

Mandatory Lighting and Lighting Controls Requirements

Title 24, Part 6, 2013

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Mission

To accelerate the development and commercialization of energy-efficient lighting and daylighting technologies in partnership with utilities, manufacturers, end users, builders, designers, researchers, academics, and governmental agencies.

MISSION-DRIVEN ACTIVITIES:

- Research & Development
- Demonstration & Outreach
- Education & Training













FOUNDING ORGANIZATIONS



UTILITIES



MANUFACTURERS



LARGE END-USERS



Lighting & Energy Efficiency

Luminous Efficacy

- **One time, long duration change**
- **Reduction of baseline**
 - Light Source Efficacy
 - Luminaire Efficacy
 - Application Efficacy

Lighting Controls

- **Continuous, real-time change**
- **Fluctuations from base line**
 - Occupancy / Vacancy
 - Daylighting
 - Demand Response
 - Tuning
 - Personal Control



Adaptive Lighting Systems...

automatically adjust their light output...

- Total Luminous Flux
- Spectral Power Distribution
- Candle Power Distribution

based on sensor input from the space they serve...

- Occupancy / Vacancy
- Daylight
- DR Signals

to optimize space and building performance.

- Comfort
- Energy Savings
- Peak Demand Reduction



Integrated Control Strategy

During occupancy focus on **comfort**

- Adjust fenestration for daylight penetration
- Adjust electric lighting for daylight contribution
- Offer manual control options
- Adjust electric lighting for demand response signal
- Adjust HVAC

During vacancy focus on **energy efficiency**

- Adjust fenestration for cooling/heating loads
- Turn electric lighting off or dim down
- Adjust electric lighting for demand response signal
- Adjust HVAC



Select the Appropriate

Source + Luminaire + Controls for the application





Photo: Cree, Inc.



Repairs, Alterations and MIPs



What is a repair?

“Reconstruction or renewal for the purpose of maintenance of any component, system, or equipment of an existing building.” Sec. 100.1

- Replacement **in kind** of lamps, lamp holders, or lenses
- Alterations caused directly by the disturbance of asbestos
- Repairs may not increase the energy consumption of the repaired equipment.
- If you replace any component, system, or equipment that is regulated by Title 24, that modification is considered an alteration and not a repair.

Repairs are not intended to trigger Title 24.



What is an alteration?

“Lighting System Alterations include alterations where an existing lighting system is modified, luminaires are replaced, or luminaires are disconnected from the circuit, removed and reinstalled, whether in the same location or installed elsewhere. Any change to the lighting system that is not part of an addition.” Sec. 141.0 (I) ii

- Luminaire replacement
- Luminaire removal or relocation
- Wiring alterations
- Connecting luminaires to switches, relays, branch circuits, and other controls

Alterations trigger Title 24 requirements.

Alterations

- More projects will be required to comply with both lighting power density (LPD) and mandatory controls measures.
- Trigger point moved to 10% of the luminaires in an enclosed space.
- Consistent with ASHRAE 90.1-2010.
- There are several layers of exceptions.



Luminaire alterations

TABLE 141.0-E Requirements for Luminaire Alterations

Quantity of existing affected luminaires per Enclosed Space ¹	Resulting Lighting Power for Each Enclosed Space	Applicable Mandatory Control Provisions for Each Enclosed Space	Multi-level Lighting Control Requirements for Each Altered Luminaire
Alterations that do not change the area of the enclosed space or the space type			
Sum total < 10% of existing luminaires	Existing lighting power is permitted	Existing provisions are permitted	Existing controls are permitted
Sum total ≥ 10% of existing luminaires	≤ 85% of allowed lighting power per Section 140.6 Area Category Method	§130.1(a), (c)	Two level lighting control ² or §130.1(b)
	> 85% of allowed lighting power per Section 140.6 Area Category Method	§130.1(a), (c), (d) ³	§130.1(b)
Alterations that change the area of the enclosed space or the space type or increase the lighting power in the enclosed space			
Any number	Comply with Section 140.6	§130.0(d) ³ §130.1(a), (c), (d) ³ , (e)	§130.1(b)
1. Affected luminaires include any luminaire that is changed, replaced, removed, relocated; or, connected to, altered or revised wiring, except as permitted by EXCEPTIONS 1 and 2 to Section 141.0(b) 2Iii: 2. Two level lighting control shall have at least one control step between 30 and 70% of design lighting power in a manner providing reasonably uniform illuminations 3. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are altered.			

Lighting controls requirements

Indoor

130.1 (a) = area controls

130.1 (b) = multi-level lighting controls

Source Dimmability

130.1 (c) = shut off controls

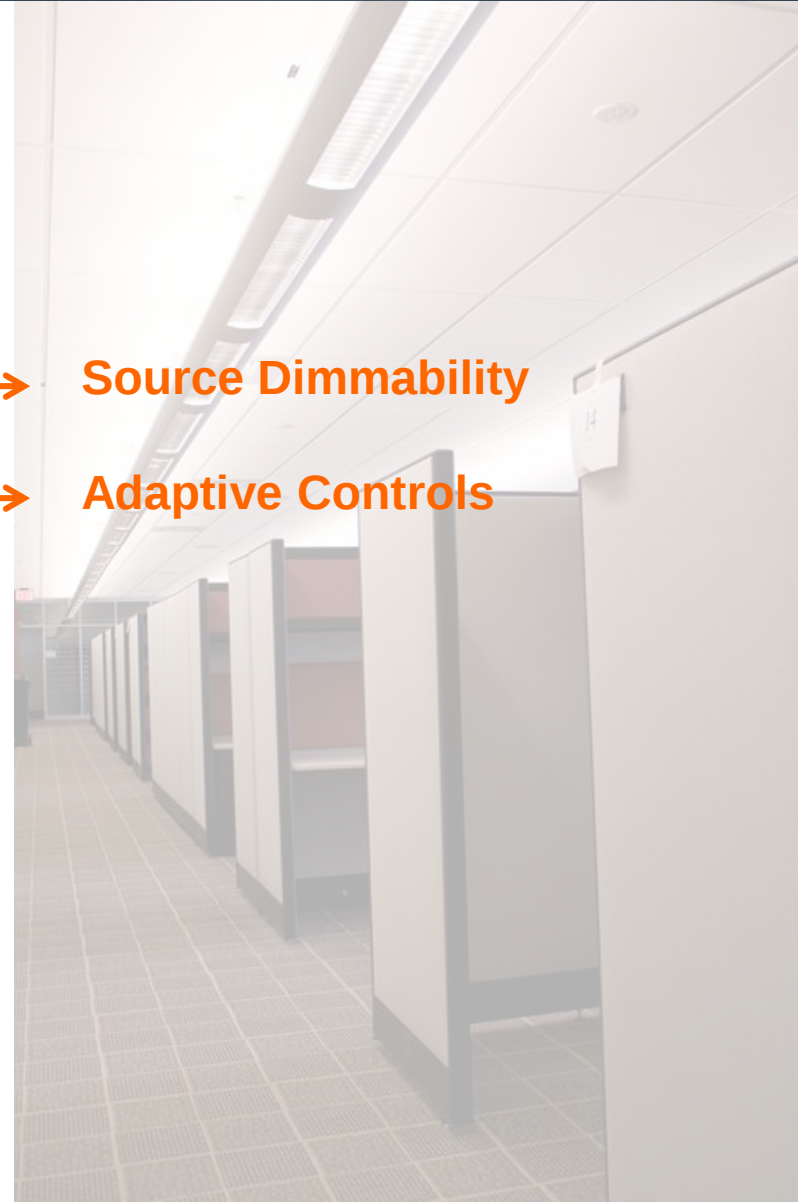
Adaptive Controls

130.1 (d) = daylighting

130.1 (e) = demand response

Outdoor

130.2 (c)



What is a luminaire modification-in-place?

- Source switch to another type (ex: fluorescent >> LED)
- Lamp and ballast upgrades
- Reflector or optical system modifications
- Luminaire retrofit kits
- Luminaire replacements, one-for-one

These trigger a slightly different set of code requirements than those for alterations.



Luminaire modifications-in place

TABLE 141.0-F-Requirements for Luminaire Modifications-in-Place

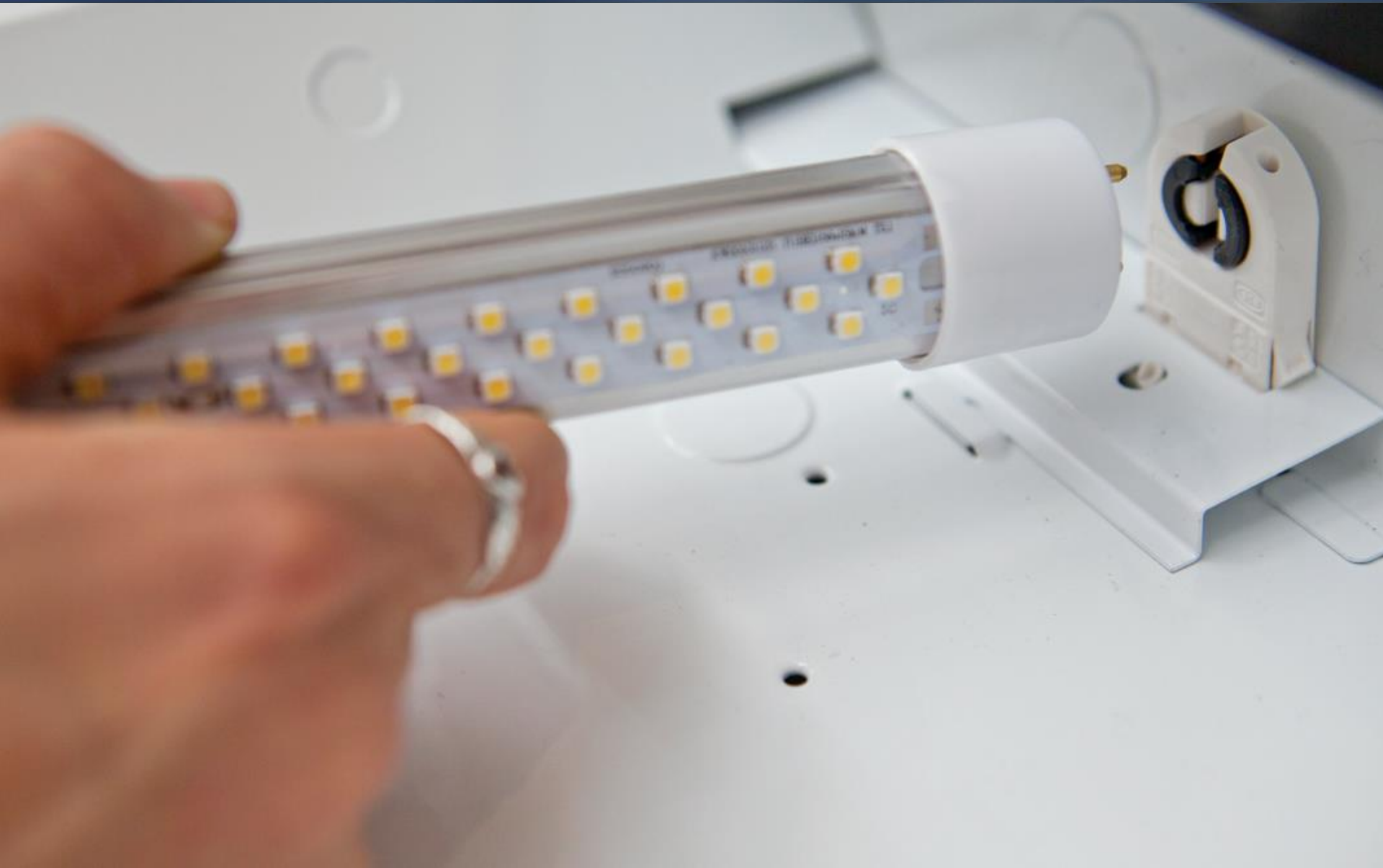
For compliance with this Table, building space is defined as any of the following:

1. A complete single story building
2. A complete floor of a multi floor building
3. The entire space in a building of a single tenant under a single lease
4. All of the common, not leasable space in single building

Quantity of affected luminaires per Building Space per annum	Resulting Lighting Power per Each Enclosed Space Where $\geq 10\%$ of Existing Luminaires are Luminaire Modifications-in-Place	Applicable mandatory control provisions for each enclosed space ¹	Applicable multi-level lighting control requirements for each modified luminaire ²
Sum total < 40 Luminaire Modifications-in-Place	Existing lighting power is permitted	Existing provisions are permitted	Existing controls are permitted
Sum total ≥ 40 Luminaire Modifications-in-Place	$\leq 85\%$ of allowed lighting power per Section 140.6 Area Category Method	§130.1(a), (c)	Two level lighting control ³ Or §130.1(b)
	$> 85\%$ of allowed lighting power per Section 140.6 Area Category Method	§130.0(d) ⁴ §130.1(a), (c), (d) ⁴	§130.1(b)

1. Control requirements only apply to enclosed spaces for which there are Luminaire Modifications-in-Place.
2. Multi-level controls are required only for luminaires for which there are Luminaire Modifications-in-Place.
3. Two level lighting control shall have at least one control step between 30% and 70% of design lighting power in a manner providing reasonably uniform illuminations
4. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are modified-in-place.

Tubular LEDs



LED Retrofit options for Linear Fluorescent Luminaires

<http://cltc.ucdavis.edu/publication/led-retrofit-options-linear-fluorescent-lighting>



LED RETROFIT OPTIONS FOR LINEAR FLUORESCENT LUMINAIRES

Fluorescent lamps currently dominate the commercial sector, where they account for 80 percent of installed lamps.¹ LED lighting products are receiving a great deal of attention for their potential to replace fluorescent lighting, reduce energy use and improve lighting quality in a variety of indoor commercial applications, including offices, classrooms and retail stores.

LED alternatives to fluorescent lighting products fall into three main categories: tubular lamps, retrofit kits and dedicated luminaires. This guide provides the latest available information on each of these three rapidly developing lighting product categories, including safety precautions and labor requirements.

¹ Department of Energy, 2010 U.S. Lighting Market Characterization. Prepared by Navigant Consulting for DOE Solid-State Lighting Program, 2012, p. 44.

TABLE 140.6-C: AREA CATEGORY METHOD — LIGHTING POWER DENSITY VALUES (W/FT²)

PRIMARY FUNCTION AREA		ALLOWED LIGHTING POWER (W/FT ²)	PRIMARY FUNCTION AREA		ALLOWED LIGHTING POWER (W/FT ²)
Auditorium Area		1.5 ³	Library Area	Reading Areas	1.2 ³
Auto Repair Area		0.9 ²		Stack Areas	1.5 ³
Beauty Salon Area		1.7	Lobby Area	Hotel lobby	1.1 ³
Civic Meeting Place Area		1.3 ³		Main entry lobby	1.5 ³
Classroom, Lecture, Training, Vocational Areas		1.2 ⁵	Locker/ Dressing Room		0.8
Commercial and Industrial Storage Areas (conditioned and unconditioned)		0.6	Lounge Area		1.1 ³
Commercial and Industrial Storage Areas (refrigerated)		0.7	Malls and Atria		1.2 ³
Convention, Conference, Multipurpose and Meeting Center Areas		1.4 ³	Medical and Clinical Care Area		1.2
Corridor, Restroom, Stair, and Support Areas		0.6	Office Area	> 250 square feet	0.75
Dining Area		1.1 ³		≤ 250 square feet	1.0
Electrical, Mechanical, Telephone Rooms		0.7 ²	Parking Garage Area	Parking Area	0.14
Exercise Center, Gymnasium Areas		1.0		Dedicated Ramps	0.3
Exhibit, Museum Areas		2.0		Daylight Adaption zones ⁹	0.6
Financial Transaction Area		1.2 ³	Religious Worship Area		1.5 ³
General Commercial and Industrial Areas	Low bay	0.9 ²	Retail Merchandise Sales, Wholesale Showroom Areas		1.2 ^{6and7}
	High bay	1.0 ²	Theater Area	Motion Picture	0.9 ³
	Precision	1.2 ⁴		Performance	1.4 ³
Grocery Sales Area		1.2 ^{6and7}	Transportation Function Area		1.2
Hotel Function Area		1.5 ³	Videoconferencing Studio		1.2 ⁵
Kitchen, Food Preparation Areas		1.6	Waiting Area		1.1 ³
Laboratory Area, Scientific		1.4 ¹	All other Area		0.6
Laundry Area		0.9			

Selected changes from 2008 – 2013

PRIMARY FUNCTION AREA		ALLOWED LIGHTING POWER (W/ft ²)	
		2013	2008
Office Area:	> 250 square feet	0.75	0.9
	< 250 square feet	1	1.1
Parking Garage Area:	Parking Area	0.14	0.2
	Dedicated Ramps	0.3	0.6
Retail Merchandise Sales, Wholesale Showroom Areas		1.2	1.6

PAFs for 2013 code: Table 140.6-A

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
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
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

Indoor Lighting Controls Requirements

Area controls

- All luminaires must have manual switching
- Each area of a building must be separately controlled
 - An area is defined by floor-to-ceiling partitions
- Up to **0.2 watts** of egress lighting may be excepted from this requirement during occupied times.
 - Down from **0.3 watts** in 2008



Separately controlled lighting systems

- General lighting must be separately controlled
- Floor and wall display, window display, case display, ornamental, and special effects lighting must be separately controlled
- Track lighting: general, display, ornamental, and special effects lighting must be separately controlled



Image credit: Acuity

Multi-level lighting control: 130.1 (b)

- Areas with LPD greater than **0.5 W/ft²**
- Requirements based on **source type**
- **One additional control strategy required**, *previously no additional requirements*
- There are some exceptions



Image Courtesy of Acuity Brands

Table 130.1-A

Any area $\geq 100 \text{ ft}^2$ with a connected lighting load $> 0.5 \text{ W/ft}^2$ must meet the control and uniformity requirements in Table 130.1-A, with each luminaire controlled by at least one of the following control strategies:

- Manual dimming
- Lumen maintenance
- Tuning
- Automatic daylighting
- Demand response

MULTI-LEVEL LIGHTING CONTROLS AND UNIFORMITY REQUIREMENTS		
Luminaire Type	Minimum Required Control Steps (Percent of Full Rated Power)	Uniform Level of Illuminance Shall Be Achieved by:
Line-voltage sockets except GU-24	Continuous dimming 10–100%	
Low-voltage incandescent systems		
LED luminaires and LED source systems		
GU-24 rated for LED		
GU-24 sockets rated for fluorescent $> 20 \text{ W}$	Continuous dimming 20–100%	
Pin-based compact fluorescent $> 20 \text{ W}$		
GU-24 sockets rated for fluorescent $\leq 20 \text{ W}$	Minimum one step between 30–70%	• Stepped dimming or • Continuous dimming or • Switching alternate lamps in a luminaire
Pin-based compact fluorescent $\leq 20 \text{ W}$		
Linear fluorescent and U-bent fluorescent $\leq 13 \text{ W}$		
Linear fluorescent and U-bent fluorescent $> 13 \text{ W}$	Minimum one step in each range: 20–40% 50–70% 80–85% 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%	• Step dimming or • Continuous dimming or • Separately switching circuits in multi-circuit track with a minimum of two circuits
HID $> 20 \text{ W}$	Minimum one step between 50–70%	• Stepped dimming or • Continuous dimming or • Switching alternate lamps in each luminaire, having a minimum of 2 lamps per luminaire, illuminating the same area and in the same manner
Induction $> 25 \text{ W}$		
Other light sources		

Lumen Maintenance

“a strategy used to provide a precise, constant level of lighting from a lighting system regardless of the age of the lamps or the maintenance of the luminaires.”

Compares the amount of light currently produced to the amount of light produced when the luminaire was brand new

L70 = the number of hours it takes for the lumen output to shrink to 70% of initial output



Albeo™ LED Luminaire – ABH2

Modular High & Low Bay Lighting

The award winning Albeo™ ABH-series LED Luminaire utilizes innovative heat-sinking and cutting-edge LED technology to deliver a wide range of light outputs that replace 250W-1,500W HID and four-to-eight lamp T5/T8 high intensity fluorescent fixtures in high bay applications. The ABH2-series offers higher efficacy than previous generations and can be matched with motion, daylight and wireless controls for increased energy savings, lower maintenance costs and shorter paybacks.

Features

- Modular design: 1, 2, 3, 4 and 6 modules
- Lumen output: 6,900-57,600 lm
- Optics: 20°, 30°, 40°, 80°, 120°, 120° diffuse, 30° diffuse
- Cable/chain, rod, indirect, or pendant mount
- 4000K or 5000K CCT
- 70 or 80 CRI
- Daylight, motion and wireless controls
- 0-10V dimming
- Lifetime: L70 at 100,000 hours
- 5-year limited system warranty

Applications

- High and low bay lighting
- Racked aisles or open floor plan
- Warehouse, cold storage, industrial, gymnasiums, sports arenas, retail, high-ceiling spaces
- Designed to meet recommended luminance and illuminance requirements for high & low bay lighting applications in industrial and commercial buildings.

Multi-level exceptions

Classrooms with connected load of $\leq 0.7 \text{ W} / \text{ft}^2$ must have at least one control step between 30–70% of full power.

Areas with only one luminaire and no more than two lamps are exempt



Image Courtesy of Acuity Brands

Shut-off Controls

Indoor lighting must have controls that:

- Automatically turn off lighting when unoccupied
- Controls each floor of a building separately
- Controls each space of a building separately

Shut-off controls exceptions

- Where the lighting is in use 24/7, 365 days a year
- Lighting for emergency egress
- Electrical equipment rooms



Occupant sensing controls required to shut off all lighting when area is vacant

- Offices 250 ft² or smaller
- Multipurpose rooms 1000 ft² or smaller
- Classrooms
- Conference rooms



Egress

Reduced exception for egress lighting

2008: 0.3 W/ft² anywhere

2013: Maximum security and egress lighting allowance of **0.2 W/ft²** when a building is occupied

- General and egress lighting must be **shut off** during unoccupied times
- **Exception:** Offices are allowed up to **0.05 W / ft²** for lighting during unoccupied periods along emergency egress areas designated on the building plans. This lighting is not required to be connected to automatic shut-off controls.



Countdown timers

- Countdown timer switches may only be used in:
 - Single-stall bathrooms < 70 ft²
 - Closets < 70 ft²
 - Aisles in server rooms, max 30 min time out



Automatic Time-switch controls

If an automatic time-switch control, other than an occupancy sensor, is used to comply with this section it should have an override that:

- Allows lighting to remain on for no more than two hours
 - Does not apply to retail spaces, restaurants, grocery stores, churches, and theatres
- Has an automatic holiday shut-off
 - Exception: retail stores, places of worship, theaters (i.e. places where people go on holidays)



Guest rooms in hotels / motels

Key card activated hotel and motel guest rooms:
Lighting OFF after 30 minutes

Hotel/motel rooms: allows for one high efficacy luminaire with a switch within 6 feet of door



Partial ON/OFF: Changes from 2008

Specific requirements for
partial ON/OFF occupancy sensors;
none required in 2008

- Library book stacks*
- Stairwells and corridors*
- Warehouse aisle ways and open areas*
- Parking garages
- Other indoor parking areas
- Indoor loading and unloading zones

** in addition to automatic time switch controls*

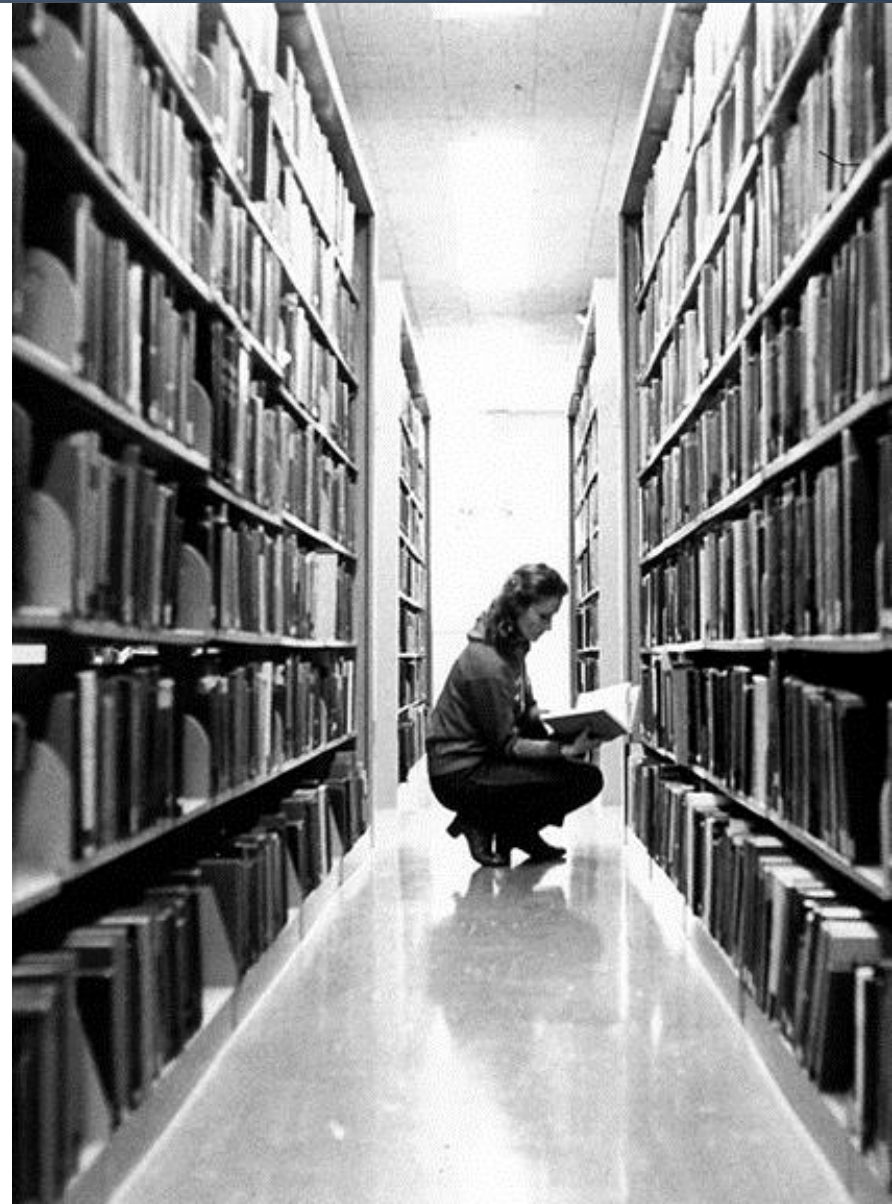


Reduce on vacancy, then off at COB

Areas where partial ON/OFF occupant sensing controls are required **in addition to** full automatic shut-off at COB:

- Stairwells
- Corridors
- Aisle ways and open areas in warehouses
- Library book stack aisles, 10 feet or longer

Reduce by 50% power on vacancy, increase when occupied



Reduce on vacancy, rather than off

Areas where partial ON/OFF occupant sensing controls are required **instead of** full automatic shut-off at COB:

- Stairwells and common area corridors in high-rise residential buildings and hotel/motels:
≥ 50% reduction
- Parking: one step between 20-50%: Indoor parking and loading/unloading areas
 - Control $\leq 500\text{W}$ per zone



Low-rise Multi-family Common Areas

A multi-family complex consists of four or more dwelling units. A low-rise is considered a building with three or fewer stories.

- All hardwired lighting must be high efficacy or controlled by a occupant sensor
- The occupant sensor must be directly on the walkway and/or view the entire space

If the building has more than three stories the common areas must comply with the nonresidential code.

*In the 2008 code: see 150 (k)16
In the 2013 code: see 150.0 (k)12*



2013 Low-rise Multi-family Common Areas

- In buildings where common areas constitute $> 20\%$ of the floor space:
 - Lighting must comply with the nonresidential standards
 - Lighting in corridors and stairwells **must** be controlled by occupancy sensors that reduce lighting power by at least 50%

In buildings with common areas that are $\leq 20\%$ of the floor space:

- All hardwired lighting must be high efficacy **or** controlled by an occupancy sensor



Image credit: The Hanover Co.

Daylighting Controls: Changes from 2008

- Manual controls requirement removed; automatic controls now required in all spaces
- Area size exemptions removed
- Calculation method for daylit zones = simplified!
- Parking garages are now included; previously exempt



Daylight Zones

Regions within a building that are close enough to a source of daylight that daylight harvesting is possible are considered within a “daylight zone.”

- **Skylit Zone:** An area illuminated by one or more skylights
- **Primary Sidelit Zone:** A daylight area directly adjacent to one or more windows
- **Secondary Sidelit Zone:** An area not directly adjacent to a window that still receives some daylight through its proximity to the window

Daylight zones must be marked on the building floor plans.

Daylighting Controls

- Luminaires in primary sidelit and skylit areas must have photocontrols
- Luminaires that fall in both sidelit and skylit zones are controlled by skylit zone
- Show primary sidelit and skylit zones on the plans
- When using the prescriptive method, the automatic daylighting controls requirements for primary sidelit zones also apply to general lighting luminaires that are at least 50% in a secondary sidelit zone.



Daylighting Controls

- Daylit zones should be controlled with the multi-level steps in Table 130.1-A unless $LPD < 0.3 \text{ W/ft}^2$
- Light levels provided at night should be available at all other times
- When sufficient daylight is available, lighting power must be reduced by at least 65%



Daylighting for Parking Garages

- Show primary and secondary zones on plans
- Automatic controls required in both primary and secondary zones, control each zone separately
- When ample daylight is available in primary zone, lighting power consumption = ZERO
- Parking garage areas with $\geq 36 \text{ ft}^2$ of glazing or opening must have automatic daylighting controls.



Demand Response

- Buildings $> 10,000 \text{ ft}^2$
- Alterations that increase the connected load within a space in a building that $> 10,000 \text{ ft}^2$
- Reduce lighting power at least 15%
- Spaces that are non-habitable or with a lighting power density of $< 0.5 \text{ W/ft}^2$ shall not be used to comply with the DR requirement



Mandatory Device Requirements

Majority of lighting control devices are now regulated by the California Appliance Efficiency Standards, Title 20:

- Time switch controls
- Daylighting controls
- Dimmers
- Occupant sensing devices
- Part-night outdoor lighting controls

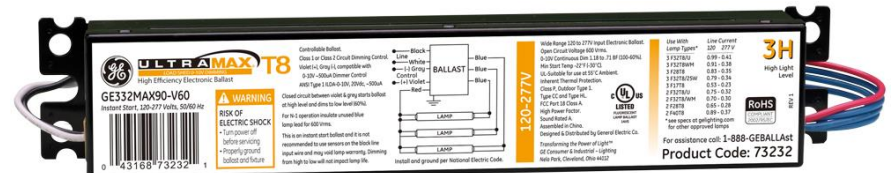


Images: Lutron

Mandatory Device Requirements

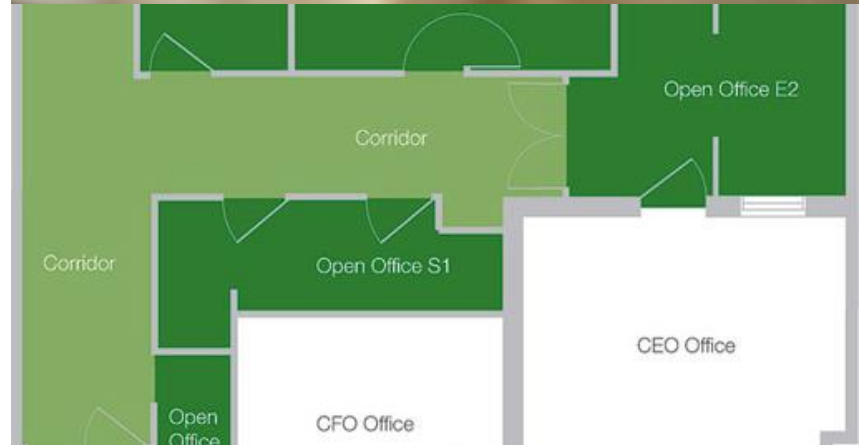
Lighting devices regulated by California Appliance Efficiency Standards, Title 20 and Certified to the Energy Commission:

- Fluorescent lamp ballasts
- Lighting control devices and lighting control systems
- Track lighting: integral current limiters and supplementary overcurrent protection panel
- High efficacy LED light sources
- Ballasts for residential recessed luminaires



Certified Lighting Controls ATT

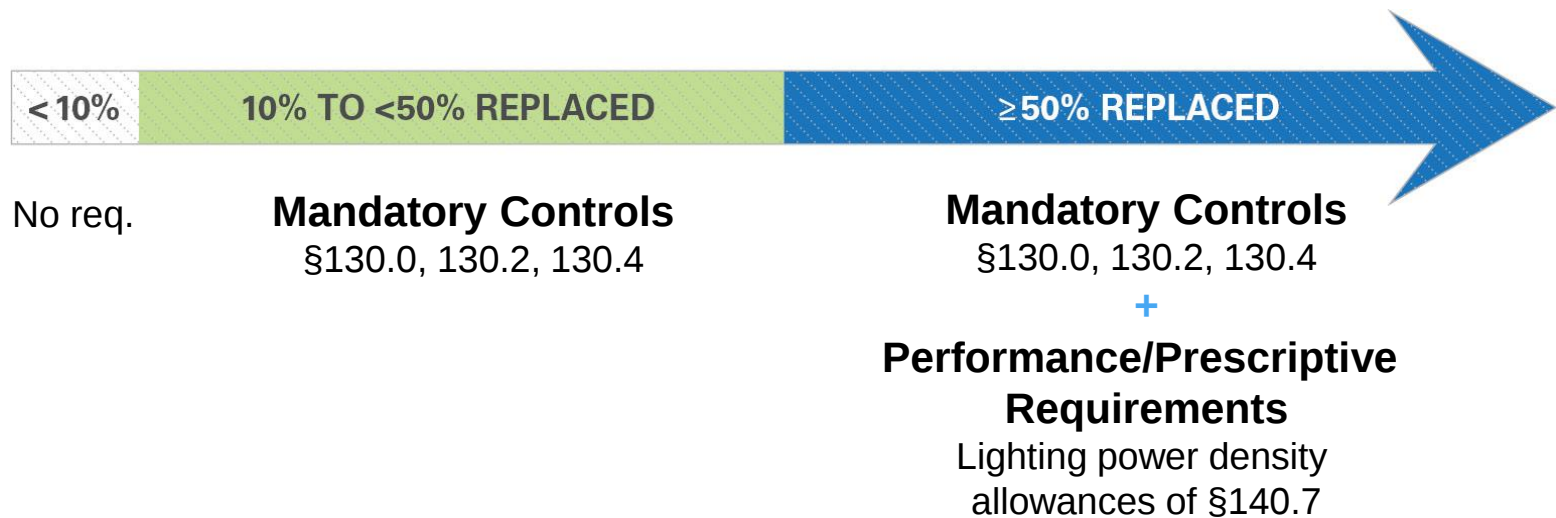
- Conducted by certified field technicians
- Verifies installation requirements are met
- Ensures installed equipment and systems operate properly
 - Automatic Daylighting Controls
 - Automatic Time Switch Controls
 - Occupancy Sensor
 - Demand Response Controls
 - Outdoor Lighting Shut-off Controls
 - Outdoor Motion Sensor



CALCTP
www.calctp.org

Outdoor Lighting Control Requirements

Additions and Alterations



Any alteration that increases the connected lighting load must meet all mandatory, prescriptive, or performance measures that are required.

Outdoor lighting

- Photocontrol AND a automatic scheduling control is required
- An astronomical time switch maybe used in lieu of this combination, covering both strategies
- Outdoor lighting must be circuited and independently controlled from other electric loads.



Lighting mounted ≤ 24 ft above the ground

Motion controls required:

- Auto-ON when the areas become occupied
- Automatic step-dimming or continuous dimming when areas are vacant
- No more than 1,500 W of lighting with a mounting height of 24 ft and under may be controlled together



Full



Dimmed

Outdoor lighting ≤ 24 ft

A few exceptions apply:

- Pole-mounted luminaires with a maximum rated wattage of 75 W
- Non-pole-mounted luminaires with a maximum rated wattage of 30 W
- Linear lighting with a maximum rated wattage of 4 W per linear foot of luminaire



Frontage areas, lots, sales canopies

A part-night outdoor lighting control, **or**

Auto-on motion sensor that automatically reduces lighting power by at least 40% power when spaces are vacant



Images Courtesy of Lithonia Lighting

Facades, outdoor dining, ornamental

A part-night outdoor lighting control, **or**

Auto-ON motion sensors that reduce lighting power by at least 40% but no more than 80%, **or**

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



Image Courtesy of Lithonia Lighting

Outdoor lighting

All outdoor incandescent luminaires rated over 100 W and installed for non-residential use must be controlled by a motion sensor **in addition to** photocontrols **and** scheduling controls.



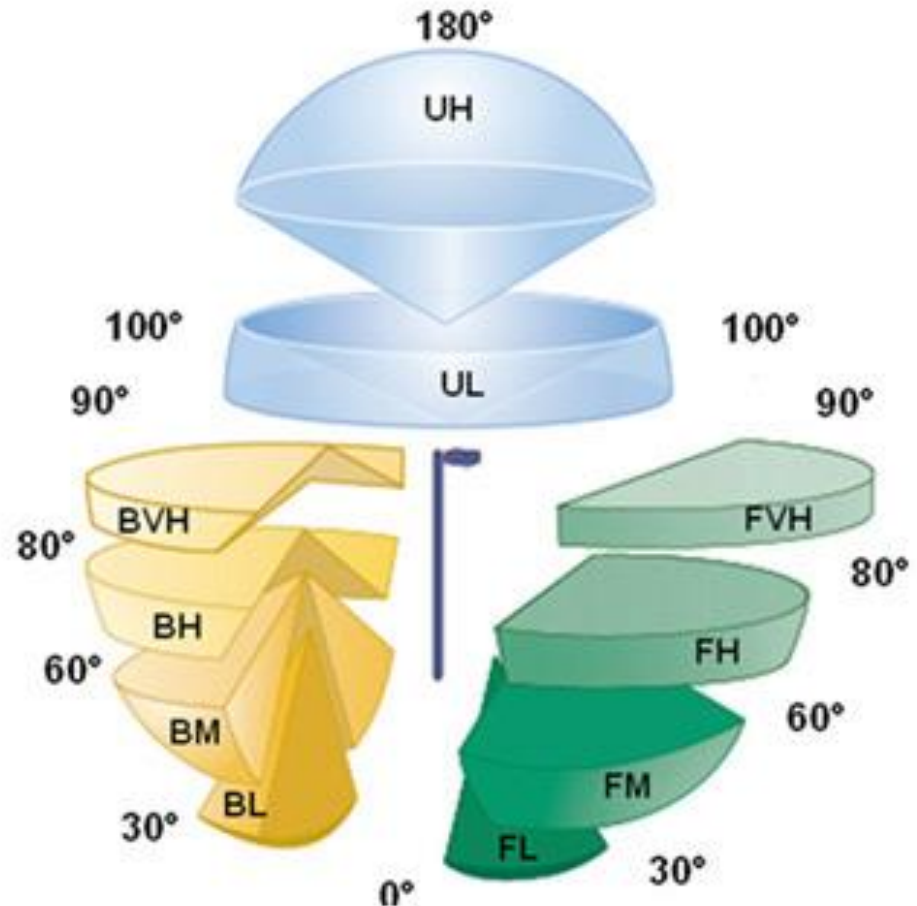
Left and Right Images Courtesy of Lithonia Lighting

(Backlight), Uplight and Glare Control

2013 code requires all outdoor luminaires ≥ 150 W to comply with the IES BUG system for assessing and limiting backlight, uplight and glare.

There are **no** Backlight requirements in Section 130.2 of Part 6

Change from the older cutoff system in 2008 standards, which applied to luminaires ≥ 175 W



Required indoor forms

Compliance:

1. **NRCC-LTI-01-E** Indoor Lighting
2. **NRCC-LTI-02-E** Indoor Lighting Controls
3. **NRCC-LTI-03-E** Indoor Lighting Power Allowance
4. **NRCC-LTI-04-E** Tailored Method Worksheets
5. **NRCC-LTI-05-E** Line Voltage Track Lighting Worksheet

Installation:

1. **NRCI-LTI-01-E** All Buildings
2. **NRCI-LTI-02-E** Lighting Controls
3. **NRCI-LTI-04-E** Two Interlocked Systems
4. **NRCI-LTI-05-E** Power Adjustment Factor
5. **NRCI-LTI-06-E** Video Conferencing Studio

Required outdoor forms

Compliance:

1. **NRCC-LTO-01-E** Outdoor Lighting
2. **NRCC-LTO-02-E** Outdoor Lighting Controls
3. **NRCC-LTO-03-E** Outdoor Lighting Power Allowances

Installation:

1. **NRCI-LTO-01-E** Outdoor Lighting Certificate of Installation
2. **NRCI-LTO-02-E** EMCS or Lighting Control System

Adaptive Lighting: Case Studies

UC Davis: Bi-level Stairwells

UC Davis installed 999 LED units

Assumed 20% occupancy rate

22W high / 5W low

PIR sensor times out after 5 min

Estimated energy use reduction: **85%**

7,008 hours in standby mode

1,752 hours in active mode



Campus Corridors Case Study: UCSF

- UCSF Medical Sciences building
- Total: 50 two-lamp T8 fluorescent fixtures addressed
- 20% of full lighting power during vacancy, 70% when occupied
- 3 different systems:
 - Lutron Energi TriPak
 - WattStopper Digital Lighting Management (DLM)
 - Enlighted



Campus Corridors Case Study: UCSF

Lutron Energi TriPak: 17 fixtures

- Occupancy rate: 12%
- Reduced lighting energy use: 62%
 - 260 kWh annual savings



Photo: Lutron

WattStopper: 14 fixtures

- Occupancy rate: 16%
- Reduced energy use: 53%
 - 3,108 kWh annual savings



Photo: WattStopper

Enlighted: 19 fixtures

- Occupancy rate: 14%
- Reduced energy use: 68%
 - 5,396 kWh annual savings



Photo: Enlighted

Office Workspaces Case Study: UCSB

- Student Information Systems and Technology office
 - Three open office spaces with cubicles
- 58 2'x2' 56W recessed fluorescent replaced by 58 dimmable LED
- Monitored from May to October 2013
- Occupancy rate: 28%
- Reduced energy use by 89%
 - Annual energy savings estimate: 11,500 kWh
 - Lifetime energy cost savings: \$315 per fixture based on UCSB rate of \$0.11/kWh



NETWORKED ADAPTIVE EXTERIOR LIGHTING

NorthBay VacaValley Hospital

Existing:

40 induction luminaires

13 HPS

7 metal halide luminaires



Project Partners:

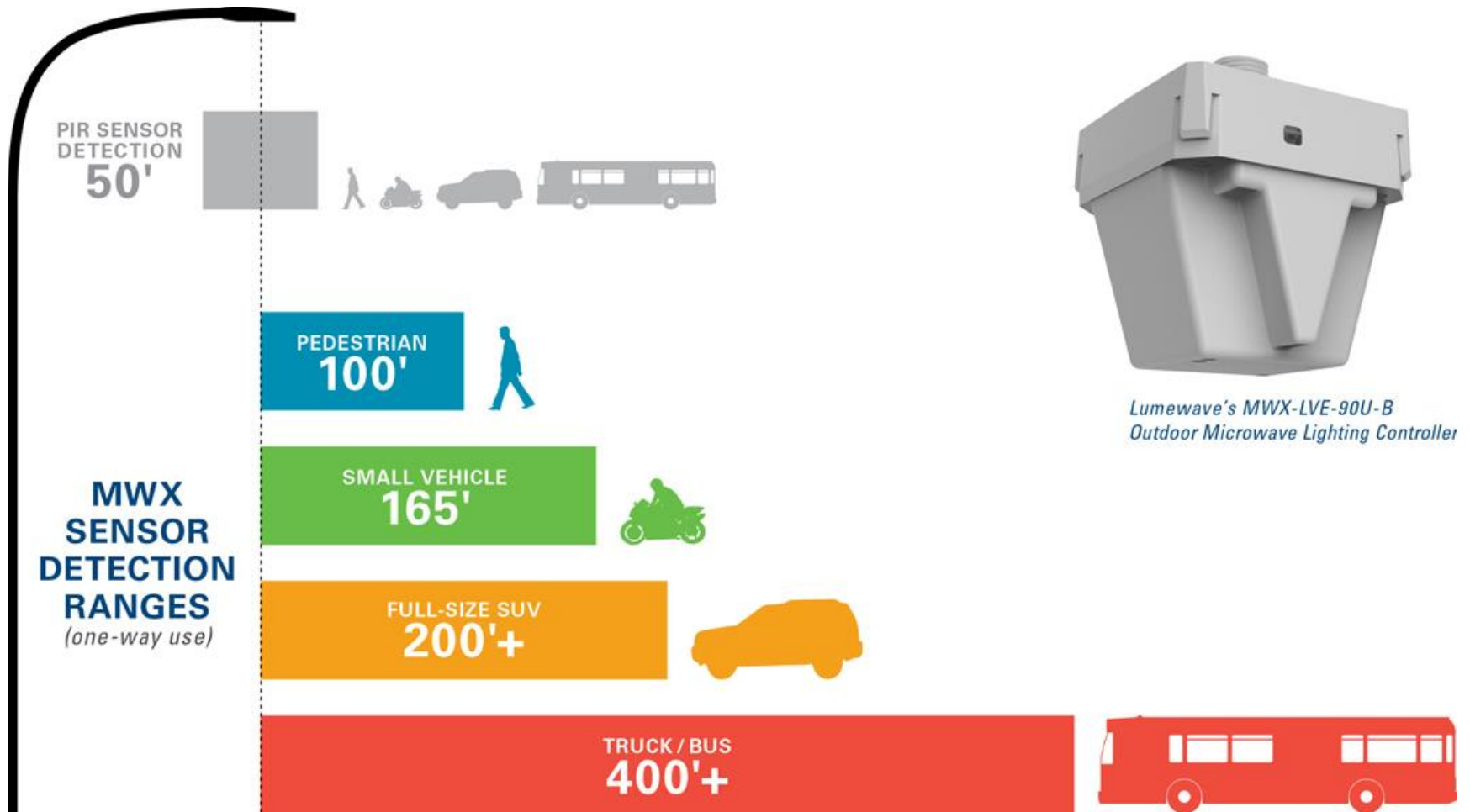


Solution

- 57 LED luminaires, passive infrared (PIR) and microwave motion sensors, and a wireless radio frequency mesh network control system
- System components meet or exceed the IES'S best-practice photometric performance recommendations and the DLC'S criteria for its Qualified Products List



MWX: Microwave Sensor



Demonstration Results

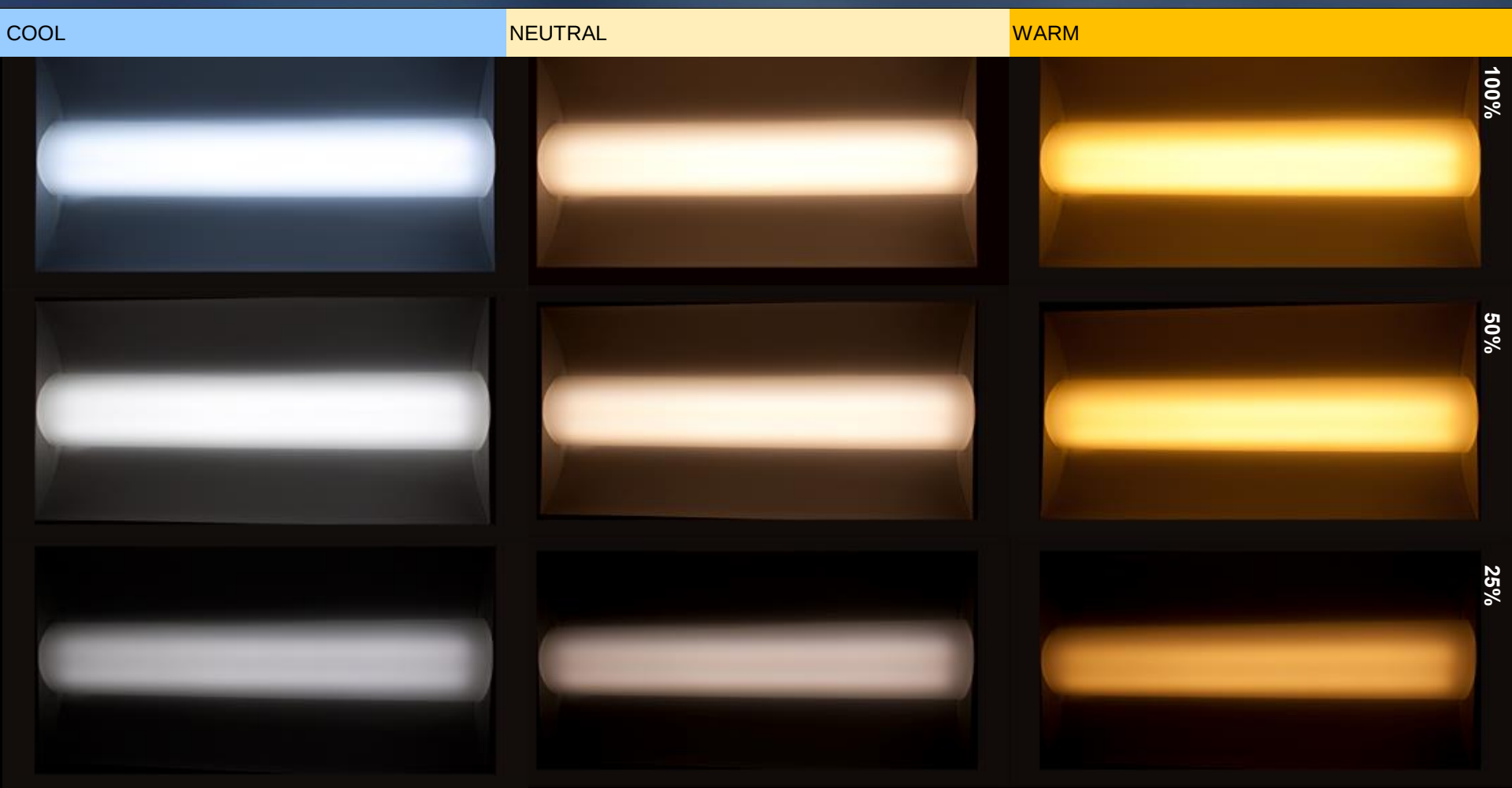
- Energy Savings: 66%
- Occupancy Rate: 35-55%
- Induction to LED luminaires reduced energy use 33.9%.
- Networked control system further reduced the energy use 49.2 %
- Total annual savings for the demonstration: 29,020 kWh
- 2014 Lighting Energy Efficiency in Parking (LEEP) Award Winner:
Best Use of Lighting Controls in a Single Facility

Next: Getting to Zero Net Energy

California Department of Public Health
Richmond, CA



Next: Customizable CCT and SPD



Next: Smart Cities, Connected Streetlighting



Resources

For more information:

California Energy Commission: Building Efficiency Standards

<http://www.energy.ca.gov/title24/2013standards/index.html>

California Energy Commission: 2013 Nonresidential Compliance Manual

<http://www.energy.ca.gov/2013publications/CEC-400-2013-002/CEC-400-2013-002-SD.pdf>

Energy Code Ace

<http://energycodeace.com>

California Lighting Technology Center, UC Davis

<http://cltc.ucdavis.edu/title24>

*A new site developed by the California Statewide Codes & Standards Program here to help you meet the requirements of Title 24, Part 6



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Did you Know?

Permits Can Save Energy

Statewide gross savings from Codes & Standards realized between now and 2020 is approximately equivalent to:

Deferring the need to run a 500 MW power plant for 16 years

Removing 2.6 million cars from the road

Permits Can Save Money and Protect the Value of Your Home Investment:

Non-permitted home improvements may not retain their value you when you sell

Permits Can Save Reputations

Clients value quality and integrity.

Pulling a permit means you are doing it right and can be trusted as a quality contractor who doesn't take shortcuts.

Not pulling a permit is breaking the law – and can

We offer FREE:



Ace*Tools™

A variety of tools to help you identify the forms, installation techniques, and standards relevant to building projects in California.



Ace*Training™

Classroom and online trainings on Title 24, Part 6. Additional 2013 classes coming soon!



Ace*Resources™

Fact Sheets, Trigger Sheets and Checklists to help you understand when Title 24, Part 6 is "triggered" and how to correctly comply when it is.

Log In or Register

Enter your e-mail address below to log in or to register a new account.

ENTER YOUR EMAIL BELOW

Go

The 2013 Building Energy Code is coming soon! Are you prepared?

Energy Code Ace is here to help you get ready. Check out our FREE Trainings, Tools and Resources and arm yourself with the knowledge you'll need to perform your job better and gain a competitive edge when new Title 24 requirements go into effect.

Countdown to July 1:

1 16 17



[Home](#) >> [title24](#) >>> [2013standards](#)

2013 Building Energy Efficiency Standards

California's building efficiency standards are updated on an approximately three-year cycle. The 2013 Standards will continue to improve upon the current 2008 Standards for new construction of, and additions and alterations to, residential and nonresidential buildings.

- » [Summary of Changes for the 2013 Standards Update](#)
- » [Background and Policy](#)
- » [12-BSTD-01 Docket Log](#)
- » [2013 Standards Rulemaking](#)

[Final Express Terms](#)

[Marked Versions and Related Documents](#)

Compliance Manuals and Forms

- » [12-BSTD-05 Docket Log](#)
- » [Supporting Documents](#)

More Information

News

[Commission Approves More Efficient Buildings for California's Future](#)

[Adoption Hearing Presentation](#) PDF file

[Frequently Asked Questions](#) PDF file

[Standards Infographics](#) PDF file

[Sacramento Bee Editorial - New standards will save dollars and megawatts](#)

[SF Chronicle Editorial - A green future starts at home for Californians](#)

Upcoming Events

March 21, 2013
Staff Workshop on Assembly Bill 2339 Requirement



cltc.ucdavis.edu/
publication/whats-new-
title24-2013-code

WHAT'S NEW IN THE 2013 CODE?

Changes to mandatory Title 24 lighting requirements

California's new Building Energy Efficiency Standards take effect in 2014. They improve the energy efficiency of homes by 25 percent and make nonresidential buildings 30 percent more efficient than the previous 2008 standards. This brief guide offers an overview of important requirements and major updates to the lighting code.

New requirements for lighting controls constitute one of the biggest changes to Title 24 standards. The latest version of the standards also includes more stringent requirements for the testing and certification of controls commissioning.

All lighting control systems with two or more components—in both residential and non-residential spaces—must meet the requirements of 2013 Title 24 standards, **Section 110.9**. Both stand-alone and luminaire-integrated lighting controls, such as vacancy sensors and photocontrols, must now comply with Title 20 regulations.

NON-RESIDENTIAL INDOOR LIGHTING REQUIREMENTS

All interior luminaires in non-residential buildings must have manual on/off controls, and each area must be independently controlled. Dimmer switches must allow manual on/off functionality, with some exceptions such as public restrooms with two or more stalls, which do not need a publicly accessible switch.

MULTI-LEVEL LIGHTING CONTROLS

In areas larger than 100 ft², installed luminaires must:

- Incorporate multi-level lighting controls or continuous dimming, depending on the lamp type
- Meet the uniformity requirements in **Table 130.1-A**
- Have at least one of the following types of controls for each luminaire:
 - Manual continuous dimming and on/off control (**Section 130.1(a)**)
 - Lumen maintenance (**Section 100.1**)
 - Tuning (**Section 100.1**)
 - Automatic daylighting controls (**Section 130.1(d)**)
 - Demand response controls (**Section 130.1(e)**)

Classrooms are one of the rare exceptions to the multi-level requirements. Instead, if they have a connected general lighting load $\leq 0.7 \text{ W/ft}^2$, they must have at least one control step between 30% and 70% of full-rated power.

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