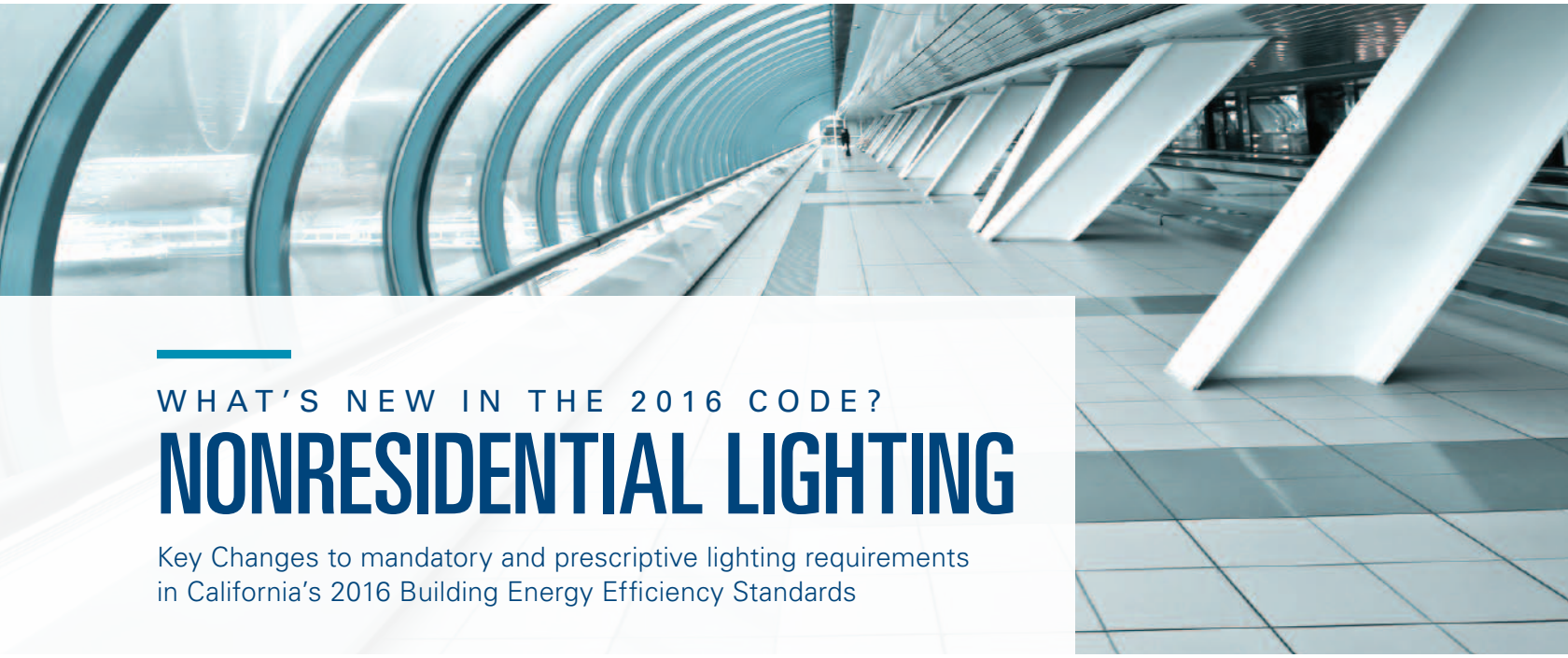

WHAT'S NEW IN THE 2016 CODE?

NONRESIDENTIAL LIGHTING

Key Changes to mandatory and prescriptive lighting requirements in California's 2016 Building Energy Efficiency Standards

California's new nonresidential Building Energy Efficiency Standards take effect on January 1, 2017. The 2016 Standards focus on several key areas to improve the energy efficiency of newly constructed buildings, additions and alterations to existing buildings. California's Standards now align with ASHRAE 90.1 2013 standards and include more stringent lighting power density limits for many indoor and outdoor spaces. Updates enhance and simplify many aspects of the 2013 requirements including indoor lighting control requirements for new construction and alterations. This publication offers an overview of important updates contained in the 2016 nonresidential lighting energy efficiency standards.

MAJOR CHANGES

REDUCTION TO LIGHTING POWER DENSITY VALUES

Lighting power density allotments have been reduced for many indoor and outdoor spaces including spaces in auditoriums, libraries, and schools. Reductions affect building, area and tailored methods of compliance.

UPDATED POWER ADJUSTMENT FACTORS

The 2016 Standards contain two new power adjustment factors (PAF) that address institutional tuning and daylight harvesting. Three other PAF have been eliminated.

MULTILEVEL LIGHTING & OCCUPANCY CONTROLS

Multilevel lighting control requirements have been simplified. In addition, spaces that utilize certain types of occupancy controls are no longer required to also include multilevel control. Other occupancy control requirements are now to apply in practice.

ALTERATIONS

The line between maintenance and retrofit has been redrawn. More projects are now exempt from alteration requirements. Those that are required to comply now have more options including some with reduced control requirements.

This guide is not intended to be used in lieu of California's Building Energy Efficiency Standards, and it is not a substitute for the code itself. Please visit ***energy.ca.gov/title24/2016standards*** *to download the official 2016 Title 24 Building Energy Efficiency Standards, Errata, Reference Appendices, and the Nonresidential Compliance Manual.*

INDOOR LIGHTING REQUIREMENTS

While the new Title 24 nonresidential standards contain many important updates, changes to the lighting requirements are minimal in most regards. In general, power density allotments have been reduced to reflect efficacy improvements and the increased prevalence of LED lighting in commercial buildings. For new construction, most lighting control requirements remain unchanged as compared to the 2013 Standards. For alterations, the path to compliance has become less complex. The following information details the major mandatory and prescriptive lighting requirements and critical changes between the 2013 and 2016 iterations of Title 24, Part 6.

Lighting Power Allowances

For many spaces, the allowed lighting power density has been reduced. Reductions affect projects using any of the three compliance methods: area category, complete building or tailored. Indoors, buildings such as auditoriums, libraries, schools, restaurants and medical buildings are most affected. For those using the tailored method to determine allowed lighting power, significant changes affect all space types.

Power Adjustment Factors

Two new PAF have been added to the Standards that encourage the use of institutional tuning and daylight harvesting control systems.

Now, projects may gain a 10% lighting power allowance credit for implementing institutional tuning. In daylit areas, the credit is reduced to 5%. Institutional tuning is a control strategy that sets the maximum output of a lighting system to at least 85% of full output. In many cases, lighting systems are designed to initially deliver more light than is needed because, over time, the light output will decrease. With tuning, the system can be set to deliver the right amount of light and use less energy. As light levels decrease over time, tuning adjustments can be made to increase output.

The second new PAF addresses daylight harvesting control systems that fully extinguish all the lighting when sufficient daylight is available. Projects may gain a 10% credit for this strategy when applied to luminaires in a skylit or primary sidelit daylit zone.

Three PAFs included in the 2013 Standards have been eliminated because the control strategies are now mandatory under **§130.1**.

- Partial-ON occupancy sensors in spaces less than or equal to 250 ft²
- Manual dimming or multiscene programmable dimming controls
- Credits for a combination of these measures

Lighting Power Density Updates 2013 to 2016: Area Category Method

Primary Function Area		Allowed Lighting Power Density (W/ft²) 2016	Δ
Auditorium Area		1.4[3]	↓ 0.1
Convention, Conference, Multipurpose and Meeting Center Areas		1.2[3]	↓ 0.2
Dining Area		1.0[3]	↓ 0.1
Electrical, Mechanical, Telephone Rooms		0.55[2]	↓ 0.15
Exhibit, Museum Areas		1.8	↓ 0.2
Financial Transaction Area		1.0[3]	↓ 0.2
Hotel Function Area		1.4[3]	↓ 0.1
Kitchen, Food Preparation Areas		1.2	↓ 0.4
Laundry Area		0.70	↓ 0.2
Library Area, Reading Areas		1.1[3]	↓ 0.1
Lobby Area	Hotel Lobby	0.95[3]	↓ 0.15
	Main Entry Lobby	0.95[3]	↓ 0.55
Locker/Dressing Room		0.70	↓ 0.1
Lounge Area		0.90[3]	↓ 0.2
Malls and Atria		0.95[3]	↓ 0.25
Transportation Function Area	Concourse & Baggage	0.50	—
	Ticketing	1.0	—
Waiting Area		0.80[3]	↓ 0.3
All Other Areas		0.50	↓ 0.1

Footnotes for **Table 140.6-C**: See **§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.

[2] Specialized task work	0.50 W/ft²
[3] Ornamental lighting as defined in **§100.1** and in accordance with **§140.6(c)2**.	0.50 W/ft²

Based on Table 140.6-C in the standards

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			
Daylight Dimming plus OFF Control*	Luminaires in skylit daylit zone or primary sidelit daylit zone		0.10
Occupant Sensing Controls in Large Open Plan Offices	In open plan offices >250 ft² one sensor controlling an area that is:	No larger than 125 ft²	0.40
		From 126 to 250 ft²	0.30
		From 251 to 500 ft²	0.20
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 daylit areas: Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.		0.05
Demand Responsive Control	All building types less than 10,000 sq. ft. Luminaires that qualify for other PAFs in this table may also qualify for this demand responsive control PAF.		0.05

* New for 2016

Table 140.6-A in the Standards

Lighting Controls

Mandatory lighting control requirements contain minor revisions throughout, which are designed to make requirements more consistent and easier to apply in practice. In particular, updates make occupant sensing controls more consistent in where they are required and how they are expected to perform.

MULTILEVEL LIGHTING CONTROLS

Multilevel lighting requirements are now simpler and easier to apply. The number of mandatory control steps is still based on the light source type per **Table 130.1-A**, however, the explicit requirement to also utilize manual dimming, tuning, lumen maintenance, automatic daylighting or demand response has been eliminated. Now, if multilevel lighting is required, multilevel controls need only allow the user to activate all the required control steps. If the lighting is dimmable, the multilevel control must be a dimmer that allows this function plus manual ON and OFF.

Two new exceptions to multilevel lighting requirements have also been added. Public restrooms and areas that are required to utilize full or partial-OFF occupancy sensors are now exempt from multilevel requirements contained in **§130.1(b)**.

OCCUPANCY CONTROLS

Various occupancy sensor control requirements have been clarified and expanded in the 2016 Standards. Performance requirements for partial-ON and partial-OFF occupancy control strategies are now specified based on the areas where the controls are installed.

As with the 2013 Standards, occupancy controls must shut OFF all the lighting in:

- Offices 250 ft² or smaller
- Multipurpose rooms less than 1000 ft²
- All classrooms, and all conference rooms

However, now the Standards also specify how the lighting in these spaces can be activated by the occupancy sensor. For spaces that also require multilevel lighting controls, sensors must act as a partial-ON device or a vacancy sensor. The partial-ON strategy may only automatically activate between 50 and 70% of the controlled lighting. For areas not required to have multilevel controls, the sensor may be a traditional, auto-ON occupancy sensor, a vacancy sensor, or employ a partial-ON strategy.

In addition, language pertaining to the potential use of a partial-ON control strategy has been removed from **§130.1(c)6** and **§130.1(c)7**. The 2013 Standards used the term partial-ON/OFF occupancy control when, in practice, partial-OFF was the intended strategy. This ambiguity has been removed and the term partial-OFF used throughout. All other requirements contained in **§130.1(c)6** and **§130.1(c)7** are unchanged.

DAYLIGHT HARVESTING & DEMAND RESPONSE

All automatic daylighting control requirements are unchanged from 2013. Demand response control requirements are also, essentially, unchanged from 2013, with only minor clarifications added to the 2016 code.

Emergency & Egress Lighting

Requirements have been updated to allow a small portion of lighting to operate continuously if it is noted for use along a building's means of egress. Up to 0.2 W/ft^2 of lighting in any area is now exempt from area control requirements if it meets the egress definition. Previously, the exemption only applied to office spaces during occupied hours. Multilevel control requirements still apply in accordance with **§130.1(b)**. Up to 0.1 W/ft^2 is also exempt from automatic shutoff control requirements. Previously, only 0.05 W/ft^2 was exempt.

In addition, a luminaire or lighting system is exempt from shut-OFF control requirements if it is designed only for emergency use, is connected to an emergency power supply, and functions only when normal power is absent. This exemption is new for 2016. However, if egress lighting falls within a daylit zone, automatic daylighting controls are still required as are demand response controls under most circumstances.

Acceptance Test Requirements

Acceptance tests for institutional tuning controls and "Daylight Dimming plus OFF" PAFs have been added to the Standards. These tests are designed to ensure that systems claiming these PAF meet the specific performance criteria required under **§140.6**.

Institutional tuning controls tests are documented on a new compliance form, **NRCA-LTI-05-A**. Test results for "Daylight Dimming plus OFF" are documented on the existing, automatic daylighting controls compliance form, **NRCA-LTI-03-A**.

All lighting controls acceptance tests must be conducted by a Certified Lighting Controls Acceptance Test Technician, a requirement that went into effect with the 2013 Standards. Technicians are required to recertify their credential to ensure they are up to date with the new 2016 requirements.

To learn more about Lighting Control Acceptance Testing, please visit **energy.ca.gov/title24/attcp**.

INDOOR LIGHTING ALTERATIONS

Requirements for indoor lighting alterations (**§141.0(b)2I-J**) have been simplified, reorganized and renamed. Indoor lighting alterations are now categorized into three types of projects, listed in the table to the right, and outdoor requirements are now listed under **§141.0(b)2L**. Two types of projects remain exempt from lighting alteration requirements: those that may disturb asbestos during construction and those that address only two or fewer luminaires in an enclosed space.

Compliance Threshold

For indoor luminaire component modifications, the threshold for compliance has been raised. This change allows a larger portion of maintenance projects to avoid additional lighting control and power density requirements intended for larger system retrofits. Previously, projects that addressed 40 or more luminaires or 10% of luminaires in a space were regulated under the Standards. This threshold is now 70 luminaires or 10% per year. Thresholds for the replacement of existing luminaires or addition of new luminaries remains at 10%. Most types of wiring alterations must comply with **§141.0(b)2K** regardless of their size, however, projects that only add lighting controls to an existing system are exempt.

Lighting Control Requirements

A new compliance path has been added for alterations. Now, when existing luminaires are replaced with new luminaires and no changes are made to walls or ceilings, a project may bypass additional multilevel and some occupancy control requirements by installing new products that achieve a minimum of 35% power reduction at full output as compared to the luminaires they replaced. For hotel, office and retail occupancies, the reduction must be at least 50%.

For all other types of projects and luminaire replacements not able to meet these power reduction thresholds, controls requirements are nearly identical to 2013 requirements. Per **Table 141.0-E**, alterations with over 85% of the lighting power allowance given in **§140.6(c)2** must meet most control requirements in **§130.1**, but those with 85% or less are exempt from daylighting and demand response control requirements.

One additional control requirement has been simplified. Lighting retrofit projects that are able to reduce the total lighting power to 85% or less of that allowed now must only include multilevel controls with one control step between 30% and 70% of full power. This requirement now applies to the enclosed space and not to each luminaire. As such, projects may meet this requirement by switching alternate luminaires in the space, for example. Under the 2013 Standards, the number of control steps was based on source type and could include up to four steps or require continuous dimming. Note, this is still a requirement for projects over the 85% threshold.

Indoor Lighting Alterations

Alteration	Scope of Work
Entire Luminaire Alterations (§141.0(b)2I.)	• Remove & reinstall existing luminaires • Remove existing luminaires, replace with new • Add new luminaires • Adding, removing, or replacing ceiling or walls along with any redesign of the lighting system
Luminaire Component Modifications (§141.0(b)2J.)	• Lamp and ballast/driver replacement • Permanently changing the light source type in an existing luminaire • Changes to the luminaire's optical system
Lighting Wiring Alterations (§141.0(b)2K.)	• New circuits • Replace, modify, or relocate wiring between a switch and a luminaire • Replace, modify or relocate wiring between a panelboard and a luminaire • Replacement of existing lighting control panels, panelboards, or branch circuiting with new

What is considered a building 'Space' under the new Standards?

For complete luminaire and wiring alterations, the compliance threshold applies to the 'enclosed space', a space substantially surrounded by walls, ceilings or roofs, fenestration, floors or ground.

For component modifications, the compliance threshold applies to any single building floor, or if there are multiple tenants on the floor, the individual tenant space.

LIGHTING WIRING ALTERATIONS

Controls requirements for lighting wiring alterations have been reduced in the new Standards. Projects are no longer required to meet the full suite of multilevel, automatic daylighting and demand response control requirements. Area controls are always required and lighting wiring alterations must meet the lighting power allowances provided in **§140.6**.

Under the 2016 Standards:

- **Multilevel Controls**— only one control step for the enclosed space as a whole between 30 and 70%
- **Automatic Daylighting Controls**— only required if alteration affects 10 or more luminaires in a primary sidelit or skylit daylit zone
- **Demand Response Controls**— no longer required

Lamp and Ballast / Driver Replacements

Ballast or driver replacements are not regulated by the Standards. Lamp replacements only or ballast/driver replacements only are both considered exceptions to **§141.0(b)2J**. However, a complete lamp and ballast/driver retrofit completed as a single project is considered a regulated alteration under the 2016 Standards and must meet lighting power density requirements in **§140.6** and controls requirements per **§141.0(b)2J**.

Acceptance Testing

Indoor lighting alterations must comply with acceptance test requirements contained in **§130.4**. When a project adds lighting controls to control 20 or fewer luminaires in total, the project is exempt. As an example, a project that adds three occupancy sensors with each controlling five luminaires, is exempt from acceptance test requirements. However, a project that adds three occupancy sensors with each controlling 10 luminaires is not. This exemption is new for 2016.

OUTDOOR LIGHTING REQUIREMENTS

Allowed Lighting Power

Lighting power allowances (LPA) for outdoor spaces have been reduced for hardscapes and building entrances or exits. Reductions range from 11–56% for general hardscape lighting with the most significant reductions affecting linear and area wattage allowances for Zones 1–4. In addition, ATM, tunnel and bridge lighting are no longer exempted from LPA calculations. Values for all outdoor areas in Lighting Zones 0–4 are shown in **Tables 140.7-A** and **140.7-B** of the Standards. Values have been lowered to reflect the industry shift to LED lighting as the basis of design.

Outdoor Power Allowance Updates – 2013 to 2016

Type of Power Allowance	Lighting Zone 0	Lighting Zone 1		Lighting Zone 2[1]		Lighting Zone 3[1]		Lighting Zone 4	
Area Wattage Allowance (AWA)	No allowance	0.02 W/ft²	↓42%	0.03 W/ft²	↓33%	0.04 W/ft²	↓35%	0.05 W/ft²	↓56%
Linear Wattage Allowance (LWA)		0.15 W/lf	↓40%	0.25 W/lf	↓44%	0.35 W/lf	↓41%	0.45 W/lf	↓47%
Initial Wattage Allowance (IWA)		340W	No Change	450W	↓11%	520W	↓32%	640W	↓37%

[1] For 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 0.035W/ft² for Lighting Zone 2 and 0.040W/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.

Based on Table 140.7-A in the Standards

In addition, **Table 140.7-A** has been modified to incorporate the new requirements of the recently revised Illuminating Energy Society of North America (IES) document RP-20-2014, Parking Lot Lighting Recommended Practice.

Lighting Zone 0

Requirements for Lighting Zone 0 have been added to the Standards. Lighting Zone 0 is designated specifically for undeveloped areas in parks and preserves, where no continuous lighting is intended.

While continuous lighting in Zone 0 is now explicitly prohibited, sites may utilize a single luminaire of 15W or less at entrances to parking lots, trail heads, or other areas in order to safely illuminate site facilities. In addition, luminaires installed in Lighting Zone 0 cannot exceed the maximum zonal lumen limits for Uplight and Glare specified in **Table 130.2-A** and **130.2-B** of the Standards.

Lighting Controls

Outdoor lighting controls requirements have changed, expanding to include more provisions for outdoor sales canopies and outdoor sales lots, which were previously exempt from occupancy-based dimming controls requirements contained in **§130.2(c)3**.

Outdoor controls must turn off all the lighting during the day and reduce or fully extinguish it at night when its not needed. These requirements are unchanged from the 2013 Standards and two types of control are required to achieve these goals. A photocontrol or astronomical time-switch is required to turn lights OFF during the day. At night, a motion sensor or time-based control is also required. The specific types of allowed devices are dependent on the mounting height of the luminaire.

Motion sensors in outdoor areas work well as a partial-OFF device, meaning they turn off only a portion of the lights at night. This saves energy and maintains a low light level for safety and wayfinding.

Automatic Lighting Controls for Outdoor Luminaires Mounted at 24 feet or Less from Grade

	NEW CONSTRUCTION	ALTERATIONS	
	All Regulated Projects	Connected Lighting Load is Increased Any Size Project	Connected Lighting Load is not Increased Greater of 5 Luminaires or 10% affected
Outdoor Sales Frontage	• Photocontrol or outdoor astronomical time-switch • Part-night control or motion sensor	• Photocontrol or outdoor astronomical time-switch • Part-night control or motion sensor	• Photocontrol or outdoor astronomical time-switch • Motion sensor or lighting must be independently controlled from all other lighting by a time-switch
Outdoor Sales Lots			• Photocontrol or outdoor astronomical time-switch • Part-night control or motion sensor
Parking Lots			

Building Facades*	• Photocontrol or outdoor astronomical time-switch
	• One of following:
	  • Part-night control
	  • Motion sensor
	  • Centralized, time-based control system
		• Photocontrol or outdoor astronomical time-switch
		• One of following:
		  • Part-night control
		  • Motion sensor
		  • Centralized, time-based control system
			• Photocontrol or outdoor astronomical time-switch
			• Motion sensor or lighting must be independently controlled from all other lighting by a time-switch

Ornamental Hardscape			
Outdoor Dining			
All Other General Hardscape	• Photocontrol or outdoor astronomical time-switch • Part-night control or motion sensor	• Photocontrol or outdoor astronomical time-switch • Part-night control or motion sensor	

* Wallpacks mounted to building facades must use motion sensors.

For certain outdoor luminaires mounted 24 feet or less above the ground, motion sensors or other occupancy-based controls are required as part of the night time control strategy. All incandescent luminaires must be controlled by a motion sensor. For all other luminaires mounted over 24 feet, motion sensors are not explicitly required. The table on the previous page details the various control requirements for luminaires mounted 24 feet or below based on the type of outdoor area.

The maximum dimming permitted as part of an active motion controlled lighting system has increased from 80% to 90%. In addition, outdoor lighting is no longer required to be separately circuited from other lighting, only separately controlled.

All outdoor lighting control provisions may be found in **§130.2** of the Standards.

Acceptance Test Requirements

In conjunction with these changes, acceptance test requirements and procedures for many types of outdoor automatic shut-OFF controls have been clarified and/or expanded. Specific functional tests for photocontrols, astronomical timeswitch controls and part-night controls are now available. Information on the updated requirements may be found in **Nonresidential Appendix 7, Section 8 (NA7.8)**.

Lastly, an alteration project where lighting controls are added to control 20 or fewer luminaires in total is now exempt from acceptance testing requirements contained in **§130.4**.

Outdoor Alterations

Requirements for outdoor lighting alterations are now more detailed and specific to the type of outdoor space. Previously, any project that met compliance thresholds was required to address all lighting control provisions contained in **§130.2**. Now, only the altered or new luminaires must comply, and the minimum threshold for projects that do not increase the connected lighting load has been raised to the greater of five luminaires or 10%. Under the 2013 Standards, small projects that addressed 1–4 luminaires were expected to comply with the full suite of controls requirements. This is no longer the case.

As with the 2013 Standards, when 50% or more luminaires are being replaced, the project must comply with lighting power and other requirements contained in **§140.7**. Under the new Standards, an exception to this rule has been added. If the new luminaires have at least 40% lower power consumption, the alteration is not required to comply with **§140.7**.

ABOUT THE CALIFORNIA LIGHTING TECHNOLOGY CENTER: *The California Lighting Technology Center was created in 2003 by the California Energy Commission in collaboration with the U.S. Department of Energy and the National Electrical Manufacturers Association. Part of the Department of Design at the University of California, Davis, CLTC is dedicated to accelerating the development and deployment of energy-efficient lighting and daylighting technologies.*

ABOUT ENERGY CODE ACE: *Developed and provided by the California Statewide Codes & Standards Program, Energy Code Ace offers free energy code training, tools and resources for those who need to understand and meet the requirements of Title 24, Part 6 and Title 20. The program aims to advance the adoption and effective implementation of energy efficiency measures and building practices to lock in long-term energy savings. For more information, visit* ***energycodeace.com****.*

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