250 square feet		0.75
Dining Area		1.1 3			≤250 square feet	1.0
Electrical, Mechanical, Telephone Rooms Exercise Center, Gymnasium Areas Exhibit, Museum Areas		0.7 2			Parking Area	0.14
		1.0		Parking Garage Area	Dedicated Ramps	0.3
		2.0		/ lica	Daylight Adaptation Zones ⁹	0.6
Financial Transaction Area		1.2 3		Religious Worship Area		1.5 3
General Commercial	Low bay	0.9 2		Retail Merchandise Sales, Wholesale Showroom Areas		1.2 6 and 7
and Industrial Work Areas	High bay	1.0 2				
	Precision	1.2 4		The star Area	Motion picture	0.9 3
Grocery Sales Area		1.2 6 and 7		Theater Area	Performance	1.4 3

ADE & CATECODY METHOD LICHTING DOWED DENSITY VALUES (WATTS/ET2

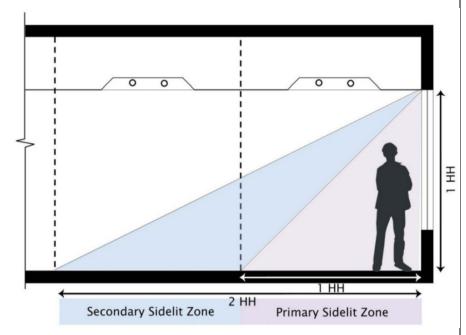


- Tailored Method:
 - ➤ TABLE 140.6-D lists function areas and target illumination levels
 - Provides general lighting power allowance
 - > Also provides additional allowance for specialized lighting if needed:
 - Wall display
 - Floor display
 - Ornamental



Daylight Controls in Secondary Zones §140.6(d)

- Secondary Daylit Zones
 - ➤ Meet §130.1(d)2
 - Separately controlled
 - \succ Shown on the plans
 - Photosensor located so that it is not readily accessible
 - Control steps according to TABLE 130.1-A
- Exception: secondary daylit zone with < 120 watts of general lighting



ENERGY COMMISSION

NONRESIDENTIAL INDOOR LIGHTING ALTERATIONS



Nonres. Indoor Lighting Alterations §141.0(b)2I, J

2013 - Lighting Alterations	2016 - Lighting Alterations		
Lighting System Alterations	 Entire Luminaire Alterations ➢ Removing and reinstalling luminaires (≥ 10% of existing) ➢ Replacing or adding luminaires ➢ Adding, removing, replacing walls along with redesign of lighting system 		
• Luminaire Modification in Place	 Luminaire Component Modification > Replacing ballast/driver and lamps > Changing the light source > Changing the optical system 		



Nonres. Indoor Lighting Alterations cont. §141.0(b)2I, J

Meeting power and control requirements

Meet LPD requirements and controls

- > Area control
- Multi-level lighting control
- ➤ Shut-OFF control
- Automatic daylight control
- Demand responsive control

Similar to 2013

Reduce existing lighting power by 50% or 35% and controls

- Area control
- Shut-OFF control

New for 2016



Nonres. Indoor Lighting Alterations cont. §141.0(b)2I, J

Table 3 - Control Requirements for Lighting Alterations						
	Resulting lighting power, compa ance specified in Section 140	Option 3				
Applicable Section 130.1 Control requirements:	Option 1 Lighting power is > 85% to 100% of allowance	Option 2 Lighting power is ≤ 85% of allowance	Lighting power is reduced by 35/50% compared to existing			
Sections 130.1(a)1, 2, and 3 Area Controls	Yes	Yes	Yes			
Section 130.1(b) Multi-Level Lighting Controls – only for alterations to gen- eral lighting of enclosed spaces 100 square feet or larger with a connected lighting load that exceeds 0.5 watts per ft ²	Yes	For each enclosed space, min- imum one step between 30-70 percent of lighting power regardless of luminaire type, or meet Section 130.1(b)	Not Required			
Section 130.1(c) Shut-Off Controls	Yes	Yes	Yes ¹			
Section 130.1(d) Automatic Daylight Controls	Yes	Not Required	Not Required			
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	Yes	Not Required	Not Required			
¹ As bi-level controls are not required for this option, partial-off controls are not required to be installed in place of "full off" automatic shutoff controls for library book stack aisles, corridors and stairwells (see Sections 141.0(b)2lii and Jii).						



Nonres. Indoor Lighting Alterations cont. §141.0(b)2K

- Lighting Wiring Alterations consist of:
 - Adding a circuit feeding luminaires
 - Replace, modify, or relocate wiring between a switch or panelboard and luminaires
 - Replace lighting control panels, panelboards, or branch circuit wiring
- Applicable Lighting Wiring Alteration requirements for the enclosed space:
 - ➤ Meet lighting power allowance requirements in §140.6
 - ➤ Area controls, shut-OFF controls
 - Multilevel lighting controls: one control step between 30 70% or meet §130.1(b)
 - > Daylighting controls \$130.1(d) (if ≥ 10 luminaires in the daylit zone)



Nonres. Indoor Lighting Alterations cont. §141.0(b)2K

- Acceptance testing is required for lighting alterations
 - Acceptance testing is not required if installing controls for 20 or fewer luminaires for the entire project.

NONRESIDENTIAL OUTDOOR LIGHTING REQUIREMENTS





Outdoor Lighting Zones Part 1, §10-114

- LZ determines outdoor lighting power allowances for the project
 - Illumination lowest in LZ0, highest in LZ4
 - Maximum zonal lumen limits (Luminaire cutoff)
- LZ prevents over lighting of outdoor areas
 - ➢ Reduce glare
 - Reduce light pollution
 - \succ Save energy



TABLE 10-114-A LIGHTING ZONE CHARACTERISTICS AND RULES FOR AMENDMENTS BY LOCAL JURISDICTIONS

Zone	Ambient Illumination	State wide Default Location	Moving Up to Higher Zones	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 maybe 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.



Outdoor Lighting Zones Part 1, §10-114

- Determining LZ
 - Lookup address on U.S. Census
 <u>Bureau site</u>
 http://factfinder.census.gov
 - Census data will specify if the address is located in rural (LZ2) or urban area (LZ3)

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MANDATORY OUTDOOR LIGHTING REQUIREMENTS

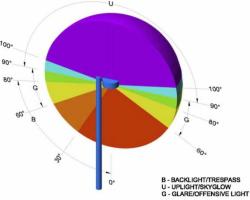


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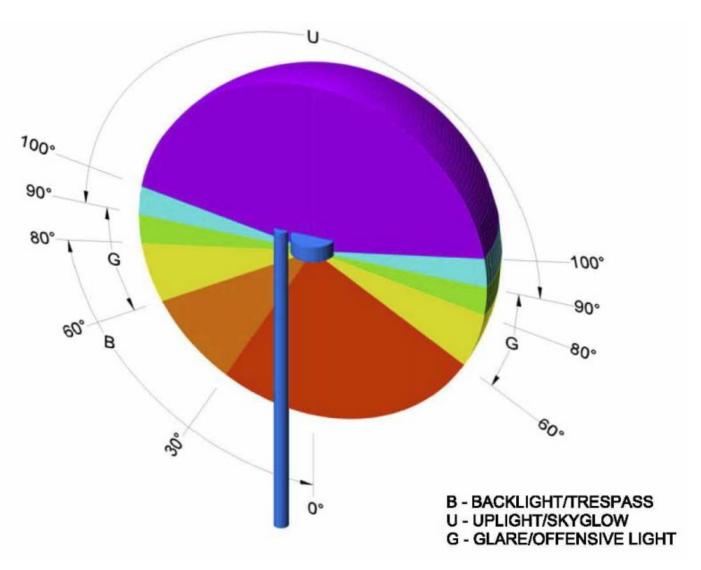


Outdoor Lighting §130.2(a), §130.2(b)

- Outdoor Incandescent Lighting §130.2(a)
 - Incandescent luminaires > 100 watts must be controlled by a motion sensor
- Luminaire Cutoff §130.2(b)
 - Outdoor luminaires > 150 watts must comply with luminaire cutoff requirements (BUG requirements)
 - Uplight lumen requirements TABLE 130.2-A
 - ➢ Glare lumen requirements TABLE 130.2-B









Outdoor Lighting Controls §130.2(c)

- ALL outdoor luminaires must have \$130.2(c)1, \$130.2(c)2:
 - Photocontrol and time-switch control; or
 - ➢ Astronomical time-switch control; or
 - Other control capable of automatically shutting OFF outdoor lighting when daylight is available



Outdoor Lighting Motion Sensors §130.2(c)

- Outdoor lighting mounted ≤ 24 feet above the ground \$130.2(c)3:
 - \blacktriangleright Motion sensor that automatically reduces lighting by 40 to 90%
 - ➢ No more than 1,500 watts controlled together
- Exceptions:
 - ▶ Pole-mounted luminaires \leq 75 watts
 - ▶ Non-pole mounted luminaires \leq 30 watts
 - \blacktriangleright Linear lighting \leq 4 watts per linear foot of luminaire
 - Sales frontage complying with §130.2(c)4
 - Building facades, ornamental hardscape, and outdoor dining complying with §130.2(c)5
 - Outdoor lighting applications exempt from 140.7(a)



Outdoor Lighting Controls cont. §130.2(c)

- Outdoor sales frontage lighting must have §130.2(c)4:
 - Part-night outdoor lighting control; or
 - > Motion sensor that automatically reduces lighting by 40 to 90%



Outdoor Lighting Controls cont. §130.2(c)

- For building facade, ornamental hardscape, outdoor dining lighting, one of the following required §130.2(c)5:
 - Part-night outdoor lighting control; or
 - > Motion sensor (reduce by 40 to 90%); or
 - Centralized time-based zone control
 - ➤ Wall packs mounted ≤ 24 feet above ground must be controlled by motion sensor



Outdoor Lighting Controls cont. §130.2(c)

	Photocell+Time-switch	cell+Time-switch		
Luminaire	or Astronomical Time- switch	Motion Sensor	Part-night outdoor lighting control	Centralized time-based zone lighting control
All Outdoor Lighting	x			
Outdoor Incandescent > 100 W	×	x		
Outdoor Lighting ≤ 24 ft above ground	×	x		
Outdoor Sales Frontage	x	x	x	
Building Facade	×	x	x	x
Ornamental Hardscape	×	x	x	x
Outdoor Dining Lighting	x	x	x	x
Wall pack ≤ 24 ft above ground	x	x		



Acceptance Testing §130.4

- Acceptance testing required for:
 - Automatic time-switch
 - Motion sensors
 - Part-night controls
 - Automatic scheduling controls



- Must use certified ATTs from an approved Acceptance Test Technician Certification Provider (ATTCP)
- http://www.energy.ca.gov/title24/attcp/



Acceptance Testing Summary

- Acceptance testing is required for indoor lighting and outdoor lighting
- When applicable, acceptance tests must be specified on respective NRCC form at permit
- Field technician must report results of acceptance testing on respective NRCA form at final inspection
- Field technicians performing testing for indoor and outdoor lighting must be a Certified Lighting Controls ATT

PRESCRIPTIVE OUTDOOR LIGHTING REQUIREMENTS



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Table 6-1: Scope of the Outdoor Lighting Requirements

Lighting Applic	Lighting Applications		
General Hardscape (trade-offs permitted)	Specific Applications (trade-offs not permitted)	Not Regulated (only as detailed in §140.7)	
The general hardscape area of a site shall include parking lot(s), roadway(s), driveway(s), sidewalk(s), walkway(s), bikeway(s), plaza(s), bridge(s), tunnel(s) and other improved area(s) that are illuminated.	Canopies: Sales and Non-sales Drive-Up Windows Emergency Vehicle Facilities Building Entrances or Exits Building Facades Guard Stations Hardscape Ornamental Lighting Outdoor Dining Primary Entrances for Senior Care Facilities, Police Stations, Hospitals, Fire Stations, and Emergency Vehicle Facilities Outdoor Sales Frontage and Lots Special Security Lighting for Retail Parking and Pedestrian Hardscape Student Pick-up/Drop-off zone Vehicle Service Station: Canopies, Hardscape, and Uncovered Fuel Dispenser ATM Machine Lighting	Temporary Required & regulated by FAA Required & regulated by the Coast Guard. For public streets, roadways, highways, and traffic signage lighting, and occurring in the public right-of-way For sports and athletic fields, and children's playground For industrial sites For public monuments Signs regulated by §130.3 and §140.8 For stairs, wheelchair elevator lifts For ramps that are other than parking garage ramps Landscape lighting For themes and special effects in theme parks For outdoor theatrical and other outdoor live performances For gualified historic buildings	

Other outdoor lighting applications that are not included in Energy Standards Tables 140.7-A or 140.7-B are assumed to be not regulated by these Standards. This includes decorative gas lighting and emergency lighting powered by an emergency source as defined by the California Electrical Code. The text in the above list of lighting applications that are not regulated has been shortened for brevity. Please see Section 6.2.2.2 for details about lighting applications not regulated.



General Hardscape Allowance §140.7(d)1

TABLE 140.7-A GENERAL HARDSCAPE LIGHTING POWER ALLOWANCE

Type of Power Allowance	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2 ²	Lighting Zone 3 ²	Lighting Zone 4
Area Wattage Allowance (AWA)		0.020 W/ft ²	0.030 W/ft ²	0.040 W/ft ²	0.050 W/ft ²
Linear Wattage Allowance (LWA)	No allowance ¹	0.15 W/lf	0.25 W/lf	0.35 W/lf	0.45 W/lf
Initial Wattage Allowance (IWA)		340 W	450 W	520 W	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.

- Significant reduction in general hardscape LPDs. LPDs are now based on LED lighting.
- Specific lighting applications in TABLE 140.7-B



General Hardscape Allowance §140.7(d)1

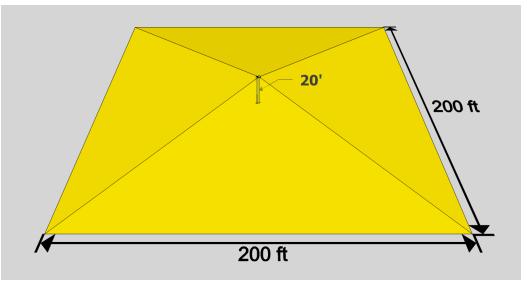
- How to calculate general hardscape allowance:
 What is the outdoor lighting zone (LZ) of the project?

 Used to determine what your allowance will be
 - > What is the illuminated hardscape area?
 - Used to calculate area wattage allowance
 - What is the the hardscape perimeter length?
 Used to calculate linear wattage allowance



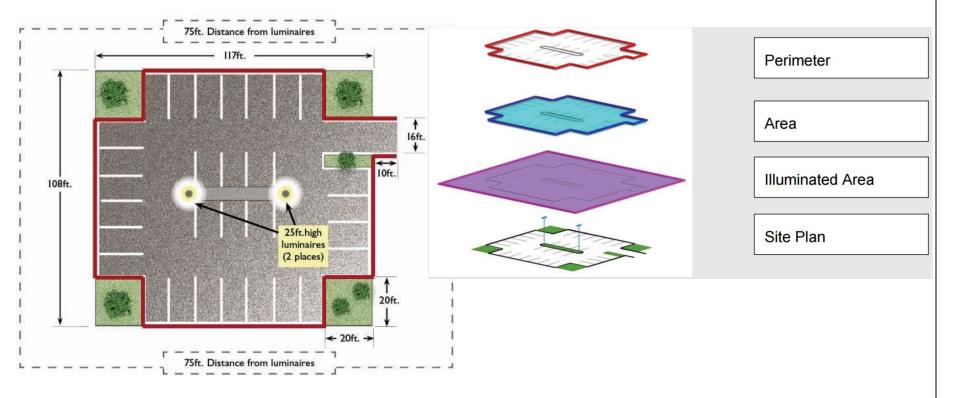
General Hardscape Allowance §140.7(d)1

- Illuminated hardscape area
 - Hardscape area within a square pattern around each luminaire that is ten times the luminaire mounting height with the luminaire in the middle of the pattern





Example: Calculating General Hardscape Allowance





Allowance for Specific Applications §140.7(d)2

- Additional Lighting Power Allowance
 - Building Entrances/Exits
 - Drive Up Windows
 - Sales Frontage
 - Hardscape Ornamental Lighting

- Building Facades
- Outdoor Sales Lots
- Vehicle Service Station Canopies/Hardscapes

 \succ Etc.

See TABLE 140.7-B for all applications



Allowance for Specific Applications cont. §140.7(d)2

- Additional Lighting Power Allowance is "use it or lose it"
 - Cannot claim additional lighting power if lighting for the specific application is not installed
 - Cannot tradeoff additional lighting power
- Allowed lighting power is:
 - Sum of the general lighting power allowance and additional lighting power allowance claimed



Outdoor Lighting Power Allowance Tradeoffs

- Total lighting power allowance is the sum of general hardscape and specific lighting application allowance
- General hardscape allowance can be traded to specific lighting applications
- Allowed lighting power for specific applications cannot be traded between specific applications or to general hardscape allowance



I Occupancy and Parking Garages

- Hospitals, Jails, Prisons
 - "I" occupancies are not regulated by the Energy Efficiency Standards. This includes outdoor areas.
- Parking Garages
 - Only the uncovered top level of parking garage meets outdoor lighting requirements

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NONRESIDENTIAL OUTDOOR LIGHTING ALTERATIONS



- Three scenarios for outdoor lighting alterations:
 - 1. Increase connected lighting load
 - 2. <u>Replacement</u> of 5 luminaires or $\geq 10\%$ of existing luminaires (whichever is greater)
 - 3. <u>Replacement</u> of 5 luminaires or \geq 50% of existing luminaires (whichever is greater)
- Requirements triggered when replacing, increasing connected lighting load, or adding new luminaires.
 > Typically does not include altering or retrofitting existing luminaires



- 1. Increase connected lighting load
 - Added or altered luminaires must meet all control requirements in §130.2(c)
 - General Hardscape or specific lighting applications with added or altered luminaires must meet power allowance in §140.7

Outdoor Lighting Alteration - Increase in Lighting Load						
	Photocell+Time-switch or	At least one of these controls				
Added or Altered Luminaire	Astronomical Time-switch, Meet 140.7	Motion Sensor	Part-night outdoor lighting control	Centralized time-based zone lighting control		
All Outdoor Lighting	Х					
Outdoor Incandescent > 100 W	Х	Х				
Outdoor Lighting ≤ 24 ft above ground	X	Х				
Outdoor Sales Frontage	X	Х	X			
Building Facade	x	Х	X	Х		
Ornamental Hardscape	x	Х	X	Х		
Outdoor Dining Lighting	X	Х	X	X		
Wall pack ≤ 24 ft above ground	X	Х				



- 2. Replacement of 5 luminaires or $\geq 10\%$ of existing luminaires (whichever is greater)
 - ➤ Altered parking lot and outdoor sales lot luminaires mounted ≤ 24 ft above ground must have:
 - Photocell or astronomical time-switch, and motion sensor
 - For all other applications and where the altered luminaire is mounted > 24 ft above ground
 - Photocell + time-switch or astronomical time-switch

Outdoor Lighting Alteration - 10% to < 50% Luminaires Replaced					
People and Luminaire	Photocell or	At least one of these controls			
Replaced Luminaire	Astronomical Time-switch	Scheduling Control	Motion Sensor		
Parking Lot Lighting ≤ 24 ft above ground	x		х		
Outdoor Sales Lot Lighting ≤ 24 ft above ground	x		х		
All other applications	x	X	X		



- 3. Replacement of 5 luminaires or \geq 50% of existing luminaires
 - ➤ Altered parking lot and outdoor sales lot luminaires mounted ≤ 24 ft above ground must have:
 - Photocell or astronomical time-switch, and motion sensor
 - For all other applications and where the altered luminaire is mounted > 24 ft above ground
 - Photocell + time-switch or astronomical time-switch
 - ➤ Altered general Hardscape or specific lighting application must meet power allowance in §140.7 unless replacement luminaires reduce power by ≥ 40%

Outdoor Lighting Alteration - ≥ 50% Luminaires Replaced					
	Photocell or	At least one of these controls			
Replaced Luminaire	Astronomical Time-switch, Meet 140.7	Scheduling Control	Motion Sensor		
Parking Lot Lighting ≤ 24 ft above ground	x		х		
Outdoor Sales Lot Lighting ≤ 24 ft above ground	x		х		
All other applications	х	Х	Х		



Nonres. Outdoor Lighting Alterations cont. §130.2(b), Exception 5

- Replacement luminaires > 150 watts must also meet Cutoff requirements
- Replacement of pole mounted luminaires meeting all of the following conditions are exempted from BUG requirements if:
 - Existing luminaire does not meet BUG requirements
 - Spacing between existing poles is greater than 6 times the mounting height of existing luminaires
 - \succ No additional poles are being added to the site
 - ▶ New wiring to the luminaires is not being installed
 - Connected lighting power wattage is not increased



- Acceptance testing is required for lighting alterations
 - Acceptance testing is not required if installing controls for 20 or fewer luminaires for the entire project.





Outdoor Lighting Additions §141.0(a)1

- Additions (adding hardscape area to existing site)
 - Additions to existing outdoor lighting must meet all mandatory measures for the added luminaires
 - Addition must also comply with lighting power allowance of §140.7
 - Acceptance testing required

ELECTRICAL POWER DISTRIBUTION SYSTEMS (EPDS)



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Service Electrical Metering §130.5(a)

- Each service or feeder must have a permanently installed metering system which measures electrical energy
 - Utility meter satisfies the metering requirement (show instantaneous kW, kWh over utility defined period)
 - If a utility meter is not installed, meter capability is dependent on kVA of the service

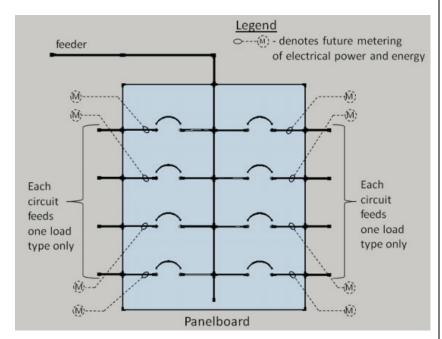
Metering Functionality	Electrical Services rated 50 kVA or less	Electrical Services rated more than 50kVA and less than or equal to 250 kVA	Electrical Services rated more than 250 kVA and less than or equal to 1000kVA	Electrical Services rated more than 1000kVA
Instantaneous (at the time) kW demand	Required	Required	Required	Required
Historical peak demand (kW)	Not required	Not required	Required	Required
Tracking kWh for a user- definable period.	Required	Required	Required	Required
kWh per rate period	Not required	Not required	Not required	Required

TABLE 130.5-A MINIMUM REQUIREMENTS FOR METERING OF ELECTRICAL LOAD



Separation of Electrical Circuits §130.5(b), 141.0(b)2P

- New Construction
 - EPDS designed to allow for measuring loads according to TABLE 130.5-B
 - Allows flexible approaches for providing measuring ability
- Alterations
 - Only applicable for complete replacements of power distribution systems
 - Most projects will not fall under this trigger





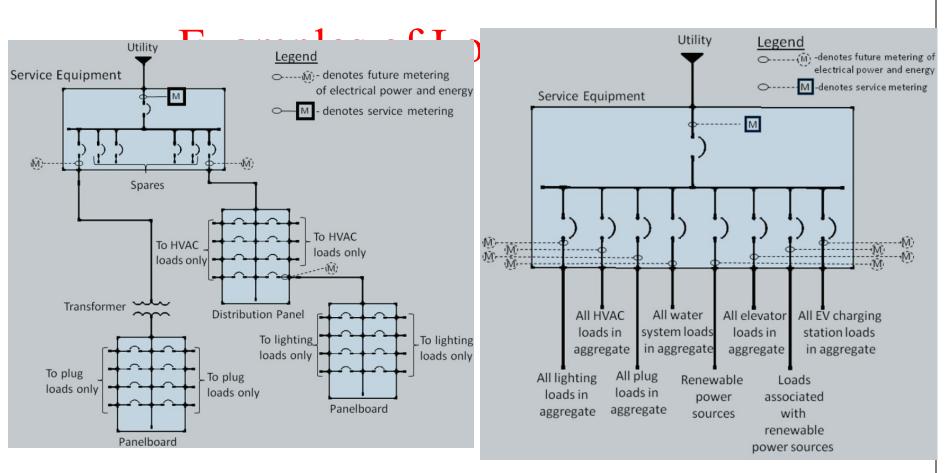
CALIFORNIA ENERGY COMMISSION

Electrical Load Type	Electrical Services rated 50 kVA or less	Electrical Services rated more than 50kVA and less than or equal to 250 kVA	Electrical Services rated more than 250 kVA and less than or equal to 1000kVA	Electrical 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 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 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 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 loads in aggregate	All loads in aggregate	All loads in aggregate
Industrial and commercial load centers 25 kVA or greater including theatrical lighting installations and commercial kitchens	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
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

TABLE 130.5-B MINIMUM REQUIREMENTS FOR SEPARATION OF ELECTRICAL LOAD



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Voltage Drop §130.5(c), 141.0(b)2P

- Now allows total combined voltage drop of feeder conductors and branch circuits to not exceed 5%
 - Previously limited feeders to 2% of voltage drop, and branch circuits to 3%
- Alterations
 - Applicable when both feeders and branch circuits are added or replaced
- Added exception for voltage drop permitted by Electrical Code



Controlled Receptacle Requirements §130.5(d), 141.0(b)2P

- **Controlled receptacles required in:** Office areas, lobbies, conference rooms, kitchen areas in office spaces, copy rooms, and hotel and motel guest rooms
- Requirements for controlled receptacles:
 - > Automatic time-switch controls (plus 2 hour override) or motion control
 - Controlled receptacle must be marked
 - At least one controlled receptacle or splitwired receptacle within 6 feet of uncontrolled receptacle



Controlled Receptacle Requirements §130.5(d), 141.0(b)2P

• Hotel/Motel Guest rooms

➤ At least 50% of receptacles must be controlled

Captive card key or occupancy sensing controls

➤ Shut-off after 30 minutes of vacancy

Alterations

> Only applicable for complete replacements of power distribution systems

• Most projects will not fall under this trigger



SIGN LIGHTING



Sign Lighting Controls §130.3(a)1, 2

• Indoor Signs must have:

Automatic time-switch; or

Astronomical time-switch

- Outdoor Signs must have:
 - Automatic time-switch and photosensor; or
 - Astronomical time-switch control and photosensor
 - Outdoor signs ON both day and night must also have a dimmer that automatically reduces power by at least 65% during nighttime hours



Sign Lighting Controls §130.3(a)3

- Electronic Message Center (EMC) with load > 15 kW must have:
 Demand responsive control
 - Must be capable of automatically reducing lighting power by a minimum of 30%



Sign Lighting Power §140.8

- Sign lighting power requirements apply to internally illuminated signs, externally illuminated signs, unfiltered LED, and unfiltered neon
- Two compliance paths:
 - Maximum Allowed Lighting Power
 - Internally illuminated signs
 - Externally illuminated signs
 - Unfiltered LEDs and neon must comply with alternate lighting sources method
 - Alternate Lighting Sources
 - Automatically comply if specific light sources are used

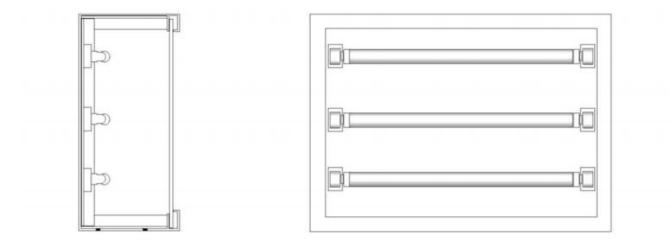


Maximum Allowed Lighting Power §140.8(a)1

• Internally illuminated signs

> Allowed lighting power is illuminated face area x 12 watts/ft²

Figure 7-2: Single-faced Internally Illuminated Cabinet Sign with Fluorescent Lamps and Translucent Face



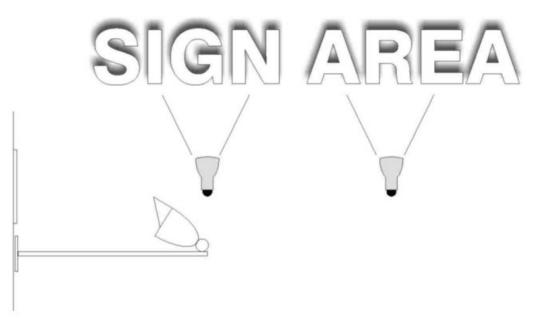


Maximum Allowed Lighting Power §140.8(a)2

• Externally illuminated signs

> Allowed lighting power is illuminated face area x 2.3 watts/ft²

Figure 7-5: Externally Illuminated Sign Using Flood Lighting





Alternate Lighting Sources §140.8(b)

- High pressure sodium (HPS)
- Metal halide (MH)
 - ▶ Pulse start or ceramic MH with ballast efficiency \geq 88%; or
 - ➢ Pulse start MH ≤ 320 watt with ballast efficiency ≥ 80% (Not including 175 watt or 250 watt MH lamps)
- Neon or cold cathode
 - ➢ Rated output current < 50 mA: power supply/transformer efficiency ≥ 75%; or</p>
 - ▶ Rated output current ≥ 50 mA: power supply/transformer efficiency ≥ 68%
 - ➤ Unfiltered neon must meet §140.8(b)



Alternate Lighting Sources §140.8(b)

• Fluorescent lighting

→ Use only lamps with CRI \ge 80; or

→ Use electronic ballasts with output frequency \geq 20 kHz

• LED

▶ Power supply efficiency $\ge 80\%$

Unfiltered LED signs must meet §140.8(b)

• Compact Fluorescent (CFL)

➢ Do not contain medium screw base socket (E24/E26)



Energy Verified Label

Complies

[]Y[]N

Complies

[]Y[]N



Indoor Electric Sign Listing Mark / Energy Mark (Holographic)



Alterations to Existing Signs §141.0(b)2M

- Sign lighting alterations must meet power requirements of §140.8 when:
 - Increase connected lighting load; or
 - > Replace and rewire > 50% of ballasts; or
 - ➤ Relocate sign to a different location on the same site or on a different site
- Note
 - ➤ Replacing ballasts or lamps alone does not trigger req.
 - > There are no control requirements for sign lighting alterations
 - > New signs must meet power and control requirements



QUESTIONS...









Certificate of Compliance

- Certificate of Compliance (NRCC-XXX)
 - Submitted with permit application, included with plans
 - ➤ Used by plans examiner to verify compliance
 - Lighting power calculations, schedules, lighting controls, PAF, voltage drop, etc.
- Indoor
 - ≻ NRCC-LTI-E
- Outdoor➢ NRCC-LTO-E
- EPDS, Sign
 ➢ NRCC-ELC-E, NRCC-LTS-E





Certificate of Installation

- Certificate of Installation (NRCI-XXX)
 - Completed by installing contractor
 - Left on-site for building inspector
 - Identifies construction documents that show lighting and controls were installed as proposed in the certificate of compliance
- Indoor
 - ► NRCI-LTI-01 NRCI-LTI-06
- Outdoor
 - ≻ NRCI-LTO-01 NRCI-LTO-02
- EPDS, Sign
 - ➢ NRCI-ELC-01, NRCI-LTS-01

CERTIFICATE OF ACCEPTANCE		CALFORNIA ENERG	NRCA-LTO-02-A									
Outdoor Lighting Acceptance Tests	(Page 3 of 3)											
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FIELD TECHNICIAN'S DECLARATION STATEMENT		101-E (Revised 0615)							CALF	ORMA ENERGY C		
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2. I am the person who performed the acceptance verificati	on repo								Date Trapertil			_
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Certificate of Acceptance

- Certificate of Acceptance (NRCA-XXX)
 - Completed by acceptance test technician
 - > Left on-site for building inspector, can also be provided electronically
 - Recording of test results and verification of installed controls
 - Form should be from one of the approved providers with logo, Energy Commission forms are watermarked as not for use
- Indoor
 - ► NRCA-LTI-02 NRCA-LTI-05
- Outdoor
 - ≻ NRCA-LTO-02



WHAT'S NEXT? AND RESOURCES





2019 Energy Standards

- 45-day Express Terms:
 - Reduce lighting power densities to reflect LED efficacy for indoor and outdoor lighting
 - Simplify language for indoor lighting alterations
 - Establish schedules of normally occupied and normally unoccupied times for outdoor lighting
 - More information: http://www.energy.ca.gov/title24/2019standards/



Approved 2016 Compliance Software

Used to demonstrate compliance with the Energy Standards when using the Performance Approach

- Residential
 - CBECC-Res
 - Energy Pro
 - Wrightsoft Right-Energy

- Nonresidential
 - CBECC-Com
 - Energy Pro
 - IES Virtual Environment

More information at:

http://www.energy.ca.gov/title24/2016standards/2016_computer_prog_list.html



HERS Counter Card

- Available online
- Intended to assist counter staff and permit technicians
- Inform applicants about HERS testing and verification

When is **HERS testing/verification** required?

- Home Energy Rating System (HERS) testing is mandatory for all newly constructed buildings, and is prescriptively required for most HVAC alterations.
- Some mechanical, envelope, and water heating systems require HERS testing when modeled for compliance credit under the performance approach.
- Any HERS testing that is required for a project will be specified on the CF1R.

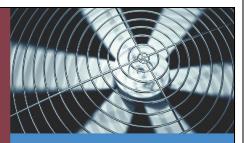
Who can conduct HERS Testing?

- Only a HERS Rater who is certified by a HERS Provider may perform HERS testing required under the Energy Standards.
- A HERS Rater can be certified to complete HERS testing for new construction (including additions) and/or alteration projects.

How do I find a HERS Rater?

- HERS Providers approved by the Energy Commission maintain a directory of certified HERS Raters on their respective websites (provided on the back of this card.)
- Search filters, like project type and county, are available to make finding a HERS Rater in your area easier.

NOTE: Duct leakage testing by a HERS Rater is prescriptively required for smaller nonresidential HVAC systems (see § 140.4 (I)).



RESIDENTIAL







Approved ATTCPs

- Lighting ATTCPs
 - CALCTP (2016 training approved)
 - NLCAA (2016 training approved)
- Mechanical ATTCPs
 - > NEMIC (also referred to as TABB)
 - > NEBB
 - > CSPTC

More information at:

http://www.energy.ca.gov/title24/attcp/



ATTCP Counter Card



NONRESIDENTIAL Including high-rise residential & hotel/motel projects

ACCEPTANCE TESTING



When is acceptance testing required?

- Acceptance testing is mandatory for certain nonresidential lighting, mechanical, site-built fenestration, and covered process systems and controls.
- Acceptance testing applies when the regulated systems and controls are installed in newly constructed buildings, additions, and alterations.
- All required acceptance testing, and the systems and controls that require testing, should/will be specified on the respective Nonresidential Certificate of Compliance (NRCC).

Who can conduct acceptance testing?

- Only a Lighting Controls Acceptance Test Technician (ATT) certified by an Acceptance Test Technician Certification Provider (ATTCP) may perform testing for indoor and outdoor lighting systems and controls.
- The builder, contractor, engineer, or commissioning agent (check NRCA signature block) may perform testing for HVAC, site-built fenestration, and covered process systems and controls.
- A Mechanical Controls ATT certified by an ATTCP will be required to perform testing for HVAC systems and controls when the industry thresholds in § 10-103-B are met.

How do I find an ATT?

- ATTCPs approved by the Energy Commission maintain a directory of certified ATTs on their respective websites (provided on back of this a card).
- Search filters, like name, county, city, zip code, employer, etc. are available to make finding an ATT in your area easier.

NOTE: Duct leakage testing by a HERS Rater is prescriptively required for smaller nonresidential HVAC systems (see § 140.4 (/)).

- Available online
- Intended to assist counter staff and permit technicians
- Inform applicants about Acceptance Testing



Blueprint

- Email Newsletter
- Published quarterly
- Clarifications on frequently asked questions
- http://www.energy.ca.gov/ efficiency/blueprint/



mendation.

Systems

the Energy Standards.

of 6.8

Mandatory Requirements

For more information, please visit:

Space Conditioning

http://energy.ca.gov/title24/attcp/

Small Duct High Velocity

Small duct high velocity (SDHV) systems may

be used to comply with the Energy Standards.

The following is a list of requirements with

direction on how SDHV systems can comply

with the low-rise residential requirements of

United States Department of Energy Standards:

SDHV systems manufactured on or after Jan

uary 23, 2006, and before January 1, 2015,

must have a minimum Seasonal Energy Ef-

ficiency Ratio (SEER) of 11, and a minimum

Heating Seasonal Performance Factor (HSPF)

- EnergyPro Version 7.0
- Alternative Path for Complying with Lighting Alteration Requirements Lighting Standards to Save Californians More Than \$4 Billion in
- Electricity Costs 0.8.8
- Illuminated Areas
- ° Track Lighting Alterations
- ° Compliance Documents
- ° Townhouses and Duplexes
- ° Commissioning
- Energy Code Ace Training Schedule

New Mechanical Acceptance Test **Technician Certification** Provider

On January 13, 2016, the California Energy Commission (Energy Commission) approved the National Environmental Balancing Bureau (NEBB), as a mechanical Acceptance Test Technician Certification Provider (ATTCP).

meet the return duct and grille sizing requirements of TABLES 150.0-C or 150.0-D.

NOTE: The return duct and grille sizing alternative will likely be the method chosen for com pliance when installing a SDHV system.

Section 150.0(m)15 - Specific to systems with multiple thermostatically controlled zones, this section requires the same mandatory airflow and fan efficacy requirements as Section 150.0(m)13B. However, it does not have the same duct and grille sizing alternative. If such systems cannot satisfy the airflow and fan efficacy requirements of this section, compliance must be demonstrated via the performance approach

The duct leakage and insulation requirements apply as with any other system.

Prescriptive Requirements

The refrigerant charge and duct insulation requirements apply as with any other system



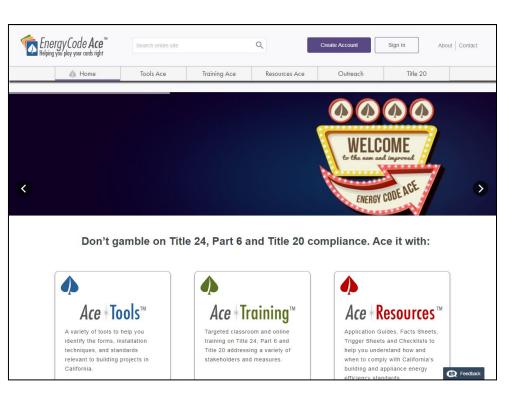
Online Resource Center (ORC)



http://www.energy.ca.gov/title24/orc/



Energy Code Ace



- Forms & Resource tools
- Free training (in person and online)
- Checklists, Trigger Sheets for building departments
- http://www.energycodea ce.com/content/home/



Hotline

- Toll-free in California
- Open Monday through Friday
 - ➢ 8:00 a.m. to noon, and 1:00 p.m. to 4:30 p.m.
- Call at:
 - ➤ 1-800-772-3300 (In CA)
 - ➤ (916) 654-5106 (Outside CA)
- Email at: Title24@energy.ca.gov



Email Lists

- Main conduit for communicating with stakeholders
- <u>Sign up</u> at:
 - http://www.energy.ca.gov/listservers/
- Subscribe to the following Efficiency Lists:
 - Building Standards
 - > Blueprint
- Respond to confirmation email within 24 hours