CA Title 24 Part 6 2013

Building Energy Efficiency Standards

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Learning Objectives

1. Cover the Drivers for the Title 24 Energy Code
2. Review the Mandatory Lighting Control requirements *(§130.0 - .5)*
3. Provide an overview of changes in the Interior and Exterior Lighting Power requirements *(§140.6 - .7)*
4. Review other key changes to the non-residential section of the Code
5. Review Residential Lighting Requirements *(§150.0)*

Slide Formats

Title 24 Section Info

Starburst at top identifies new / major changes. Adjustments to rules are shown in red

New info!

Area Controls

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§130.1(a)1-3: Area Controls

- All luminaries need manually switched On and Off Lighting Controls, and each area enclosed by ceiling height partition shall be independently controlled
  - Exception for .2 W/ft² (was .3W/ft²)
    - Must be designated an Emergency Egress Area on plans
    - Lighting's switches only accessible to Authorized Personnel.
- Lighting Controls must be:
  - Readily accessible
  - Operated by a manual switch in room ~~or occupancy sensor~~
  - Malls, Auditoriums, Sales Floors, Industrial, Conv/Arenas can be pilot lit
  - If controlling dimmable fixtures, control must go to all mandated levels
  - 2 or more stall restrooms switch accessible to only Authorized Personnel
- Other devices may be installed as long the above functionality is not lost.

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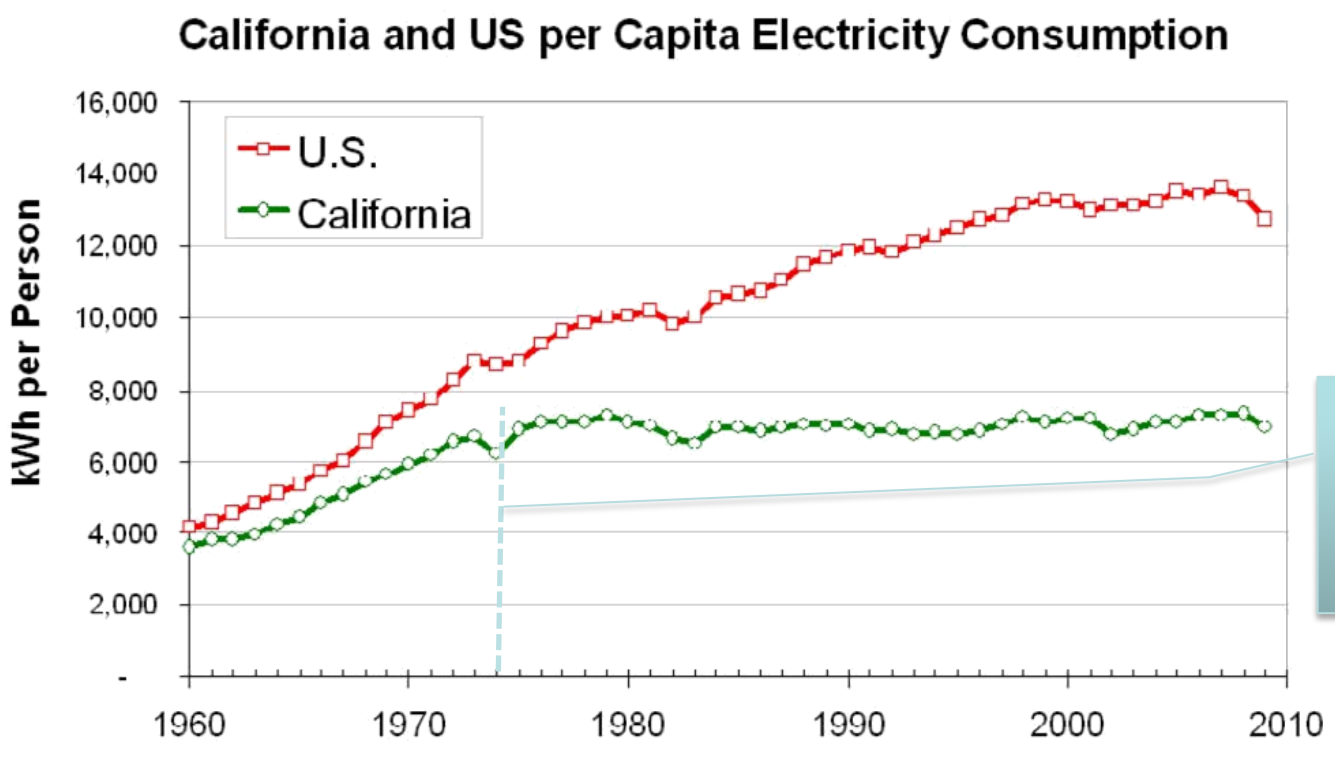
A Group Brand | legrand

Why Bother?

- Energy Savings
  - Green House Gas reductions
- Future Energy Supply Questions
  - Uncertain supply
  - “Decoupled” Energy Costs
  - Capacity constraints
    - Cost and Environmental impact to build new power new generation plants
- Zeitgeist, i.e. “Spirit of Times”
  - Green Building Designs
  - LEED
  - Darksky

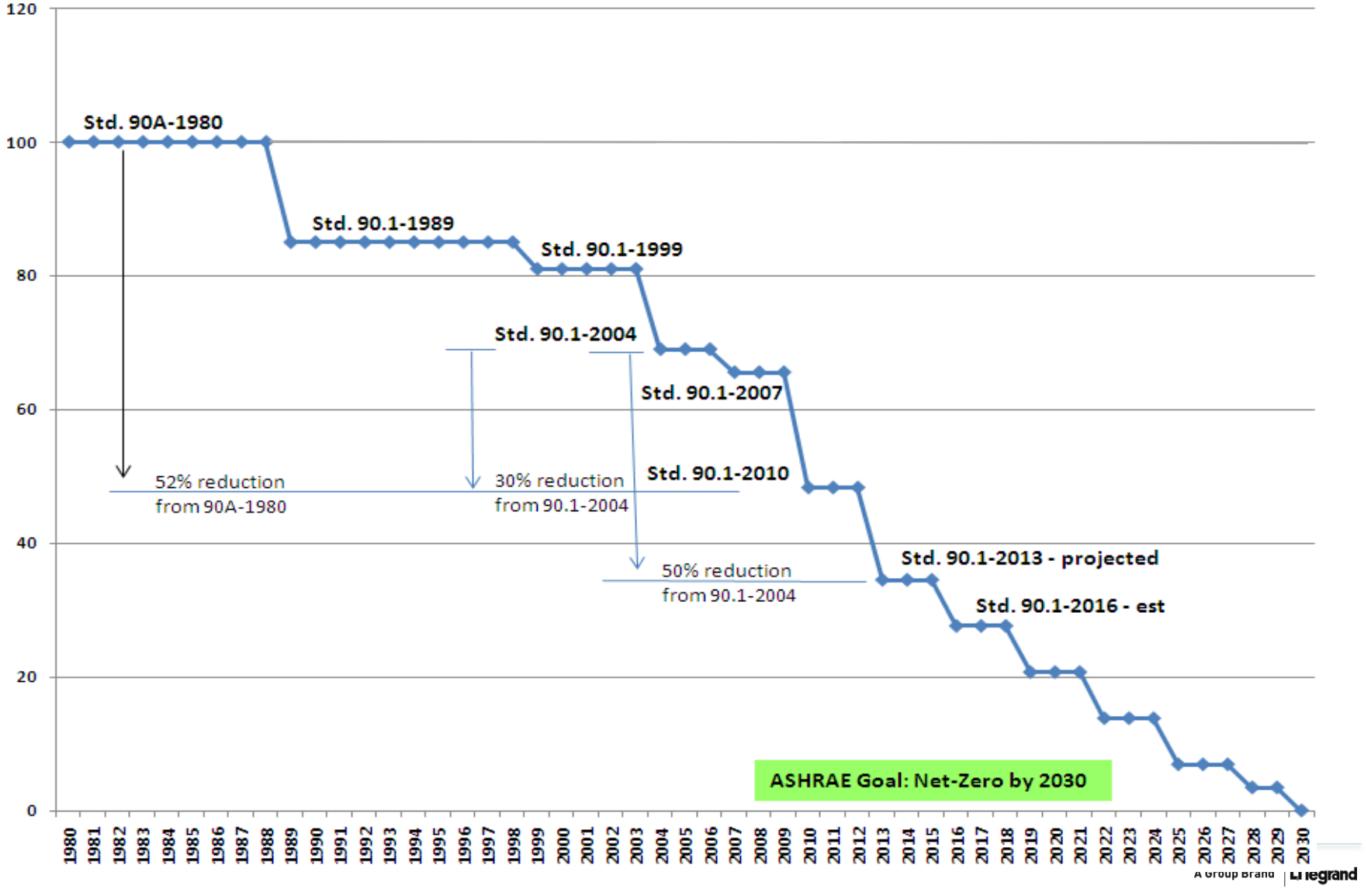
2013 Title 24 (Part 6) Policy Objectives



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

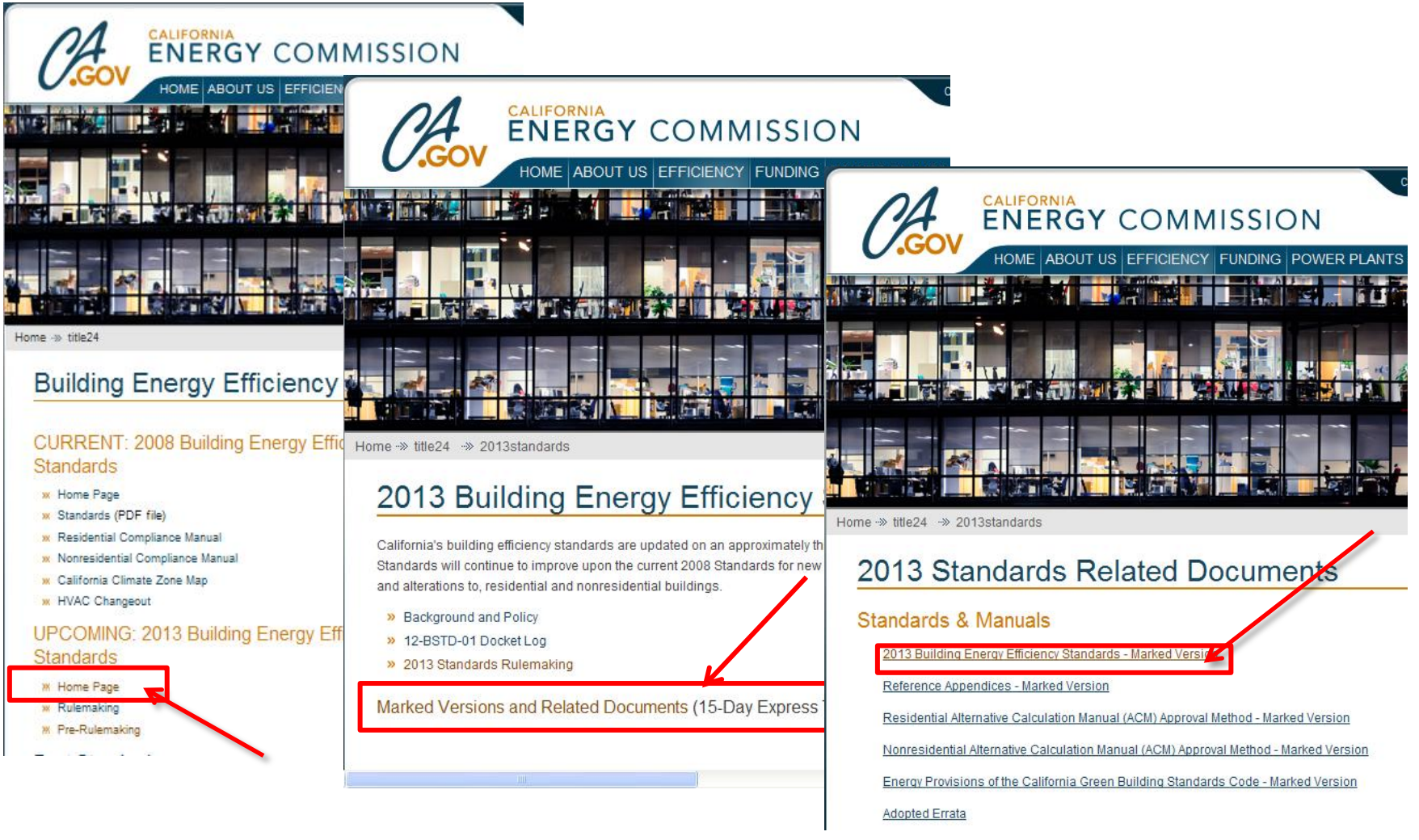
- Achieve big step towards Zero Net Energy policy goals
  - 15 – 25% improvement in Standards
- Include CEC Approved Reach Standards
  - Propose for Energy Chapter of T24, Part 11 (GBSC)

Savings from the National Code



Where is the Code?

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



When?

2013 Building Energy Standards take effect January 1, 2014, and sites filing for a permit after that date should follow the new code.

Overview of Sections

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

Review the definitions…

§100.1: Definitions

- "Shall" is mandatory, "May" is permissive
- Highlights:
  - "**Lighting**"
    - Includes definitions for all types
    - Permanently Installed, Portable
  - **"Lighting Controls"**
    - Occupancy Sensing Controls: Motion Detectors, Partial On, Partial Off, Vacancy
  - "**Nonresidential Building Occupancy Types**"
    - Classroom, Office, Parking Garage Building…
  - "**Outdoor Areas**"
    - Canopy, Hardscape, ~~Lantern, Pendant~~…

Lighting Control Definitions

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§100.1: Definitions

40 ~~26~~ Pages!

- **Occupant Sensors** turn off lights in an indoor lighting system after an area is empty of people.
  - When used to control outdoor lighting systems, called a **motion sensor**.

- **Vacancy Sensor** are OS where the lights must manually be turned on, but the sensor automatically turns the lights off soon after an area is vacated.
  - Also called “Manual-On Occupant Sensor”

NEW

- **Partial-On Occupant/Motion Detector**
  - Automatically or Manually turn part of the lights on when an area is occupied, automatically turns lights off

NEW

- **Partial-Off Occupant/Motion Detector**
  - Turns lights On automatically, and turns off part of the lighting when an area is vacated

NEW

- **Part Night Outdoor Lighting Control**
  - Time or Occupancy based device that reduces or turns off power to a outdoor luminaire for a portion of the night.

“Self Contained” Control Devices to T20

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

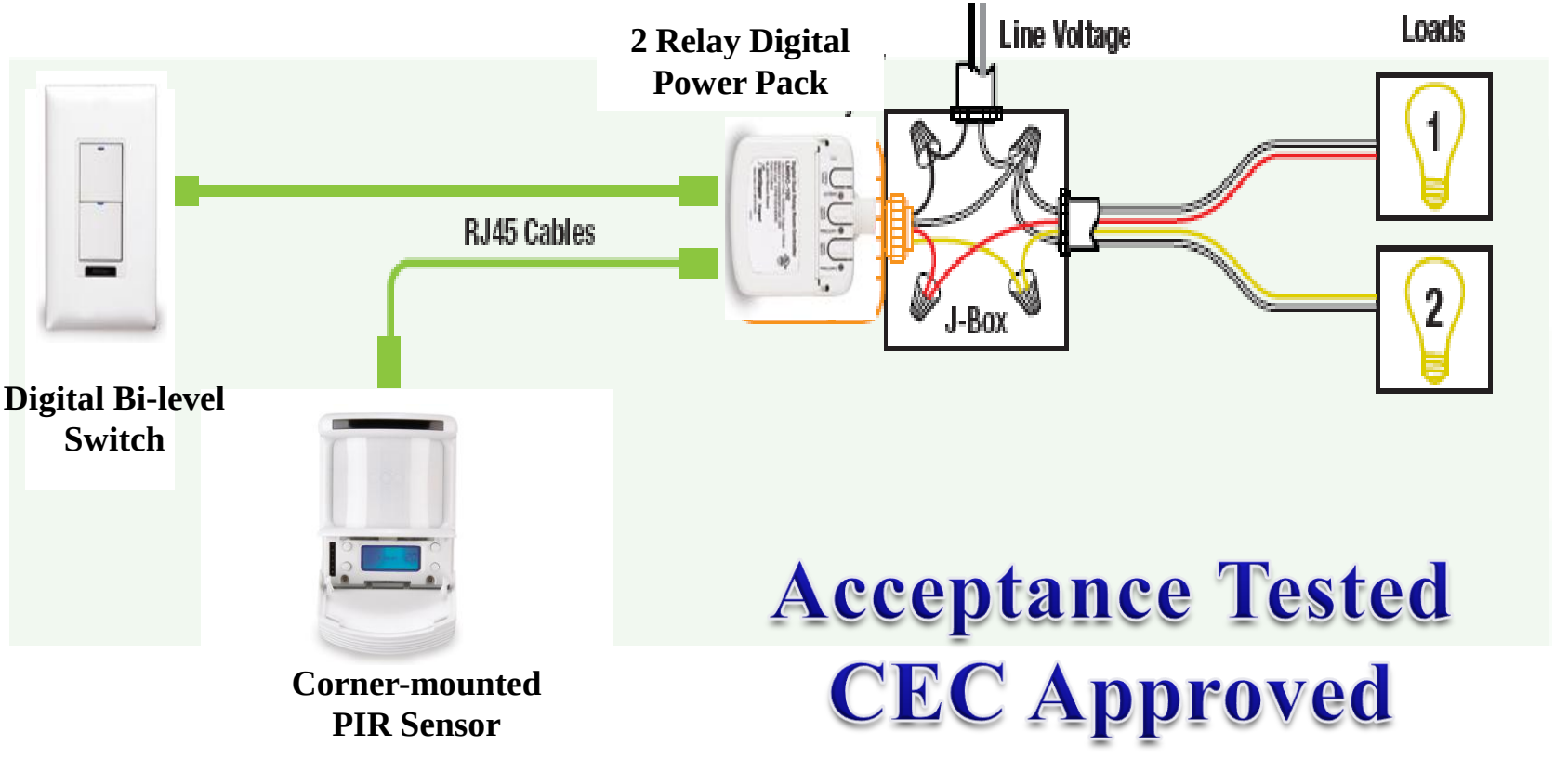
- Time-Switch Controls
  - Automatic Time-Switch
  - Astronomic Time-Switch Controls
  - Multi-Level Astronomical Time-Switch Controls
  - Outdoor Astronomic Time-Switch Controls (w/Setback)
- Automatic Daylight Controls
- Lighting Photo Controls
- Dimmer Controls
- Occupancy, Motion, and Vacancy Sensor Controls
  - Occupancy Sensors
  - Motion Sensors
  - Vacancy Sensors
  - Partial-On Sensors
  - Partial-Off Sensors
- Exception that users should not be able to convert manual-on t… auto-on when required by code.

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

Need Title 20 Approval

“Lighting Control System” in T24

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



Solar Ready Requirements

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

- Mandates a “Solar Zone” for:
  - Single Family
  - Low-rise Multi-family
  - Hotel/Motel Occupancies & High Rise Multi Family
  - All other Nonresidential Buildings 3 stories or less
- Includes Interconnection Pathways, Documentation, and Main Service Panel requirements

Luminaire Labeling

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

Simplified

Line Voltage Luminaires

§130.0(c)2 Mandatory Lighting Requirements - General

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

Ballasted Luminaires

- Wattage of luminaires with internal or remote ballasts is lamp/ballast combo via UL 1598
  - Per manufacture's literature or testing.
  - Replacement of lamps with linear lamps of another technology does not change the luminaire.

Line Track Luminaires

- Wattage for line voltage track is
  - For tracks rated > 20A, use VA of circuit
  - For tracks rated ≤ 20A, use
    - VA of branch circuit, or
    - Higher total all rated luminaire wattages, or 45 W/ft., or
    - When using integral current limiter, higher of VA of CEC Certified current limiter or 12.5 w/ft, (with reference to 130.4(B)iii) or
    - When using dedicated track current limiter panel, sum of all V*A for the panel.

Luminaires & Systems with Transformers

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

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

LED and LED Light Engines

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

Other

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

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


Indoor Lighting Controls that shall be Installed

Overview

§130.1: Indoor Lighting Controls that Shall be Installed

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

Area Controls

§130.1(a)1-3: Area Controls

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

Area Controls

§130.1(a)4: Area Controls

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

General Lighting Multi-level Controls

§130.1(b): Multi-Level Controls

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

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

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

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

Dimming = "Enabling Technology"

Exemption: **Spaces < 100 ft², or ≤ 0.5 W/ft²**
Classrooms ≤ 0.7 W/ft²
Space with just a 1- or 2-lamp fixture.

Shut-off Requirements

§130.1(c)1: Shut-off Controls

- All interior lighting shall turn Off automatically when space typically unoccupied, by using:
  - Occupancy sensor,
  - Automatic time switch,
  - Other signal or device
- Separate Controls per floor
- Separate Controls per 5,000 ft²
  - 20,000 ft² for Malls, auditoriums, Single tenant Retail, Industrial, Convention, Arenas
- Separate Controls for General, Display, Ornamental, and Display Case lighting (?)
- Exceptions:
  - 24/365 operational areas
  - Areas that require Occupancy Sensors, or Partial On/Off Sensors
  - ~~Corridor, guest-rooms & dwelling units, parking garages~~
  - .05 W/ft² (was .3 W/ft²) in Office Buildings security/emergency egress
  - Electrical Equipment Rooms

Countdown Timers and Time Clocks

§130.1(c)2-4: Shut-off Controls

- Countdown timer switches cannot be used as an Auto Off Device, except
  - Single Stall bathrooms or closets < 70 ft^2, if timer ≤10 minutes
  - Server Aisles, if timer ≤ 30 minutes
- Timeclock Override switching device
  - Meets Area Control requirements
  - Allow override ≤ 2 hours
    - Malls, Single Tenant Retail, Auditoriums, Industrials, and Arenas allowed longer via captive key switches
- Most sites require automatic holiday shutoff
  - Not needed in churches, retailers, restaurants or theatres.

Mandatory use of Sensors

§130.1(c)5: Indoor Lighting Controls

- Occupancy sensors must be installed in the following areas to shut off the lighting:
  - Offices ≤ 250 ft^2
  - Multipurpose rooms ≤ 1000 ft^2
  - Classrooms any size
  - Conference rooms any size
- Controls must allow the lights to be manually shut off in compliance with §130.1(a) regardless of the sensor's status

New!

Partial ON/OFF Sensor (w/ Auto Off)

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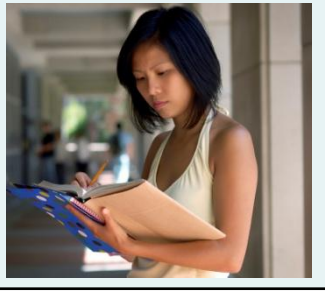
§130.1(c)6: Indoor Lighting Controls

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

New!

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

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§130.1(c)7: Indoor Lighting Controls

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

Guestrooms

§130.1(c)8: Indoor Lighting Controls

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

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

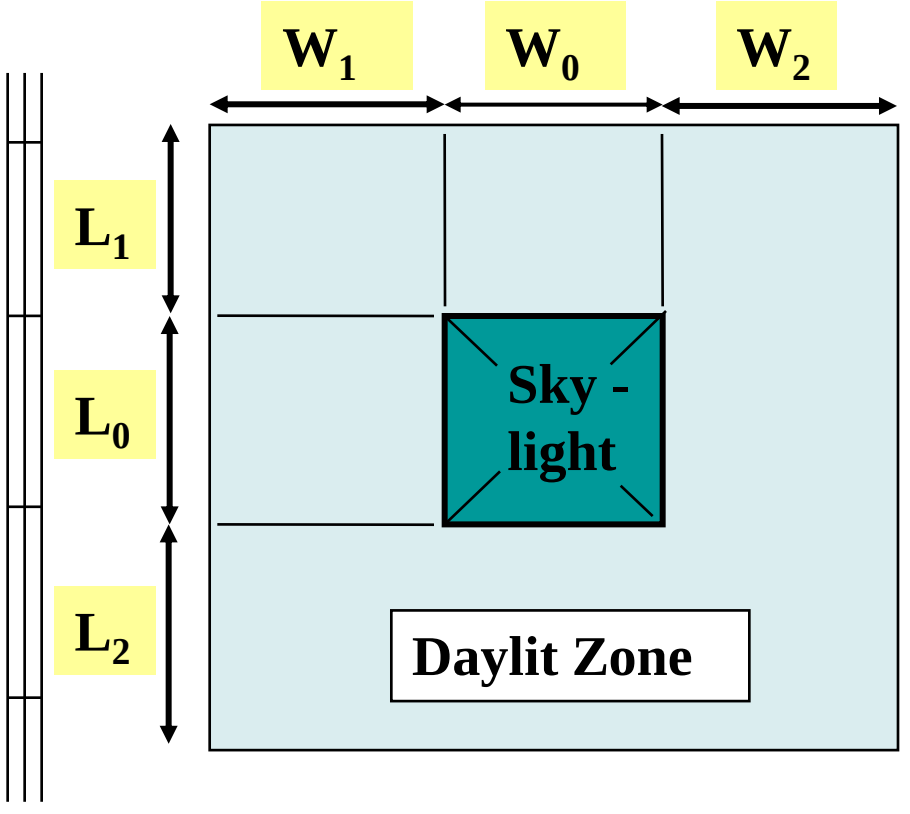
Daylighting Definitions

§130.1(d): Daylit Areas

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

Skylit Area

- Control luminaires in or partially in the daylit area



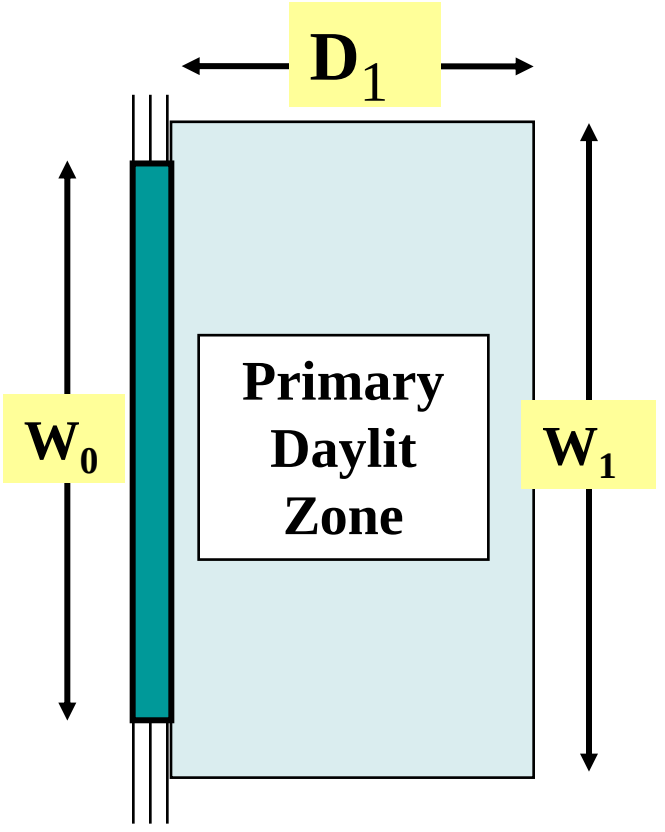
L_1, L_2, W_1,W_2 = smallest of the following values:

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

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

Primary Sidelit Area

Control luminaires in the Primary Sidelit area



D_1 = **Window Head Height**, or

- Distance to closest 60" high permanent obstruction*

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

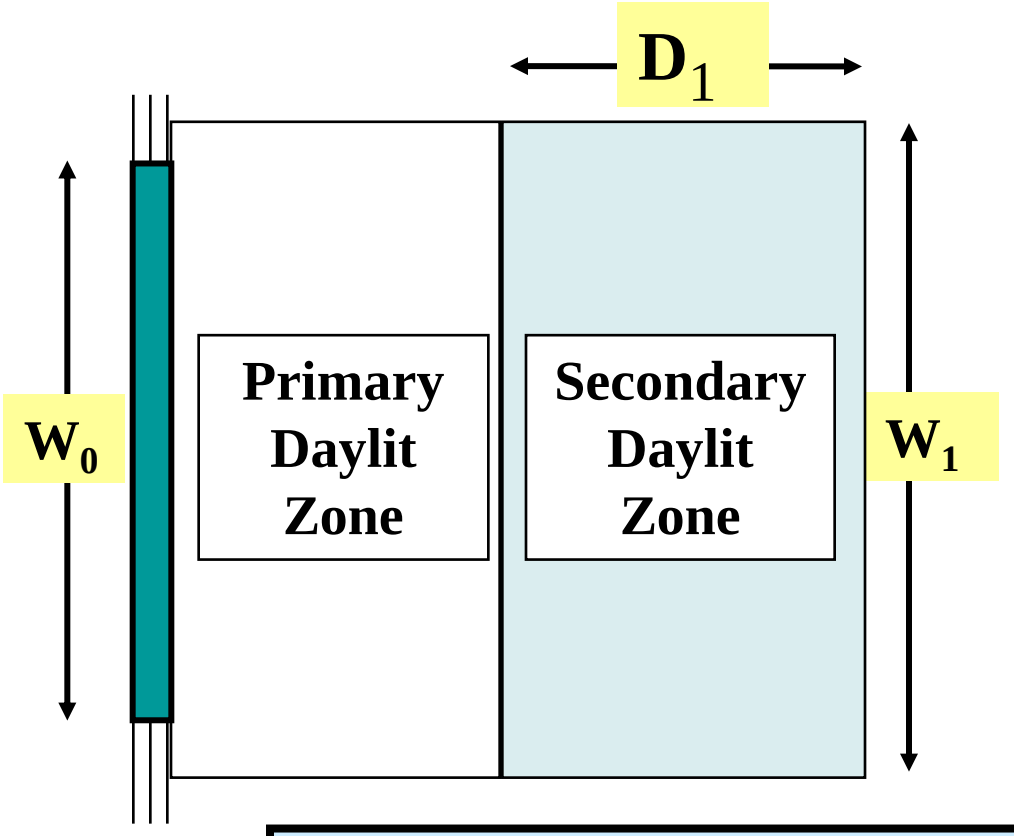
- .5 x Window Head Height, or
- Distance to closest 60" high permanent obstruction

Primary Sidelit area = (D_1) x (W_1)

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

Secondary Sidelit Area

§130.1(d)1C: Daylit Areas



D_1 = **Window Head Height**, or

- Distance to closest 60" high permanent obstruction*

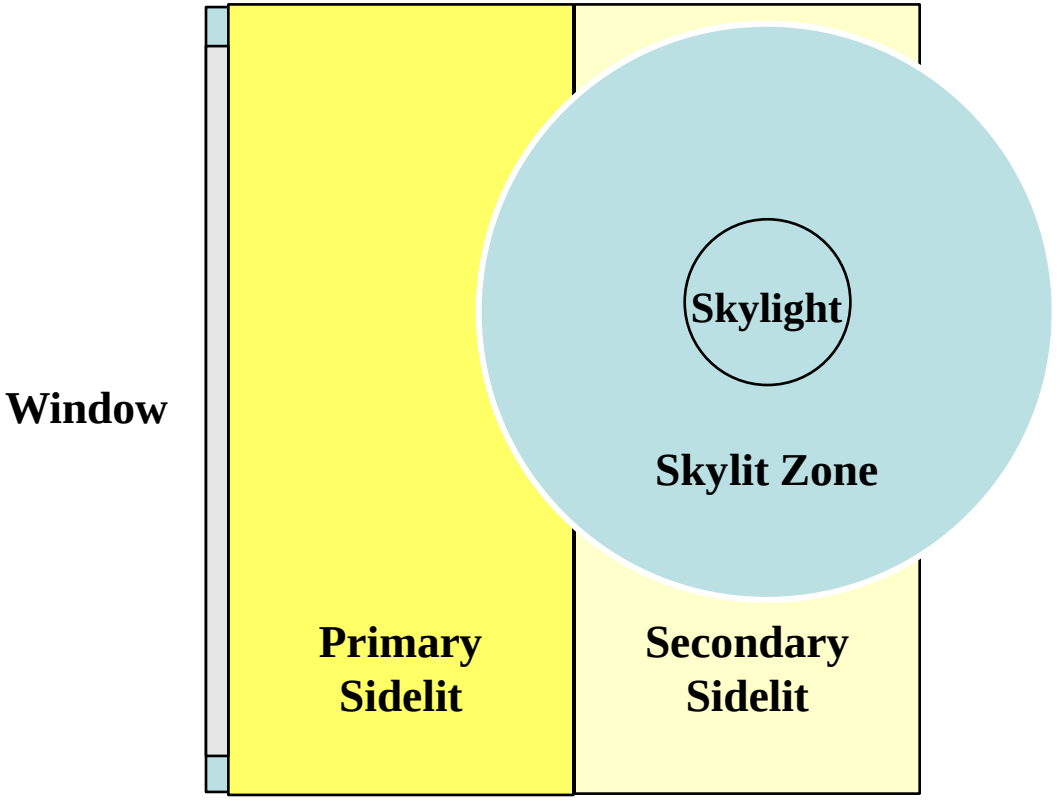
W_1= Window Width (W_0) + (on each side):

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

Secondary Sidelit area = (D_1) x (W_1)

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

Daylight Zones



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

Daylight Areas

§130.1(d)2A-C: Daylight

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

Automatic Daylighting Control Device

§130.1(d)2D: Daylight

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

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

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

i.e. DOES NOT mandate full off

- Exceptions
  - Total installed general lighting power **Skylit + Primary Sidelit zones < 120W**
  - When glazing in room is < 24 ft^2

Parking Garage Daylighting

§130.1(d)3: Daylight

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

i.e. DOES mandate full off

http://www.everlastlight.com/

All Buildings!

Demand Responsive Controls

§130.1(e): Indoor Lighting Controls

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

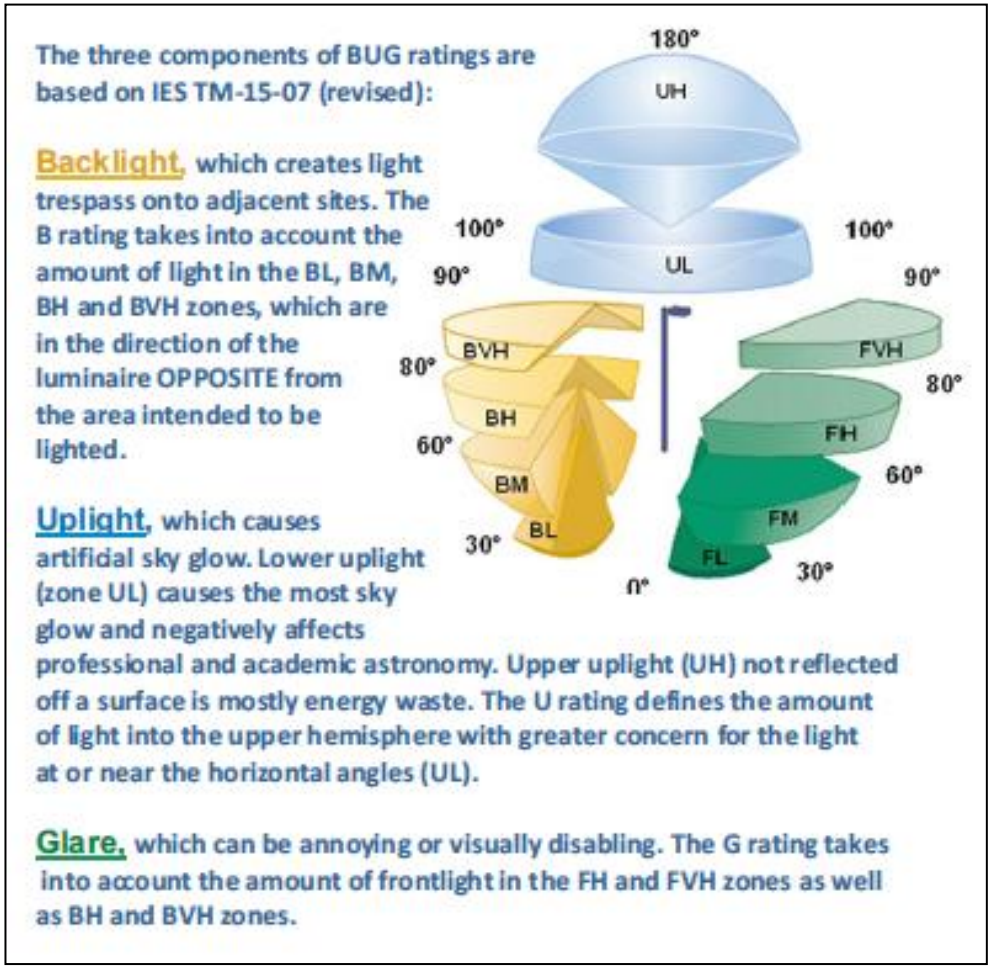
- Per 130.5(e) DRC and equipment shall be capable of receiving and automatically responding to at least one standards based messaging protocol.


Outdoor Lighting Controls & Equip

Exterior Lighting and Cutoff

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

- Outdoor incandescent luminaires >100W controlled by a motion sensor
  - **Exceptions**: Health or life safety, pools, temp., theme parks, LED/Neon and Sign Lighting
- Outdoor luminaires > 150W follow **Backlight, Uplight, & Glare** (BUG) requirements:
  - No Backlight Requirements
  - Max zonal Uplight lumens: Table 130.2-A
  - Max zonal Glare lumens: Table 130.2-B
  - **Exceptions:**
    - Signs, façade lighting (not wallpacks), statutes, bridges, health or life safety lighting to be cutoff, temp…
    - When replacing some existing Pole Luminaires
    - Luminaires that illuminate public right of way roads, sidewalks, and bikeways.



From IDA-IES Model Lighting Ordinance

Exterior Lighting and Cutoff

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

Uplight Ratings

TABLE 130.2-A Uplight Ratings (Maximum Zonal Lumens)

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

Glare Ratings - Asymmetrical

TABLE 130.2-B Glare Ratings (Maximum Zonal Lumens)

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

Glare Ratings - Quadrilateral Symmetrical

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

Outdoor Controls

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

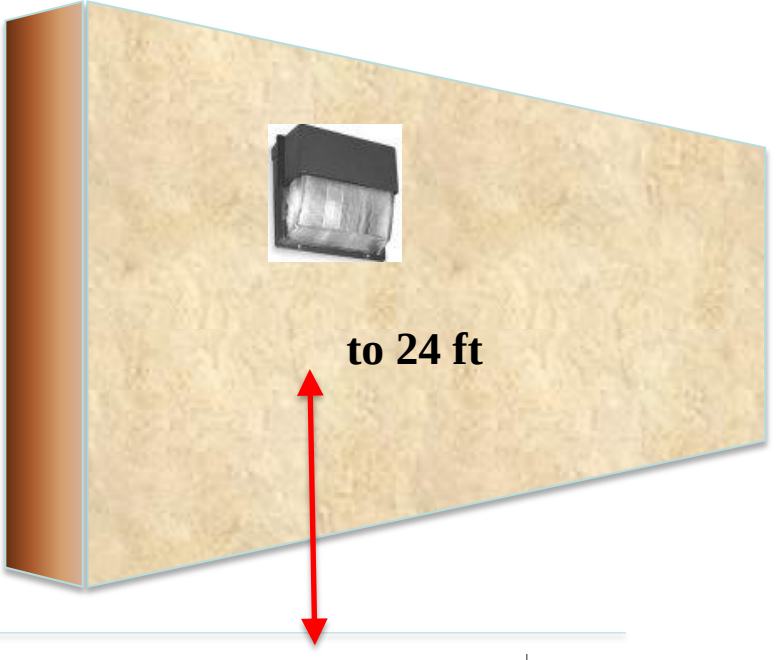
- All installed outdoor lighting shall:
  - Have Auto-OFF by a photo control or astronomical time switch;
  - Be circuited and controlled to turn off independently from other electrical loads by an automatic scheduling control.
- Exceptions:
  - Lights that health and life safety regulations say cannot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

Controls for Outdoor Lighting

§130.2(c)3: Outdoor Lighting Controls

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

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



Outdoor Sales Frontage, Lots & Canopies

§130.2(c)4: Outdoor Lighting Controls

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

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

Façade, Ornamental Hardscape & Dining

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§130.2(c)5: Outdoor Lighting Controls

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

Acceptance and Certificate Requirements

§130.4: Lighting Control Acceptance

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

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

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

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

CLCATT = “Cool Cat”

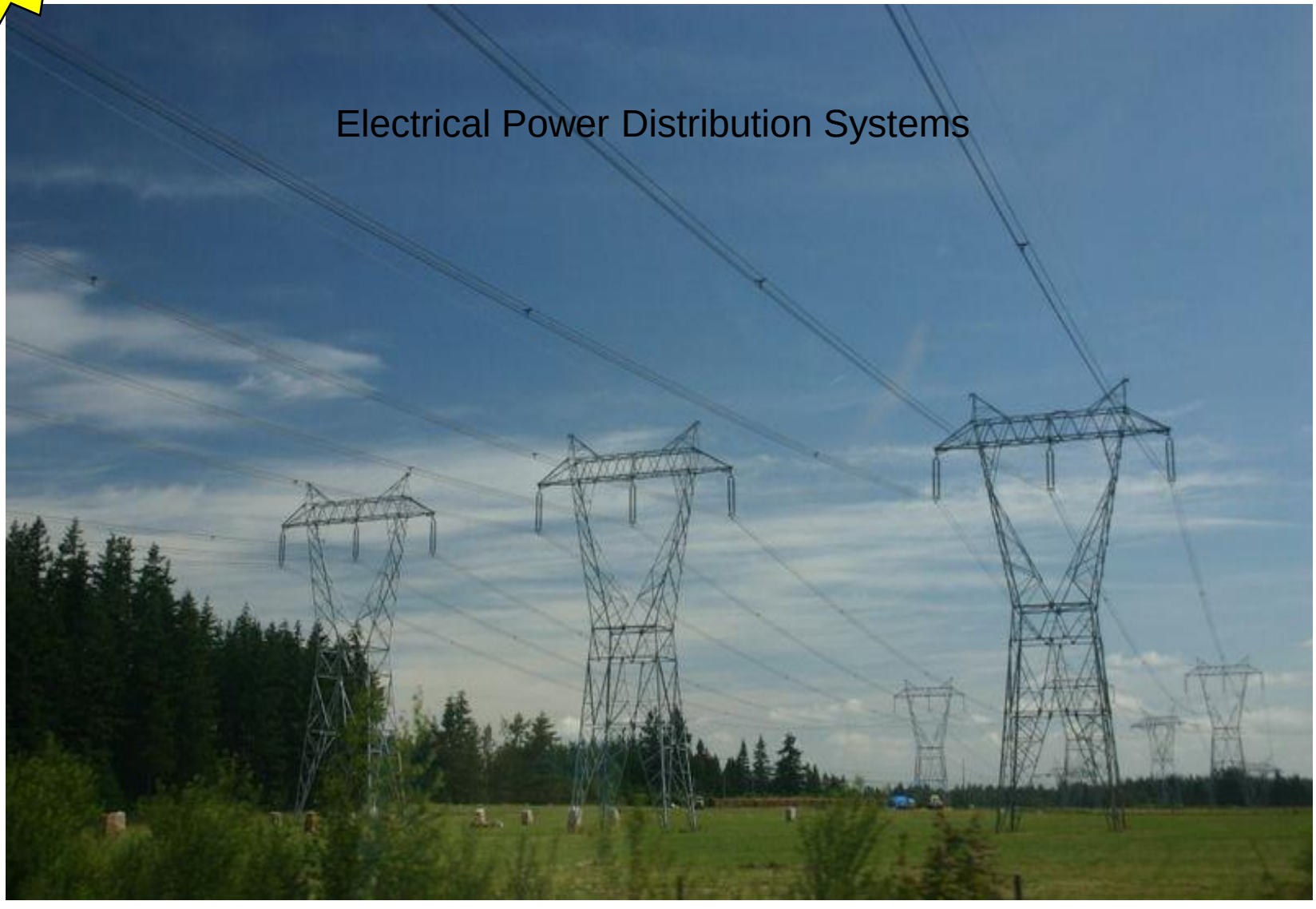
§10-103-A: Lighting Control Acceptance Test Technician

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

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

New Section!

§130.5



Electrical Distribution Systems

Mandatory Measures for:

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

Minimum for Electrical Load Metering

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Table 130.5 A

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

Minimum for Separation of Electrical Load

(Table is Only Lighting, Plug and EV!)

Table 130.5 B

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

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

Controlled Receptacles

§130.5(d): Plug Loads

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

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

Controlled Receptacles

§130.5(d): Plug Loads

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

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

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

Performance vs. Prescriptive

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

Prescriptive Requirements

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

Skylights

§140.3(a) 6: Minimum Skylight Areas

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

More Sites!

Large Spaces, ~~Bldgs ≤ 3 Stories~~

§143(c): Minimum Daylighting

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

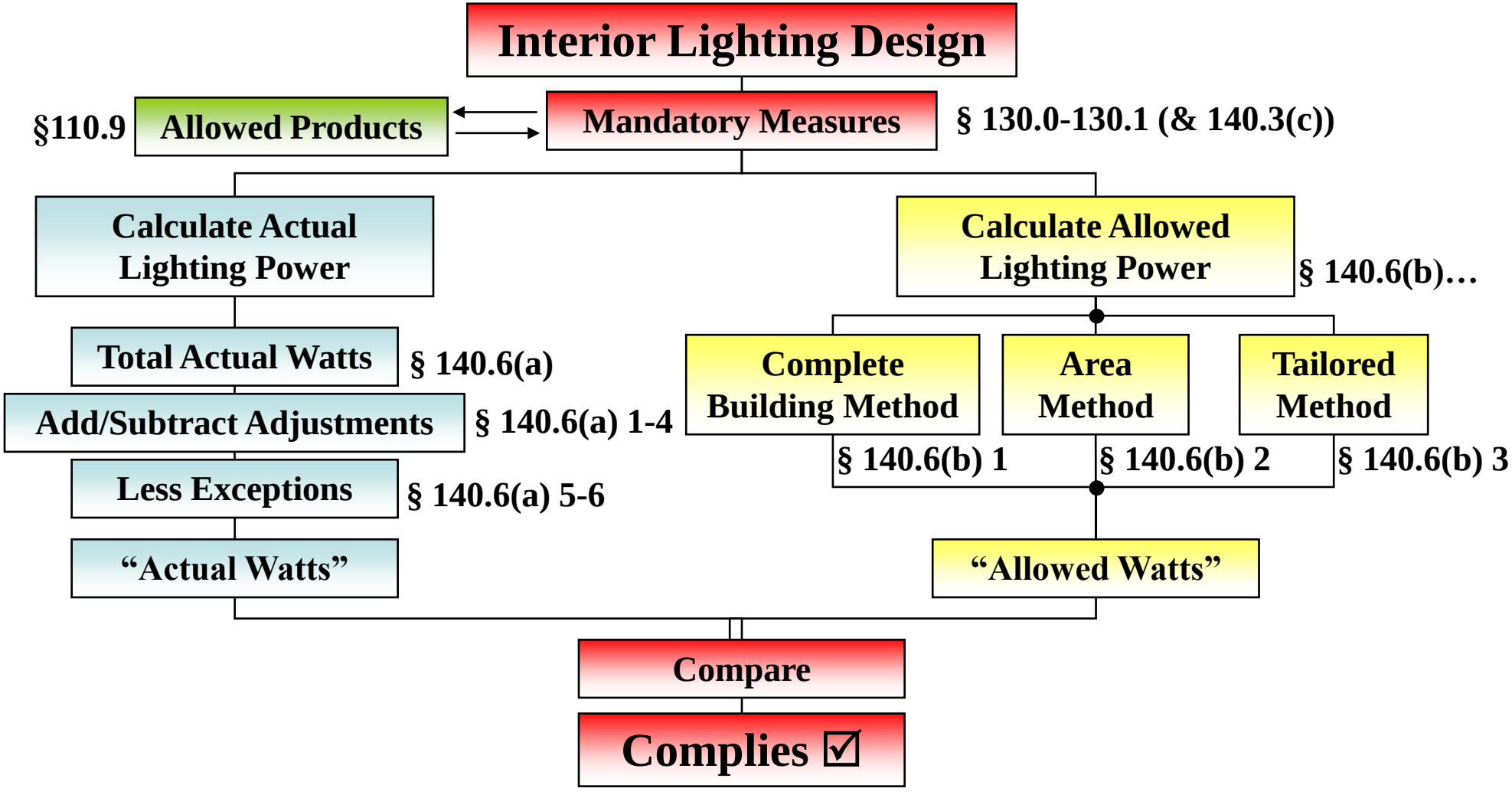
- Lighting in daylit area controlled per §130.1(d)

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

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

Prescriptive Indoor Lighting Overview

§140.6: Prescriptive Requirements for Indoor Lighting



Actual Lighting Power Density (LPD)

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

Interlocked Lighting

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

Reduction of Wattage through Controls

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

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

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

Lighting Power Adjustment Factors

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Table 140.6-A: Lighting Power Adjustment Factors

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

TYPE OF CONTROL		TYPE OF AREA		FACTOR
a. To qualify for any of the Power Adjustment Factors in this table, the installation shall comply with the applicable requirements in Section 140.6(a)2 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 ≤ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, conference or waiting room.		0.20
2. Occupant Sensing Controls in Large Open Plan Offices		In open plan offices > 250 square feet: One sensor controlling an area that is:	No larger than 125 square feet	0.40
			From 126 to 250 square feet	0.30
			From 251 to 500 square feet	0.20
3. Dimming System	Manual Dimming	Hotels/motels, restaurants, auditoriums, theaters		0.10
	Multiscene Programmable			0.20
4. Demand Responsive Control		All building types less than 10,000 square feet. Luminaires that qualify for other PAFs in this table may also qualify for this demand responsive control PAF		0.05
5. Combined Manual Dimming plus Partial-ON Occupant Sensing Control		Any area ≤ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, conference or waiting room		0.25

Lighting Power Deductions

§140.6(a) 3: Lighting Wattage Excluded

- Lighting Watts from many applications are exempted:
  - Some lighting in theme parks
  - Lighting for film, video, and photography studios
  - Theatrical controlled by multiscene or crossfade controller
  - Pre-installed in some refrigerators, freezers, vending machine
  - Lighting for plant growth (must have timeclock)
  - Lighting that is for sale
  - Exit Signs if they have maximum lamp power 5W/face
  - Guestrooms in Hotel/Motels, High-rise Resi Living quarters
  - Temporary Lighting Systems
  - Lighting in Elevators (per ASHRAE 90.1 2010?)
  - Others… See Complete List!

Indoor Lighting Power General Rules

- Conditioned and unconditioned spaces must be calculated separately - no trading allowed
- No trading between indoor and outdoor areas
- Three possible methods
  - Complete Building Method
  - Area Category Method (can be combined with Tailored)
    - LPD for some tasks/items can't be raised by decreasing others
  - Tailored Method (can be combined with Area)
    - LPD for Wall / Floor / Ornamental / Valuable Case can't be traded

Calc of Allowed Indoor Lighting Power Density

Choose between 3 methods

1) Complete Building Method
   - Must be listed specifically, and can only apply to one building
     - Exception: If combination parking garage and another type use building, then each portion can be determined separately.
   - Can use for building or tenant space where one type of use accounts at least 90% of the space

Complete Bldg. – Lighting Power Density

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Table 146-E

TABLE 140.6-B COMPLETE BUILDING METHOD LIGHTING POWER DENSITY VALUES ~~(WATTS/FT²)~~

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

Calc of Allowed Indoor Lighting Power Density

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

Choose between 3 methods

2) Area Category Method

- Total allowed lighting power is the sum of the allowed lighting powers for all individual areas
- Multi-tenant areas with an unknown tenant, use 0.6W/ft^2 for lighting (Unleased Tenant Area)
- Allowance in Table's footnote for specialized tasks, ornamental, precision, accent, display, decorative, video conferencing, white and chalk boards under specific conditions

Area Method – Lighting Power Density

Table 140.6-C

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

PRIMARY FUNCTION AREA		ALLOWED LIGHTING POWER (W/ft²)	PRIMARY FUNCTION AREA		ALLOWED LIGHTING POWER (W/ft²)
Auditorium Area		1.5 [3]	Library Area	Reading areas	1.2 [3]
Auto Repair Area		0.9 [2]		Stack areas	1.5 [3]
Beauty Salon Area		1.7	Lobby Area	Hotel lobby	1.1 [3]
Civic Meeting Place Area		1.3 [3]		Main entry lobby	1.5 [3]
Classroom, Lecture, Training, Vocational Areas		1.2 [5]	Locker/Dressing Room		0.8
Commercial and Industrial Storage Areas (conditioned and unconditioned)		0.6	Lounge/~~Recreation~~ Area		1.1 [3]
Commercial and Industrial Storage Areas (refrigerated)		0.7	Malls and Atria		1.2 [3]
Convention, Conference, Multipurpose and Meeting Center Areas		1.4 [3]	Medical and Clinical Care Area		1.2
Corridor, Restroom, Stair, and Support Areas		0.6	Office Area	≥ 250 square feet	0.75
Dining Area		1.1 [3]		≤ 250 square feet	1.0
Electrical, Mechanical, Telephone Rooms		0.7 [2]	Parking Garage Area	Parking Area	0.14
Exercise Center, Gymnasium Areas		1.0		Dedicated Ramps	0.3
Exhibit, Museum Areas		2.0		Daylight Adaptation Zones [9]	0.6
Financial Transaction Area		1.2 [3]	Religious Worship Area		1.5 [3]
General Commercial and Industrial Work Areas	Low bay	0.9 [2]	Retail Merchandise Sales, Wholesale Showroom Areas		1.2 [6 and 7]
	High bay	1.0 [2]	~~Tenant Lease Space~~		~~0.75~~
	Precision	1.2 [4]	Theater Area	Motion picture	0.9 [3]
Grocery Sales Area		1.2 [6 and 7]		Performance	1.4 [3]
Hotel Function Area		1.5 [3]	Transportation Function Area		1.2
Kitchen, Food Preparation Areas		1.6	Videoconferencing Studio		1.2 [8]
Laboratory Area, Scientific		1.4 [1]	Waiting Area		1.1 [3]
Laundry Area		0.9	All other areas		0.6
Footnotes for this table are listed below.					

Area Method – Lighting Power Density

Table 140.6-C Footnotes

FOOTNOTES FOR TABLE 140.6-C:

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

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

Calc of Allowed Indoor Lighting Power Density

Choose between 3 methods

3) Tailored Method

- Re-worked based on Lux vs. IES Type
- Use on projects with primary function areas that do not use the Area Category Method
- General Lighting can't be
  - Narrow beam, wall washer, valence, direct cove, perimeter linear slot
- Voluminous clarifications for most specific applications have been added to the code
  - Wall, Floor, Ornamental/Special Effect, Valuable Case

Tailored Method

- Start by determining spaces general lighting allowance (Column 2) from Table 146-G.
  - If not listened, refer to IESNA Handbook's Design Guide for Horizontal Illuminance.
  - Tasks less than 2 hours, or poor quality tasks, can't be used to justify types E, F, or G.

TABLE 146-G ~~D~~ TAILORED METHOD SPECIAL LIGHTING POWER ALLOWANCES

1	2	3	4	5	~~6~~
Primary Function	Illumination Category	Wall Display Power (W/ft)	Allowed Floor Display Power (W/ft²)	Allowed Ornamental/ Special Effect Lighting	~~Allowed Very Valuable Display Power (W/ft²)~~
Auditorium	D	~~2.5~~ 2.25	0.3	0.5	~~0~~
Civic Meeting Place	D	~~3.5~~ 3.15	0.2	0.5	-
~~Classrooms, lecture, training, vocational room~~	~~D~~	~~7~~	~~0~~	~~0~~	~~0~~
Commercial and industrial storage Inactive Active: bulky items; large labels Active: small items; small labels	~~IESNA HB~~ B C D	~~0~~	~~0~~	~~0~~	~~0~~
Convention, conference, multipurpose and ing centers	D	2.5	0.4	0.5	~~0~~
~~Corridors, restrooms, stairs and support~~	~~IESNA~~	~~0~~		~~0~~	~~0~~
Correction Facility cells and day rooms		0			
Dining		.5		0.6	~~0~~
Dressing room		0		0	
Education facilities Classrooms, lecture, training, vocational room	D	5.5	0	0	

Gone

Tailored Method – Lighting Power Density

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Table 140.6-D

TABLE 140.6-D TAILORED METHOD ~~SPECIAL~~ LIGHTING POWER ALLOWANCES ~~(THIS IS A REFORMATED VERSION OF THE TABLE ABOVE)~~

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

Tailored Method - RCR

Table 140.6-F

- Determine Room Cavity Ratio of each space.

TABLE 140.6-F ROOM CAVITY RATIO (RCR) EQUATIONS

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

Tailored Method - Task Areas

§146(c) 3A iv: Task Areas

- Based on Lux and RCR, look up allowed LPD
- Multiply by Area Ft^2

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

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

RCR

Tailored Method - “Use it or Lose it”

Table 140.6-D: Additional Allowed Power

- For primary functions listed in Table 140.6-D, there may be Additional Allowed Power.
- If these additional powers aren’t used, they’re lost.

Ornamental/Special

Floor Displays

Wall Displays

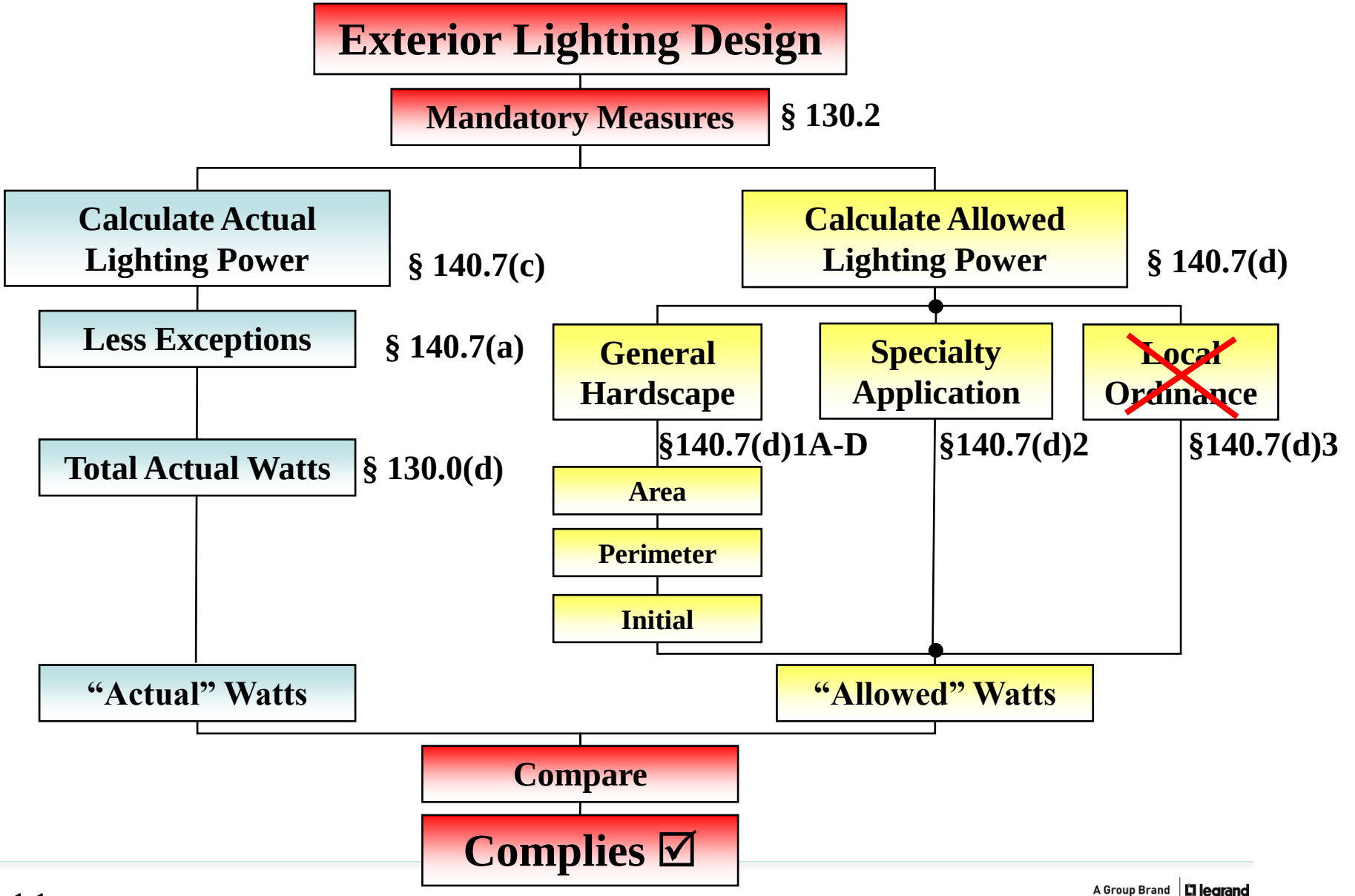
TABLE 140.6-D TAILORED METHOD ~~SPECIAL~~ LIGHTING POWER ALLOWANCES ~~(THIS IS A BEFORE VERSION OF THE TABLE ABOVE)~~

1	2	3	4	5
Primary Function Area	General Illumination Level (Lux)	Wall Display Power (W/ft)	Allowed Combined Floor Display Power and Task Lighting Power (W/ft²)	Allowed Ornamental/ Special Effect Lighting
Auditorium Area	300	2.25	0.3	0.5
Civic Meeting Place	300	3.15	0.2	0.5
Convention, Conference, Multipurpose, and Meeting Center Areas	300	2.50	0.4	0.5
Dining Areas	200	1.50	0.6	0.5
Exhibit, Museum Areas	150	15.0	1.2	0.5
Financial Transaction Area	300	3.15	0.2	0.5

Use It Or Lose It!

Prescriptive Outdoor Lighting Overview

§140.7: Prescriptive Requirements for Outdoor Lighting



Outdoor Lighting

- Compliance requires Actual LPD to be less than Allowed LPD
- Long list of exceptions when 50% light falls within following applications
  - Temporary, FAA required, roadway, sports fields, children's playgrounds, industrial site lighting, ATMs, public monuments, signs, ~~pools and water features,~~ tunnels, stairs, some ramps, landscape lighting, some historic lighting elements, etc...

Allowed Lighting Power

- **Allowed Lighting is total of:**
  - **General Hardscape Lighting** includes: parking lots, roadways, sidewalks, walkways, bikeways, plazas
  - **Specific Applications** includes items from Table 147-B
    - Building Entrance/Exit, Drive-up window, etc…
  - ~~**Local Ordinance** includes items from Table 147-C~~ **Gone**

Lighting Power Trade-offs

§140.7(b): Requirements for Outdoor Lighting

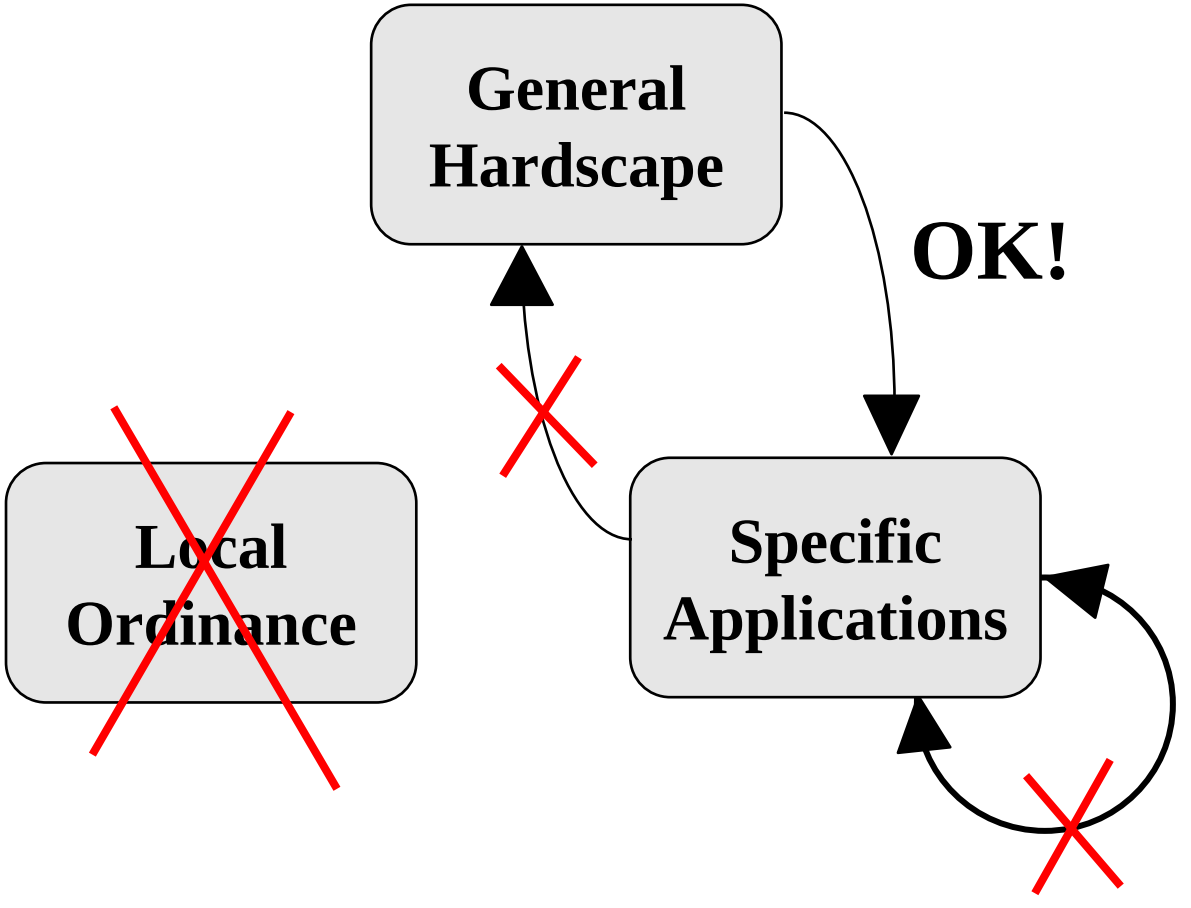


Table Only Changes

General Hardscape is a Total of:

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§140.7(d): Requirements for Outdoor Lighting

- **Area Based**
  - Total all “Illuminated Areas”, which is a Square with sides **= 10 x mounting height**, centered each luminaire or pole
  - Multiply “Illuminated Area” x Area Allowance in Table 140.7-A
- **Perimeter Based**
  - Perimeter of Illuminated Hardscape, less small landscape areas and permanent planters
  - Multiply Illuminated Perimeter x Linear Allowance Table 140.7-A
- **Initial Wattage**
  - One time allowance of power per site per Table 140.7-A

TABLE 140.7-A GENERAL HARDSCAPE LIGHTING POWER ALLOWANCE

Type of Power Allowance	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Area Wattage Allowance (AWA)	~~0.036~~ 0.035 W/ft²	0.045 W/ft²	~~0.092~~ 0.090 W/ft²	0.115 W/ft²
Linear Wattage Allowance (LWA)	~~0.36~~ 0.25 W/lf	0.45 W/lf	~~0.92~~ 0.60 W/lf	~~1.15~~ 0.85 W/lf
Initial Wattage Allowance (IWA)	340 W	510 W	770 W	1030 W

Determination of Outdoor Lighting Zones

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§10-114: Outdoor Lighting Zones

Zone	Ambient Illumination	State wide Default Location	Moving Up to Higher Zone	Moving Down to Lower Zones
LZ1	**Dark**	**Government designated parks, recreation areas, and Wildlife preserves.**	Designated park, recreation area, wildlife preserve can be designated as LZ2 or LZ3 if they are contained within such a zone.	NA
LZ2	**Low**	**Rural areas,** as defined by the 2000 U.S. Census.	Districts may designated as LZ3 by a local jurisdiction. Examples include special commercial or industrial districts or areas with special security considerations located within a rural area.	Special districts and government designated parks may be designated as LZ1 by the local jurisdiction for lower illumination standards, without any size limits.
LZ3	**Medium**	**Urban areas,** as defined by the 2000 U.S. Census.	Districts may be designated as a LZ4 by local jurisdiction for high intensity nighttime use, such as entertainment or commercial districts or areas with special security considerations requiring very high light levels.	Special districts and government designated parks may be designated as LZ1 or LZ2 by the local jurisdiction, without any size limits.
LZ4	**High**	**None**	NA	NA

Specific Application – "Use it or Lose it"

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

- Similar to Indoor Lighting for Specific Applications, but for Outdoor Applications. Review Table 140.7-B to see if allowed for specific Lighting Zones
  - Building Façade Lighting
  - Outdoor Sales Frontage Lighting
  - Outdoor Ornamental Lighting
  - Lighting under Canopies
  - Vehicle Service Station
    - Without Canopies
    - Hardscape Areas
  - Drive-up Windows
  - Guarded Facilities
  - Outdoor Dining

TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS

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

	Lighting Application	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
WATTAGE ALLOWANCE PER APPLICATION. Use all that apply as appropriate.					
	Building Entrances or Exits. Allowance per door. Luminaires qualifying for this allowance shall be within 20 feet of the door.	30 watts	~~75~~ 60 watts	~~100~~ 90 watts	~~120~~ 90 watts
	Primary Entrances to Senior Care Facilities, Police Stations, Hospitals, Fire Stations, and Emergency Vehicle Facilities. Allowance per primary entrance(s) only. Primary entrances shall provide access for the general public and shall not be used exclusively for staff or service personnel. This allowance shall be in addition to the building entrance or exit allowance above. Luminaires qualifying for this allowance shall be within 100 feet of the primary entrance.	45 watts	80 watts	120 watts	130 watts
	Drive Up Windows. Allowance per customer service location. Luminaires qualifying for this allowance shall be within 2 mounting heights of the sill of the window.	40 watts	75 watts	125 watts	200 watts
	Vehicle Service Station Uncovered Fuel Dispenser. Allowance per fueling dispenser. Luminaires qualifying for this allowance shall be within 2 mounting heights of the dispenser.	120 watts	175 watts	185 watts	330 watts
WATTAGE ALLOWANCE PER UNIT LENGTH (w/linear ft). May be used for one or two frontage side(s) per site.					
	Outdoor Sales Frontage. Allowance for frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. Luminaires qualifying for this allowance shall be located between the principal viewing location and the frontage outdoor sales area.	No Allowance	22.5 W/linear ft	36 W/linear ft	45 W/linear ft
WATTAGE ALLOWANCE PER HARDSCAPE AREA (W/ft²). May be used for any illuminated hardscape area on the site.					

Alteration vs. Modification-in-Place

- **Lighting System Alterations**
  - Where an existing lighting system is modified, luminaires are replaced, or luminaires are disconnected from the circuit, removed and reinstalled, whether in the same location or installed elsewhere. Does not include:

- **Luminaire Modification-in-Place**
  - Replacing lamps and ballasts with like type or quantity in a manner that preserves the original luminaire listing.
  - Changing the number or type of light source in a luminaire including: socket renewal, removal or relocation of sockets or lampholders, and/or related wiring internal to the luminaire including the addition of safety disconnecting devices.
  - Changing the optical system of a luminaire in part or in whole.
  - Replacement of whole luminaires 1 for 1 in which the only electrical modification involves disconnecting the existing luminaire and reconnecting the replacement luminaire.

Alteration vs. Modification-in-Place

- Luminaire Modification-in-Place
  - Can't be part of any general remodeling or renovation of their enclosed space
  - Can't cause, be the result of, or involve any changes to the panelboard or branch circuit wiring
    - Including line voltage switches, relays, contactors, dimmers and other control devices, providing power to the lighting system.
    - Exemption for Circuit modifications strictly limited to the addition of occupancy or vacancy sensors and class two lighting controls

Luminaire Alterations

Table 141.0-E: Additions, Alterations Repairs

Over 10% Rule!

TABLE 141.0-E Requirements for Luminaire Alterations

Quantity of existing affected luminaires per Enclosed Space [1]	Resulting Lighting Power for Each Enclosed Space	Applicable Mandatory Control Provisions for Each Enclosed Space	Multi-level Lighting Control Requirements for Each Altered Luminaire
Alterations that do not change the area of the enclosed space or the space type			
Sum total < 10% of existing luminaires	Existing lighting power is permitted	Existing provisions are permitted	Existing controls are permitted
Sum total ≥ 10% of existing luminaires	≤ 85% of allowed lighting power per Section 140.6 Area Category Method	§130.1(a), (c)	Two level lighting control [2] or §130.1(b)
	> 85% of allowed lighting power per Section 140.6 Area Category Method	§130.1(a), (c), (d) [3]	§130.1(b)
Alterations that change the area of the enclosed space or the space type or increase the lighting power in the enclosed space			
Any number	Comply with Section 140.6	§130.0(d) [3] §130.1(a), (c), (d) [3], (e)	§130.1(b)

1. Affected luminaires include any luminaire that is changed, replaced, removed, relocated; or, connected to, altered or revised wiring, except as permitted by EXCEPTIONS 1 and 2 to Section 141.0(b)**2Iii:**
2. Two level lighting control shall have at least one control step between 30 and 70% of design lighting power in a manner providing reasonably uniform illuminations
3. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are altered.

Remember:

130.1(a) = Area Device
130.1(b) = Multilevel Off
130.1(c) = Automatic Shut
130.1(d) = Daylighting
130.1(e) = Demand Response
130.0(d) = Mfg. Instructions

Modification-in-Place

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Table 141.0-F: Additions, Alterations Repairs

≥ 40 Rule!

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

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

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

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

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

Building Commissioning

- Building commissioning to be included in the design and construction of the building project to verify that the energy systems and components meet the owner's or owner representative's project requirements.
- Commissioning shall be performed in accordance with this section by trained personnel with experience on projects of comparable size and complexity.
- All building systems and components covered by Sections 110.0, 120.0, 130.0, and 140.0 shall be included in the scope of the commissioning requirements in this Section, excluding covered processes.
- For buildings less than 10,000 ft^2, only the design review requirements in Section 120.8(d) and 120.8(e) shall be completed.

Summary of Commissioning Requirements

§120.8(a): Building Commissioning

The following items shall be completed:

1. Owner's or owner representative's project requirements;
2. Basis of design;
3. Design phase design review;
4. Commissioning measures shown in the construction documents
5. Commissioning plan;
6. Functional performance testing;
7. Documentation and training; and
8. Commissioning report.

Owner's Project Requirements (OPR)

§120.8(b): Building Commissioning

The energy-related expectations and requirements of the building shall be documented before the design phase of the project begins. This documentation shall include the following:

1. Energy efficiency goals;
2. Ventilation requirements;
3. Project program, including facility functions and hours of operation, and need for after hours operation; and
4. Equipment and systems expectations.

EXCEPTION: Buildings less than 10,000 ft2.

Basis of Design

A written explanation of how the design of the building systems meets the OPR shall be completed at the design phase of the building project, and updated as necessary during the design and construction phases. The Basis of Design document shall cover the following systems:

1. Heating, ventilation, air conditioning (HVAC) systems and controls;
2. Indoor lighting system and controls; and
3. Water heating system.

EXCEPTION: Buildings less than 10,000 ft^2.

Design Phase Design Review

1. **Design Reviewer Requirements.** Based on Building Size:
   a) <10,000 ft^2: Design phase design review may be completed by the design engineer.
   b) 10,000 to 50,000 ft^2 require completion of the design review checklist by an engineer in-house to the design firm not associated with the building project.
   c) >50,000 ft^2 or for buildings with complex mechanical systems, an independent, third party review of these documents is required.

2. **Design Review.**

During schematic design, the owner/representative, design team and design reviewer to discuss the project scope, schedule and how design reviewer will coordinate with project team. The building owner / representative shall include the Design Review Checklist compliance form in the Certificate of Compliance documentation (see Section 10-103).

3**. Construction Documents Design Review.**

The Construction Documents Design Review compliance form lists the items that shall be checked by the design reviewer during the construction document review. The completed form shall be returned to the owner and design team for review and sign-off. The building owner/representative shall include this Construction Documents Design Review compliance form in the Certificate of Compliance documentation (§10-103).

Commissioning measures shown in the construction documents

- Include commissioning measures or requirements in the construction documents (plans and specifications). Be clear, detailed and complete. Include:
  - Systems and assemblies commissioned,
  - Testing scope
  - Roles and responsibilities of contractors
  - Requirements for meetings
  - Management of issues
  - The commissioning schedule,
  - Operations and maintenance manual development and of training
  - Checklist and test form development
  - Execution and documentation.

- Include, for information only, roles of non-contractor parties.

Commissioning Plan

§120.8(f): Building Commissioning

- Commissioning Plan. Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started during the design phase of the building project. The Commissioning Plan shall include the following:
  - 1. General project information;
  - 2. Commissioning goals;
  - 3. Systems to be commissioned.
  - 4. Plans to test systems and components shall include:
    - A. An explanation of the original design intent;
    - B. Equipment and systems to be tested, including the extent of tests;
    - C. Functions to be tested;
    - D. Conditions under which the test shall be performed;
    - E. Measurable criteria for acceptable performance;
    - F. Commissioning team information; and
    - G. Commissioning process activities, schedules and responsibilities. Plans for the completion of commissioning requirements listed in Sections 120.8(g) through 120.8(i) shall be included.

- EXCEPTION for buildings less than 10,000 ft^2 .

Functional Performance Testing

§120.8(g): Building Commissioning

- Functional performance tests shall demonstrate the correct installation and operation of each component, system and system-to-system interface in accordance with the Construction Documents.
- Functional performance testing reports to contain:
  - Information on each of the building components tested,
  - Testing methods utilized, and any readings and adjustments made.
  - All Acceptance Requirements for Code Compliance shall be completed as part of this functional performance testing.
- EXCEPTION: Buildings less than 10,000 ft^2.

Documentation and Training

1. Systems manual. Documentation of the operational aspects of the building shall be completed within the Systems Manual and delivered to the building owner or representative and facilities operator. The Systems Manual shall include the following:
   - A. Site information, including facility description, history and current requirements;
   - B. Site contact information;
   - C. Basic operations and maintenance, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, site events log;
   - D. Major systems;
   - E. Site equipment inventory and maintenance notes;
   - F. A copy of all special inspection verifications required by the enforcing agency or this code; and
   - G. Other resources and documentation.

2. Systems operations training. The training of the appropriate maintenance staff for each equipment type and/or system shall be documented in the commissioning report and shall include the following:
   - A. System/equipment overview (what it is, what it does and with what other systems and/or equipment it interfaces)
   - B. Review and demonstration of operation, servicing and preventive maintenance
   - C. Review of the information in the Systems Manual
   - D. Review of the record drawings on the system/equipment

EXCEPTION to Section 120.8(h): Buildings less than 10,000 ft^2 .

Permit, Certificate, …

All registration of nonresidential compliance documents with a HERS provider.

An electronic storage mechanism to archive all residential HERS and Nonresidential Compliance.

HVAC Occupant Sensors

§120.1(c)5: Mechanical Controls

- HVAC systems are required to have Demand Control Ventilation to insure Air Quality.
  - One way of meeting the requirement is CO_2 Sensors.
  - Another way for spaces <1,500 ft^2 is Occupancy Sensors which reduce airflow when space is unoccupied.

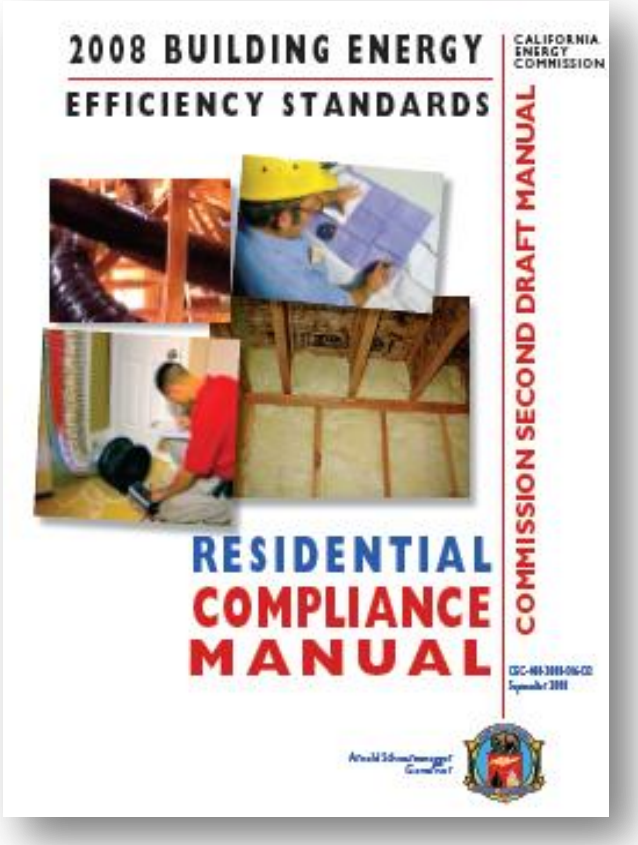
Shut-off/Reset for Space Conditioning

- Each space-conditioning have controls that automatically shut off the system during periods of nonuse using:
  - An automatic time switch control device complying with Section 110.9, with an accessible manual override that allows operation of the system for up to 4 hours; or
  - An occupancy sensor; or
  - A 4-hour timer that can be manually operated.
- Exception
  - Mechanical systems serving retail stores and associated malls, restaurants, grocery stores, churches, and theaters equipped with 7-day programmable timers.

HVAC Occupancy Controls

- Following spaces **must have occupancy sensors**
  - Multipurpose room < 1000 ft^2,
  - Classrooms > 750 ft^2 and
  - Conference, Convention, Auditorium and Meeting Center rooms > 750 ft^2
- During unoccupied periods:
  - Automatically setup the operating cooling temperature set point by 2°F or more and setback the operating heating temperature set point by 2°F or more; and
  - Automatically reset the minimum required ventilation rate with an occupant sensor ventilation control device according to Section 120.1(c)5.
  - Exemption for spaces with processes or operations that generate dusts, fumes, vapors or gasses

Residential Requirements



Under T24 <u>Commercial</u> Rules, CEC dictates power requirements, but doesn't care about the fixtures used.

Under T24 <u>Residential</u> Rules, CEC doesn't limit power used, but wants High Efficacy Fixtures.

Residential Lighting

§150.0 (k)1-2: Low-rise Residential Buildings

- Per Tables 150.0-A and 150.0–B, Luminaires are either
  - High Efficiency
  - Low Efficiency

- If it's a hybrid Luminaire with both High and Low Efficiency systems, each separately complies with 150.0(k) requirements

LEDs in Resi Applications

§110.9 (e): Mandatory Requirements for Lighting Control Devices

- To be High Efficacy, Resi LED Luminaries and Light Engines shall be Certified to CEC per JA-8.
  - If not certified, considered Low Efficacy
  - Non-resi LED lighting not required to be certified
  - JA-8 mandates a minimum **LED CRI of 90!**

Residential Lighting

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§150 (k)1-2: Low-rise Residential Buildings

TABLE 150.0-~~C~~A CLASSIFICATION OF HIGH EFFICACY AND LOW EFFICACY LIGHT SOURCES

High Efficacy Light Sources	Low Efficacy Light Sources
Luminaires manufactured, designed and rated for use with only lighting technologies in this column shall be classified as high efficacy:	Luminaires manufactured, designed or rated for use with any of the lighting technologies in this column shall be classified as low efficacy.
1. Pin-based linear or compact fluorescent lamps with electronic ballasts. Compact fluorescent lamps ≥ 13 watts shall have 4 pins for compliance with the electronic ballast requirements in Section 150(k)1D. 2. Pulse-start metal halide lamps. 3. High pressure sodium lamps. 4. GU-24 sockets rated for LED lamps. 5. GU-24 sockets rated for compact fluorescent lamps~~, and which are not recessed luminaires~~. 6. Luminaires using LED light sources which have been certified to the Commission as high efficacy in accordance with Reference Joint Appendix JA-8. 7. Luminaire housings rated by the manufacturer for use with only LED light engines. 8. Induction lamps. **Note:** Adaptors which convert an incandescent lamp holder to a high-efficacy luminaire shall not be used to classify a luminaire as high efficacy.	1. Line-voltage lamp holders (sockets) capable of operating incandescent lamps of any type. 2. Low-voltage lamp holders capable of operating incandescent lamps of any type. 3. High efficacy lamps installed in low-efficacy luminaires, including screw base compact fluorescent and screw base LED lamps. 3. Mercury vapor lamps. 4. Track lighting or other flexible lighting system which allows the addition or relocation of luminaires without altering the wiring of the system. 6. Luminaires using LED light sources which have not been certified to the Commission as high efficacy. 7. Lighting systems which have modular components that allow conversion between high-efficacy and low-efficacy lighting without changing the luminaires' housing or wiring. 8. Electrical boxes finished with a blank cover or where no electrical equipment has been installed, and where the electrical box can be used for a luminaire or a surface mounted ceiling fan.

legrand

Low-Rise Residential

TABLE 150-B: Low Rise Residential Mandatory Features - Lighting

Lamp Power Rating	Minimum Lamp Efficacy
5 watts or less	30 lumens per watt
Over 5 - 15 watts	45 lumens per watt (was 40)
Over 15 watts to 40 Watts	60 lumens per watt (was 50)
Over 40 watts	90 lumens per watt (was 60)

Note: Determine minimum luminaire efficacy using the system initial rated lumens divided by the luminaire total rated system input power.

Luminaire wattage

§150(k)3, 5, 6 : Low-rise Residential Buildings

- Luminaire Wattage
  - Permanently installed luminaries wattage per Section 130.0(c)
  - In kitchens electrical boxes with a blank cover or where no electrical equipment is installed is **180 watts of low efficacy lighting** per electrical box
- Electronic Ballasts
  - For all Fluorescent lamps over 13W
- Nightlights Alone and in Exhaust Fans
  - ~~Contain only high efficacy lamps~~
  - Rated to consume no more than 5 watts of power per Luminaire or Fan
  - Not required to be controlled by a vacancy sensor
- Exhaust Fan Lighting
  - In all rooms ~~except kitchens~~ must comply to Section 150 (k)
  - Except for Lighting installed by manufacturer in Kitchen Exhaust Hoods

Switching Devices & Controls

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§150(k)7 : Low-rise Residential Buildings

- Switch High & Low Efficacy luminaires **separately**
- Switch **Exhaust fans** separately from **lighting**
  - **Exception** Lighting integral to an exhaust fan may be on the same switch as the fan provided the lighting can be switched OFF in accordance with the applicable provisions in Section 150(k)2 while allowing the fan to continue to operate for an extended period of time.
- Controls must be **readily accessible** and installed in accordance with the manufacturer's instructions
- **Cannot** have controls that **bypass** any required dimmer or vacancy sensor
- An Energy Management Control System and/or multi-scene programmable controller may be used if it complies with Dimming or Vacancy Sensor requirements.

Simplified

Lighting Specific to rooms

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§150(k)8 : Low-rise Residential Buildings

- **Kitchens**: ≥ 50% of permanently installed lighting must be high efficacy (by Watts)

- Exemption for:

  50W for dwelling units ≤ 2,500 ft^2, or

  100W for dwelling units > 2,500 ft^2 if:

  - Meet 150.0(k)2 and ~~low efficacy~~ **All kitchen luminaires** are controlled by a vacancy sensor or dimmer, ~~EMCS, or programmable control system,~~ **~~AND~~**
  - ~~All permanently installed lights in garages, laundry rooms, closets > 70 ft^2, and utility rooms are high efficacy **AND** controlled by a vacancy sensor~~
    ~~(Note bathrooms are not included in list).~~

Lighting Specific to rooms

§150(k)9-11 : Low-rise Residential Buildings

- **Internal Cabinet Lighting:** ≤ 20 W/ linear ft.
  Regardless of the number of shelves or the number of doors per cabinet section, the length of an illuminated cabinet shall be determined by:
  - One horizontal length of illuminated cabinet; or
  - One vertical length, per illuminated cabinet section; or
  - No more than one vertical length per every 40 horizontal inches of illuminated cabinet.

- **Bathrooms:** Must have 1 High efficacy light, and all other should be high efficacy lighting unless it's controlled by a vacancy sensor

- **Garages, Laundry Rooms, Utility Rooms**: Use high efficacy lighting AND must be controlled by a vacancy sensor

- **Other rooms**: High efficacy lighting or controlled by a dimmer or vacancy sensor
  - Closets < 70 ft^2 exempted
  - Doesn't include small detached storage buildings

Title 24 Resources

- http://www.energy.ca.gov/title24
  - Energy Efficiency Standards
  - Compliance Manual
- Hotline: 800-772-3300

California Energy Commission
Energy Standards Hotline

(916) 654-5106
or toll free in California
(800) 772-3300

HOURS:
Monday through Friday
8 a.m. to 12 p.m. and 1 p.m. to 4:30 p.m.

E-mail: title24@energy.state.ca.us

Questions???

WattStopper Education Series

Thank you

What are your questions?

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