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5. Nonresidential Indoor Lighting

This chapter covers the Title 24 California Code of Regulations, Part 6 (the Energy Standards), requirements for indoor lighting design and installation, including controls, for both conditioned and unconditioned nonresidential buildings. It is addressed primarily to lighting designers, electrical engineers, and enforcement agency personnel responsible for lighting design, installation, plan check, and inspection.

Chapter 6 addresses nonresidential outdoor lighting requirements.

Chapter 7 addresses sign lighting requirements.

5.1 Overview

The primary mechanism for regulating nonresidential indoor lighting energy under the Energy Standards is to limit the allowed lighting power in watts installed in the building. Other mechanisms require basic equipment efficiency and that the lighting be controlled automatically for efficient operation.

5.1.1 Significant Changes in the 2016 Energy Standards

- Reductions to some Lighting Power Density (LPD) values in Tables 140.6-B and 140.6-C.
- Reduction to LPD values in Table 140.6-G for applying specific Illuminating Energy Society of North America (IES) design criteria with the Tailored Method.
- New requirements for partial-ON occupancy controls in some spaces including private offices, conference rooms, multipurpose rooms, and classrooms.
- Removal of three Power Adjustment Factors (PAFs):
  - Partial-ON Occupant Sensing Control
  - Manual Dimming and Multi-scene Programmable Dimming for Hotels/motels, Restaurants, Auditoriums, and Theaters
  - Combined Manual Dimming plus Partial-ON Occupant Sensing Control
- Addition of two new Power Adjustment Factors (PAFs):
  - Institutional Tuning
  - Daylight Dimming plus OFF Control

5.1.2 Scope and Application

- The Energy Standards, nonresidential indoor lighting requirements and supporting definitions are contained in §100, §110.9, §120.8, §130.0, 1§30.1, §130.4, §140.3, §140.0, §140.1, §140.6, and §141.0.
- The nonresidential indoor lighting requirements apply to nonresidential buildings, high-rise residential buildings (except dwelling units), and hotel/motel occupancies (including guest rooms) as defined in §100.1.
- The nonresidential indoor lighting requirements are the same for unconditioned spaces as for conditioned spaces, as defined in §100.1, except that Performance Approach trade-offs are not allowed between unconditioned and conditioned spaces.

- Some function areas within buildings classified as low-rise residential are required to comply with the nonresidential indoor lighting requirements (for example, §150.0(k)6B places additional lighting requirements on the common area in a low-rise multi-family residential building when there is greater than 20 percent common area in the building).
- Some function areas in nonresidential, high-rise residential, and hotel/motel occupancies are required to comply with low-rise residential lighting requirements. The low-rise residential lighting requirements are covered in chapter 6 of the 2016 Residential Compliance Manual.
- Hotel/motel guest rooms are covered by portions of both the nonresidential indoor lighting requirements and the residential indoor lighting requirements. The residential indoor lighting requirements are covered in the Residential Compliance Manual.
- Qualified historic buildings are not covered by the Energy Standards, as stated in exception 1 to §100.0(a). Historic buildings are regulated by the California Historical Building Code (Title 24 California Code of Regulations, Part 8 or Part 2, Volume 2, Chapter 34). However, non-historical components of the buildings, such as new or replacement mechanical, plumbing, and electrical (including lighting) equipment, additions and alterations to historic buildings, and new appliances in historic buildings may need to comply with the Energy Standards and the Appliance Efficiency Regulations, as well as other codes. For more information about energy compliance requirements for Historic Buildings, see Section 1.7.2 of this manual.
- All section (§) and Table references in this Chapter refer to sections and Tables contained in Title 24 California Code of Regulations, Part 6, also known as the Energy Standards or California Energy Code.

5.1.3 Mandatory Measures

§130.0 through §130.4

Some requirements in the nonresidential lighting Standards are classified as “Mandatory Measures,” because they are required to be met regardless of the compliance approach used. There are no alternate options for the Mandatory Measures. All projects must comply with all Mandatory Measures.

5.1.4 Lighting Power Allotments

Lighting Power Allotments are the established maximum lighting power (typically watts per square foot) that can be installed based upon the compliance approach used, the building type, and the type of primary function area. Lighting Power Allotments for an application are determined by one of the following four compliance approaches:

A. **Prescriptive Approach – Complete Building Method**: applicable when the entire building’s lighting system is designed and permitted at one time, and when at least 90 percent of the building is one primary nonresidential building type of use, as defined in §100.1. In some cases, the complete building method may be used for an entire nonresidential building type tenant space in a multi-tenant building. A single Lighting Power Density Allotment value governs the entire building §140.6(c)1.

B. **Prescriptive Approach – Area Category Method**: applicable for any permit situation, including tenant improvements. Lighting power values are assigned to each of the primary function areas of a building (offices, lobbies, corridors, etc., as defined in

§100.1). This approach provides some flexibility to accommodate special tasks by providing an additional power allowance under some circumstances.

C. **Prescriptive Approach – Tailored Method:** applicable for a limited number of defined primary function areas when additional flexibility is needed to accommodate special task lighting needs. Several layers of lighting power allotments may be allowed depending on the space and tasks. Lighting power allotments are determined room-by-room and task-by-task. When using the Tailored Method, the Area Category Method shall be used for the remainder of the interior lighting in the building.

D. **Performance Approach:** applicable when the designer uses an Energy Commission-certified compliance software program to demonstrate that the proposed building's energy consumption, including indoor lighting power, meets the energy budget. The performance approach incorporates one or more of the three previous methods which set the appropriate Lighting Power Allotment used in calculating the building's custom energy budget.

The Performance Approach allows energy allotments to be traded between space conditioning, mechanical ventilation, indoor lighting, service water heating, envelope, and covered process loads. Such trade-offs can only be made when permit applications are sought for those systems involved. For example, under the performance approach, a building with an indoor lighting or mechanical ventilation system that is more efficient than the prescriptive efficiency requirements may be able to meet the energy budget for a standard designed building with more lighting power than allowed under the three prescriptive lighting approaches.

No additional lighting power allotment is gained by using the Performance Method unless it is traded from the space conditioning, mechanical ventilation, service water heating, envelope, or covered process systems. Therefore, the Performance Approach is not applicable to lighting compliance alone. The Performance Approach may only be used to model the performance of indoor lighting systems that are covered under the building permit application.

5.1.5 Forms, Plan Check, Inspection, Installation, and Acceptance Tests

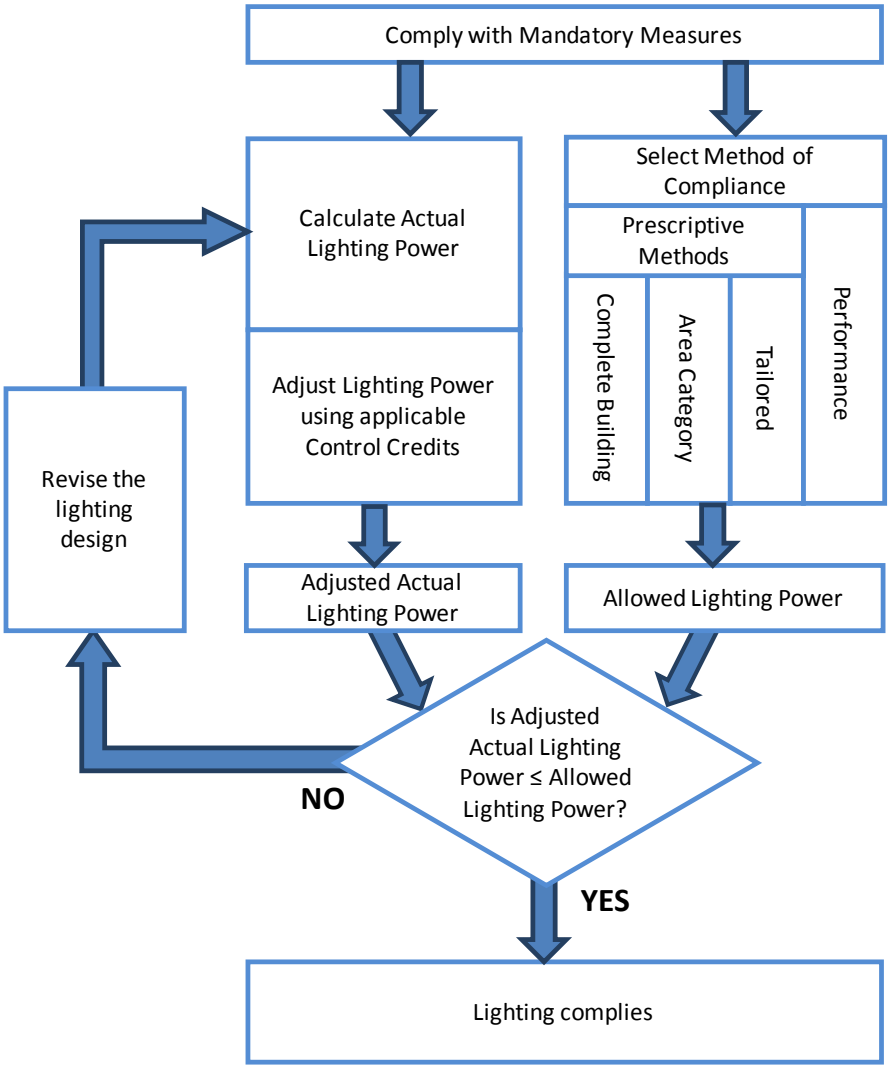
In summary, the compliance process begins with the builder submitting Certificates of Compliance, which provide all design information necessary to show that the proposed project will comply with the Energy Standards, to the responsible code enforcement agency. Construction may not begin until all Certificates of Compliance are reviewed and approved by the agency. As construction proceeds, builders must submit Certificates of Installation certifying that installed equipment and systems meet or exceed the design criteria specified in the approved Certificates of Compliance. Code enforcement officials may conduct field inspections to verify information submitted by builders. At the end of construction, acceptance tests must be performed by qualified contractors on all specified systems to ensure they are installed correctly and function adequately.

If inspections or acceptance tests identify noncompliant or nonfunctional systems, these defects must be fixed before the building can be approved. Once the code enforcement agency determines the project complies with all building code requirements, including the energy code, the building will receive a Certificates of Occupancy, which certify that the building is in compliance with the Energy Standards.

5.1.6 The Lighting Compliance Process

Figure 5-1 below, shows the process for complying with the nonresidential indoor lighting requirements.

Figure 5 1 – Lighting Compliance Flowchart



A. First, following the right side of Figure 5-1:

The Mandatory Measures are required regardless of the compliance method selected.

Select one of the four possible methods for complying with the nonresidential indoor lighting requirements of the Energy Standards. There are three Prescriptive compliance methods: Complete Building Method, Area Category Method, and Tailored Method; and one Performance Method where compliance is demonstrated using one of the software programs that have been approved by the Energy Commission.

This process will result in the permitted lighting power for the building.

B. Second, following the left side of Figure 5-1:

Calculate the actual lighting power installed by totaling all of the lighting proposed in the building design.

For any of the the three Prescriptive Methods (Complete Building, Area Category, and Tailored), subtract lighting control credits. The result is the adjusted actual watts of lighting power for the proposed building design.

For the Performance approach, adjusted actual watts of lighting power can be calculated automatically by the compliance software based on the modelling approach. Refer to the compliance software documentation for details.

C. Conclusion

If the adjusted actual watts are less than the permitted lighting power, then the lighting in the building complies with the Energy Standards. If the adjusted actual watts are equal to or greater than the permitted lighting power than the lighting in the building does not comply with the Energy Standards and either the lighting power must be reduced, or additional lighting credits must be acquired from improved efficiency in other systems.

5.2 General Requirements for Mandatory Measures

Some requirements in the nonresidential lighting Standards are classified as “Mandatory Measures” because they are required regardless of the compliance approach used. All projects must comply with all Mandatory Measures.

It is the responsibility of the designer to specify products that meet these requirements. It is the responsibility of the installer to comply with all of the mandatory requirements, even if the plans mistakenly do not. It is the responsibility of code enforcement officials, in turn, to check that the mandatory features and specified devices are installed.

The mandatory measures for nonresidential indoor lighting include the following:

- Some functional areas in nonresidential buildings are required to comply with the low-rise residential lighting Energy Standards (§130.0(b)).
- Manufactured lighting equipment, products, and devices must be appropriately certified (§110.0(b) and §110.1).
- Requirements for how luminaires shall be classified according to technology and how installed lighting power shall be determined (§110.9).
- Required indoor lighting controls (Section 5.4).
- Lighting control acceptance testing (Section 5.4.6).
- Lighting control Certificates of Installation (Section 5.4.7).
- Although not related exclusively to lighting, the Energy Standards impose mandatory measures for electrical power distribution systems. See Chapter 8 of this manual for additional information about mandatory measures for electrical power distribution systems.

5.2.1 Residential Function Areas in Nonresidential Buildings

The following function areas in nonresidential, high-rise residential, and hotel/motel occupancies are required to comply with the low-rise residential lighting Standards (§130.0(b)):

1. High-rise residential dwelling units.
2. Outdoor lighting attached to a high-rise residential or hotel/motel building and separately controlled from inside a dwelling unit or guest room.
3. Fire station dwelling units.
4. Hotel and motel guest rooms. Note that hotel and motel guest rooms are also required to comply with the nonresidential lighting requirements in §130.1(c)8, which require captive card key controls, occupant sensing controls, or automatic controls. In addition, hotel and motel guest rooms shall meet the controlled receptacle requirements of §130.5(d)4.
5. Dormitory and senior housing dwelling units.

All other function areas in nonresidential, high-rise residential, and hotel/motel occupancies, such as common areas, shall comply with the applicable nonresidential lighting Standards.

5.2.2 Certification Requirements for Manufactured Lighting Equipment, Products, and Devices

§110.0(b) and §110.1

For lighting products that are subject to State or federal appliance regulations, installation shall be limited to those products that have been certified to the Energy Commission by their manufacturer, pursuant to the provisions of the Appliance Efficiency Regulations (Title 20 California Code of Regulations, §1606).

Once a device is certified, it will be listed in the Appliance Efficiency Database, which is available from:

http://www.energy.ca.gov/appliances/database/

Call the Energy Hotline at 1-800-772-3300 to obtain more information.

If a device is certified to the Energy Commission, the Energy Standards do not require a builder, designer, owner, operator, or enforcing agency to independently test it to confirm its compliance with the Appliance Efficiency Regulations.

5.2.3 Requirements for Lighting Control Devices and Systems, Ballasts, and Luminaires

§110.9

For the purposes of the Energy Standards, lighting controls are separated into two categories:

- Self-Contained Lighting Controls are unitary lighting control modules that do not require any additional components to be fully functional.
- Lighting Control Systems require two or more components to be installed in the building to provide all of the functionality required to make up a fully functional and compliant lighting control.

Both categories of lighting controls must meet specified performance and certification requirements.

The Energy Standards also cover lighting controls which are not covered by the Title 20 Appliance Efficiency Regulations, such as field assembled lighting control systems, line-voltage track lighting integral current limiters, supplementary overcurrent protection panels for use with track lighting, ballasts for residential recessed compact fluorescent luminaires, and qualifications for residential high efficacy LED luminaires.

The requirements in §110.9 for ballasts used in residential recessed compact fluorescent luminaires, and for residential high efficacy LED luminaires, do not apply to most nonresidential lighting function areas, except for inside dwelling units of high-rise residential, hotel/motel, fire stations, and dormitory/senior housing.

A. General Lighting Control Requirements

The following lighting controls systems must comply with the applicable part of the Title 20 Appliance Efficiency Regulations and must include the specific functionality listed below (§110.9(b)). In addition, all components of the systems considered together as installed shall meet all applicable requirements for the application for which they are installed, as required in §130.0 through 130.5, §140.6 through 140.8, §141.0, and §150.0(k).

1. Time-Switch Lighting Controls
   - Automatic Time-Switch Controls
   - Astronomical Time-Switch Controls
   - Multi-Level Astronomical Time-Switch Controls
   - Outdoor Astronomical Time-Switch Controls
2. Daylighting Controls
   - Automatic Daylight Controls
   - Photo Controls
3. Dimmers
4. Occupant Sensing Controls
   - Occupant Sensors
   - Motion Sensors
   - Vacancy Sensors
   - Partial-ON Sensors
   - Partial-OFF Sensors

B. Self-Contained Lighting Control Devices

A Self-Contained Lighting Control is defined in §100.1 as a unitary lighting control module that requires no additional components to be a fully functional lighting control. Self-Contained Lighting Controls are required by §110.9(a)3 to be certified by the manufacturer according to the Title 20 Appliance Efficiency Regulations. Lighting controls regulated by the Energy Standards, but not regulated by the Title 20 Appliance Efficiency Regulations, shall meet the following requirements:

1. Part-Night Outdoor Lighting Control (§110.9(b)5)

Part-Night outdoor lighting controls do not apply to nonresidential indoor lighting requirements (see Section 6.3.4 for additional information).

A Part Night Outdoor Lighting Control is defined by §100.1 as a time or occupancy-based lighting control device or system that is programmed to reduce or turn off the lighting power to an outdoor luminaire for a portion of the night. (Note that this lighting control does not apply to nonresidential indoor lighting Standards).

2. Track lighting integral current limiter (§110.9(c))

A track lighting current limiter is used to limit the rated power that can go through a section of track lighting. Without the current limiter, the “installed” wattage of a long section of track could be excessive and use up all of the allotted lighting power for a space. With track lighting and a current limiter, one can space the track heads far apart and use high efficacy sources in the track heads so it is possible to stay below the rated wattage of the current limiter. If the wattage served by the current limiter exceeds the rated wattage of the current limiter, the current limiter turns off the current to the controlled lighting.

A track lighting integral current limiter shall be recognized for compliance with the Energy Standards only for line-voltage track lighting systems and only if it meets all of the following requirements:

a. Shall be certified to the Energy Commission by the manufacturer in accordance with the requirements in §110.9(c).

b. Before a Line-Voltage Track Lighting Integral Current Limiter will be recognized for compliance with the lighting requirements, the person who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices shall sign and submit the Certificate of Installation.

    i. If any of the requirements in the Certificate of Installation are not met, the Line-Voltage Track Lighting Integral Current Limiter shall not be recognized for compliance with the Energy Standards.

c. Shall be manufactured so that the current limiter housing is used exclusively on the same manufacturer's track for which it is designed.

d. Shall be designed so that the current limiter housing is permanently attached to the track so that the system will be irreparably damaged if the current limiter housing were to be removed after installation into the track. Methods of attachment may include but are not limited to one-way barbs, rivets, and one-way screws.

e. Shall employ tamper resistant fasteners for the cover to the wiring compartment.

f. Shall have the identical volt-ampere (VA) rating of the current limiter, as the system is installed and rated for compliance with the Energy Standards clearly marked on all of the following places:

    i. So that it is visible for the building officials’ field inspection without opening coverplates, fixtures, or panels.

    ii. Permanently marked on the circuit breaker.

    iii. On a factory-printed label that is permanently affixed to a non-removable base-plate inside the wiring compartment.

g. Shall have a conspicuous factory installed label permanently affixed to the inside of the wiring compartment warning against removing, tampering with, rewiring, or bypassing the device.

h. Each electrical panel from which track lighting integral current limiters are energized shall have a factory printed label permanently affixed and prominently located, stating the following:

"NOTICE: Current limiting devices installed in track lighting integral current limiters connected to this panel shall only be replaced with the same or lower amperage. Adding track or replacement of existing current limiters with higher continuous ampere rating will void the track lighting integral current limiter certification, and will require re-submittal of compliance documentation to the enforcement agency responsible for compliance with the California Title 24, Part 6 Building Energy Efficiency Standards."

3. Track Lighting Supplementary Overcurrent Protection Panel (§110.9(d))

A Track Lighting Supplementary Overcurrent Protection Panel is a subpanel that contains current limiters for use with multiple track lighting circuits only.

A Track Lighting Supplementary Overcurrent Protection Panel shall be used only for line-voltage track lighting and shall be recognized for compliance with the Energy Standards only if it meets all of the following requirements:

a. Before a Track Lighting Supplementary Overcurrent Protection Panel will be recognized for compliance with the lighting requirements in the Energy Standards, the person who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices shall sign and submit the Certificate of Installation.

    i. If any of the requirements in the Certificate of Installation are not met, the Track Lighting Supplementary Overcurrent Protection Panel shall not be recognized for compliance with the Energy Standards.

b. Shall be listed in accordance with Article 100 of the California Electric Code.

c. Shall be used only for line voltage track lighting. No other lighting or building power shall be used in a Supplementary Overcurrent Protection Panel, and no other lighting or building power shall be recognized for compliance with the Energy Standards by using a Supplementary Overcurrent Protection Panel.

d. Be permanently installed in an electrical equipment room, or permanently installed adjacent to the lighting panel board providing supplementary overcurrent protection for the track lighting circuits served by the supplementary over current protection pane.

e. Shall have a permanently installed label that is prominently located stating the following:

"NOTE: This Panel for Track Lighting Energy Code Compliance Only. The overcurrent protection devices in this panel shall only be replaced with the same or lower amperage. No other overcurrent protective device shall be added to this panel. Adding to, or replacement of existing overcurrent protective device(s) with higher continuous ampere rating, will void the panel listing and require re-submittal of compliance documentation to the enforcement agency responsible for compliance with the California Title 24, Part 6 Building Energy Efficiency Standards."

C. Requirements for Lighting Control Systems

Lighting Control Systems are defined by §100.1 as requiring two or more components to be installed in the building to provide all of the functionality required to make up a fully functional and compliant lighting control. Lighting control systems may be installed for compliance with lighting control requirements in the Energy Standards providing they meet all of the following requirements:

1. A lighting control system shall comply with all requirements listed below; and all components of the system considered together as installed shall meet all applicable requirements for the lighting control application for which they are installed as required in §130.0 through §130.5, §140.6 through §140.8, §141.0, and §150(k).
2. Before a Lighting Control System (including an EMCS) can be recognized for compliance with the lighting control requirements in the Energy Standards, the person who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices shall sign and submit the Certificate of Installation.
    i. If any of the requirements in the Certificate of Installation are not met, the Lighting Control System (or EMCS) shall be considered noncompliant.
3. If there are indicator lights that are integral to a lighting control system, they shall consume no more than one watt of power per indicator light.
4. A lighting control system shall meet all of the functional requirements in the Title 20 Appliance Efficiency Regulations for the comparable self-contained lighting control devices.
    i. For example, if a lighting control system is installed to comply with the Energy Standards for an occupancy sensor, then the lighting control system shall comply with all of the requirements for an occupancy sensor in Title 20. If that same lighting control system is also installed to comply with the Energy Standards for a daylighting control, then it shall also comply with all of the requirements for a daylighting control in Title 20. Each of these functions shall be documented in the Certificate of Installation (see item 2 above).
5. If the system is installed to function as a partial-on or partial-off occupant sensor, the installation may be made up of a combination of single or multi-level Occupant, Motion, or Vacancy Sensor Controls, provided that the components installed to comply with manual-on requirements shall not be capable of conversion by the user from manual-on to automatic-on functionality.

Figure 5-2 – Functional Diagram for Partial-ON Occupant Sensor

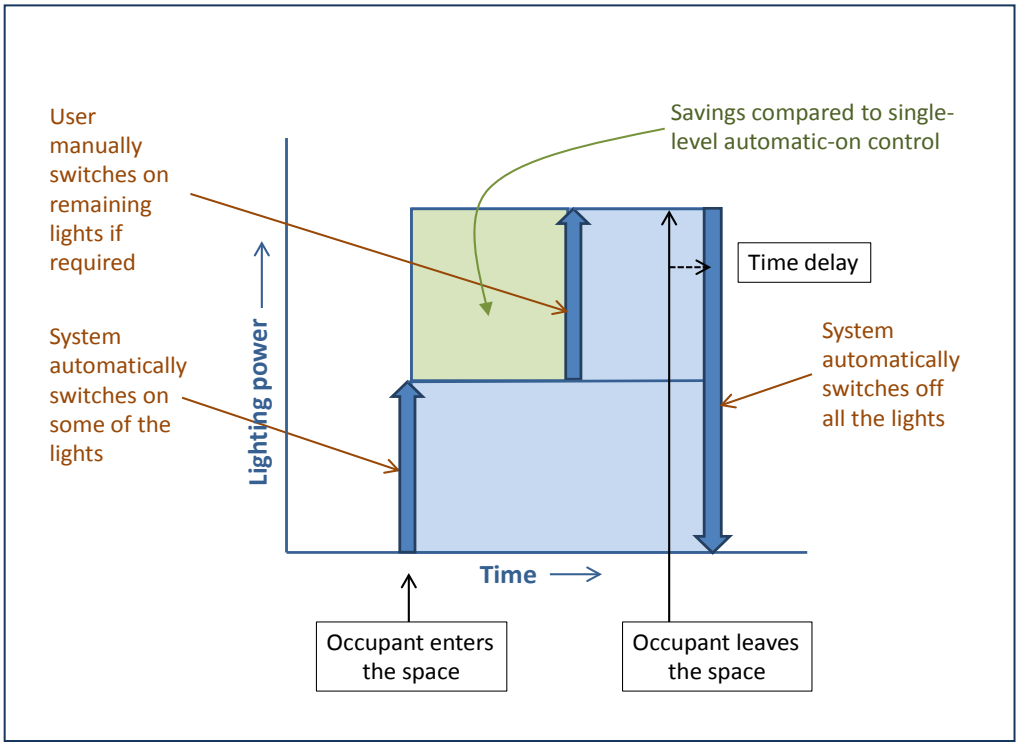
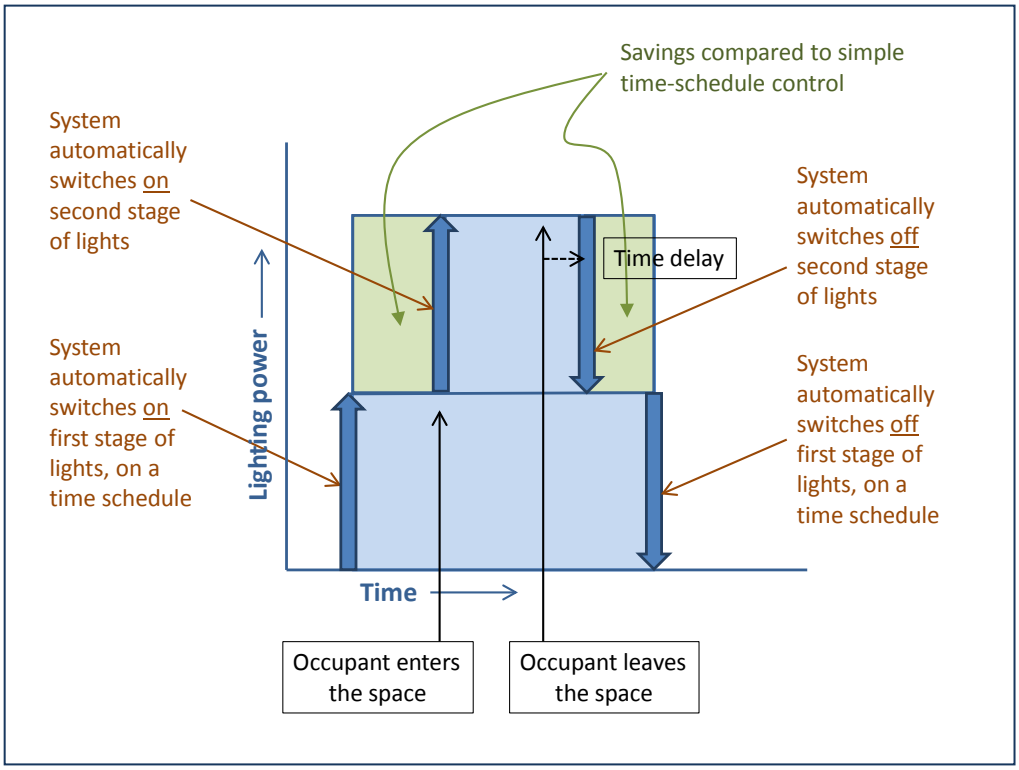


Figure 5-3 – Functional Diagram for Partial-OFF Occupant Sensor



D. Requirements for Residential Luminaires

The following requirements apply only to residential lighting installations:

1. The requirements for residential lighting only apply when installed in specifically defined residential function areas that are within a nonresidential building. (See Section 5.2.1)

2. There are no requirements for certifying nonresidential luminaires in accordance with the Energy Standards. However, there are some luminaires and light sources that are designed to be installed in either residential or nonresidential applications.

   If the luminaires are designed to be installed in residential lighting applications as specified in §150.0(k) and the luminaires are classified as JA8 high efficacy luminaires in accordance with Table 150.0-A, the luminaires shall be certified to the Energy Commission according to the requirements in Reference Joint Appendix JA8 as a JA8 High Efficacy Light Source.

3. Residential High Efficacy Luminaires. Certain types of light sources are automatically classified as high efficacy, unless they are in recessed downlight luminaires. (Recessed downlight luminaires in ceilings have specific requirements, outlined in Residential Compliance Manual Chapter 6.)

   Luminaires with the following light sources are automatically classified as high efficacy:

   a. Pin-based linear fluorescent luminaires using electronic ballasts
   b. Pin-based compact fluorescent luminaires using electronic ballasts
   c. Pulse-start metal halide luminaires
   d. High pressure sodium luminaires
   e. Luminaires with GU-24 sockets other than LEDs
   f. Luminaires with hardwired high frequency generator and induction lamp
   g. Inseparable SSL luminaires installed outdoors
   h. Inseparable SSL luminaries with colored light sources for decorative lighting purpose

   The luminaire types listed here are the only types that are automatically classified as high efficacy for residential lighting application. All other luminaire types must have a light source or lamp that meets the requirements of Reference Joint Appendix JA8.

4. Ballasts for Residential Recessed Luminaires. To qualify as high efficacy for compliance with the residential lighting in §150.0(k), any compact fluorescent lamp ballast in a residential recessed luminaire shall meet all of the following conditions, in accordance with §110.9(f):

   a. Be rated by the ballast manufacturer to have a minimum rated life of 30,000 hours when operated at or below a specified maximum case temperature. This maximum ballast case temperature specified by the ballast manufacturer shall not be exceeded when tested in accordance to UL 1598 Section 19.15.
   b. Have a ballast factor of no less than 0.90 for non-dimming ballasts and a ballast factor of no less than 0.85 for dimming ballasts.

5.3 Mandatory Requirements for Luminaire Labeling, Classification, and Determination of Luminaire Power

§130.0(c); NA8

The requirements for maximum rated wattage labeling, classifying the type of lighting technology used, and determining how many watts of power are used in luminaires is contained in §130.0(c). While all residential luminaires are required to be high efficacy, there are no similar requirements for nonresidential luminaires.

A. Manufacturer labeling of luminaires.

1. The maximum relamping rated wattage of a luminaire shall be listed on a permanent, pre-printed, factory-installed label, as specified by UL 1574, 1598, 2108, or 8750, as applicable.
2. Peel-off and peel-down labels that allow the maximum labeled wattage to be changed are prohibited, except for luminaires meeting ALL of the following requirements:
   a. It can accommodate a range of lamp wattages without changing the luminaire housing, ballast, transformer or wiring.
   b. It has a single lamp.
   c. It has an integrated ballast or transformer.
   d. Peel-down labels are layered such that the rated wattage reduces as successive layers are removed.
   e. Qualifies as one of the following three types of luminaires:
      i. High intensity discharge luminaires, having an integral electronic ballast, with a maximum relamping rated wattage of 150 watts.
      ii. Low-voltage luminaires (this shall not apply to low voltage track systems), ≤ 24 volts, with a maximum relamping rated wattage of 50 watts.
      iii. Compact fluorescent luminaires, having an integral electronic ballast, with a maximum relamping rated wattage of 42 watts.

B. Luminaires with line voltage lamp holders not containing permanently installed ballasts are always classified as incandescent luminaires. The wattage of such luminaires shall be determined as follows:

1. The maximum relamping rated wattage of the luminaire.
2. For recessed luminaires with line-voltage medium screw base sockets, wattage shall not be less than 50 watts per socket.

For example, if a recessed luminaire has a relamping rated wattage on a permanent, pre-printed, factory-installed label of 30 watts, it shall be counted as 50 watts; if a recessed luminaire has a relamping rated wattage of 90 watts, it shall be counted as 90 watts.

Peel-down labels are never recognized for any type of incandescent luminaire.

C. Luminaires and luminaire housings designed to accommodate a variety of trims or modular components that allow the conversion between incandescent and any other lighting technology without changing the luminaire housing or wiring shall be classified as incandescent.

D. Screw-based adaptors shall not be used to convert an incandescent luminaire to any type of non-incandescent technology. Screw-based adaptors, including screw-base adaptors classified as permanent by the manufacturer, shall not be recognized for compliance with the Energy Standards.

E. Luminaires and luminaire housings manufactured with incandescent screw base sockets shall be classified only as incandescent. Field modifications, including hard wiring of an LED module, shall not be recognized as converting an incandescent luminaire or luminaire housing to a non-incandescent technology for compliance with the Energy Standards unless such sockets are removed.

F. The wattage of luminaires with permanently installed or remotely installed ballasts or drivers shall be determined as follows:

1. The operating input wattage of the rated lamp/ballast combination published in ballast manufacturer's catalogs based on independent testing lab reports as specified by UL 1598.
2. The maximum input wattage of the rated driver published in driver's manufacturer catalogs based on independent testing lab reports as specified by UL 8750 or LM-79-08.

G. The wattage of line-voltage lighting track and plug-in busway which allows the addition or relocation of luminaires without altering the wiring of the system shall be determined by one of the following methods:

1. There is only one option for line voltage busway and track rated for more than 20 amperes. Wattage shall be the total volt-ampere rating of the branch circuit feeding the busway and track.
2. There are four options for determining the wattage of line voltage busway and track rated for 20 amperes or less, as follows:
   a. The volt-ampere rating of the branch circuit feeding the track or busway.
   b. The higher of:
      i. The rated wattage of all of the luminaires included in the system, where luminaire classification and wattage is determined according to the applicable provisions in §130.0(c).
      ii. 45 watts per linear foot.
   c. When using a Line-Voltage Track Lighting Integral Current Limiter, the higher of:
      i. The volt-ampere rating of an integral current limiter controlling the track or busway.
      ii. 12.5 watts per linear foot of track or busway.

   An integral current limiter shall be certified to the Energy Commission in accordance with §110.9, and shall comply with the Lighting Control Installation Requirements.

Before a Line-Voltage Track Lighting Integral Current Limiter will be recognized for compliance with the lighting requirements in the Energy Standards, the person who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices shall sign and submit the Certificate of Installation.

If any of the requirements in the Certificate of Installation are not met, the Line-Voltage Track Lighting Integral Current Limiter shall not be recognized for compliance with the Energy Standards.

d. When using a dedicated track lighting supplementary overcurrent protection panel, the sum of the ampere (A) rating of all of the overcurrent protection devices times the branch circuit voltages.

Track lighting supplementary overcurrent protection panels shall comply with the applicable requirements in §110.9, and shall comply with the Lighting Control Installation Requirements.

Before a dedicated track lighting supplementary overcurrent protection panel will be recognized for compliance with the lighting requirements, the person who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices shall sign and submit the Certificate of Installation.

If any of the requirements in the Certificate of Installation are not met, the track lighting supplementary overcurrent protection panel shall not be recognized for compliance with the Energy Standards.

H. Luminaires and lighting systems with permanently installed or remotely installed transformers. The wattage of such luminaires shall be determined as follows:

1. For low-voltage luminaires that do not allow the addition of lamps, lamp holders, or luminaires without rewiring, the wattage shall be the rated wattage of the lamp/transformer combination.

2. For low-voltage lighting systems, including low voltage tracks and other low-voltage lighting systems which allow the addition of lamps, lamp holders, or luminaires without rewiring, the wattage shall be the maximum rated input wattage of the transformer, labeled in accordance with item 1, or the maximum rated wattage published in transformer manufacturer's catalogs, as specified by UL 2108.

I. Light emitting diode (LED) Luminaires, and LED Light Engine for nonresidential applications are not required to be certified to the Energy Commission. An LED light engine is a an integrated assembly comprised of LED packages (components) or LED arrays (modules), LED driver, and other optical, thermal, mechanical and electrical components. The light engine is intended to connect directly to the branch circuit through a custom connector compatible with the LED luminaire for which it was designed and does not use an ANSI standard (screw) base. LED luminaires and light engines for residential applications shall be certified to the Energy Commission in order to be classified as high efficacy. See Chapter 6 in the 2016 Residential Compliance Manual for information on classifying residential LED luminaires as high efficacy.

1. The wattage of such luminaires shall be the maximum rated input wattage of the system when tested in accordance with IES LM-79-08.
2. The maximum rated input wattage shall be labeled on the luminaire, light engine, or luminaire housing in accordance with §130.0(c)1. Labels only on the power supply are not sufficient for compliance with this requirement.
3. An LED lamp, integrated or non-integrated type in accordance with the definition in ANSI/IES RP-16-2010, shall not be classified as a LED lighting system for compliance with the Energy Standards. LED modules having screw-bases including but not limited to screw based pig-tails, screw-based sockets, or screw-based adaptors shall not be recognized as an LED lighting system for compliance with the Energy Standards. The intent of this requirement is to not give credit for screw based LED lamps. An ANSI/IES RP-16-2010 integrated or non-integrated LED lamp is one with a screw base. The governing wattage of a luminaire with a screw based lamp is the rated luminaire wattage and not the LED lamp. If one wants to take credit for the lower wattage afforded by a LED lamp then the luminaire must have a **GU-24 socket** or be a hard wired LED luminaire (i.e. contain a LED light engine) that is rated according to IES LM-79-08.
4. Luminaires manufactured or rated for use with low-voltage incandescent lamps, into which have been installed LED modules or LED lamps, shall not be recognized as a LED lighting system for compliance with the Energy Standards.
5. For LED lighting systems which allow the addition of luminaires or light engines without rewiring, the wattage of such luminaires shall be the maximum rated input wattage of the power supply, labeled in accordance with §130.0(c)1 or published in the power supply manufacturer's catalog.

J. The wattage of all other miscellaneous lighting equipment shall be the maximum rated wattage of the lighting equipment, or operating input wattage of the system, labeled in accordance with §130.0(c)1, or published in manufacturer's catalogs, based on independent testing lab reports as specified by UL 1574 or UL 1598.

5.3.1 Summary of Installed Luminaire Wattage

The installed wattage of indoor lighting luminaires are calculated as follows for the various type of systems:

A. Line voltage screw based luminaires (not including track lighting)

- The maximum rated wattage of the luminaire, regardless of the wattage of the lamp that is installed.
  - Additional requirements for recessed luminaires: The wattage of recessed luminaires shall not be less than 50 watts

B. Luminaires containing a hardwired ballasts

- The rated input wattage of the lamp/ballast

C. Line voltage track lighting one of the following:

1. The larger of the rated wattage of luminaires installed on the track or 45 Watts per linear foot.
2. The volt-amps of the circuit serving the track.

3. The larger of the volt-amps of the integral current limiter serving the track or 12.5 Watts per linear foot of track.
4. The volt amps of the dedicated overcurrent protection in track lighting supplementary overcurrent protection panel.

D. Low voltage luminaires with hardwired or remotely installed transformers

- If the lamps cannot be replaced without rewiring, the rated wattage of lamp/transformer combination.
- If the lamps can be replaced without rewiring (i.e. the lamps fit into a socket), the maximum rated input wattage of the transformer.

E. Light emitting diode (LED) luminaires and LED light engines:

- The maximum rated input wattage of the system when tested in accordance with IES LM-79-08, or

F. Screw-in LED or CFL lamps or screw-in assemblies are not recognized for their lower wattages, the rating for luminaires with screw-in lamps or assemblies is the labeled rating of the luminaire itself.

Note: The Energy Standards Nonresidential Appendix NA8 provides an alternate option for determining how many watts of power is used per luminaire. NA8 provides tables that contain a limited list of lamp and ballast combinations. These tables in NA8 provide an alternate voluntary option to the provision in §130.0(c) for determining luminaire power for any lamp and ballast combination specifically listed in NA8. Appendix NA8 is not intended to list all possible lamp and ballast combinations, and shall not to be used to determine luminaire power for any lighting system not specifically listed in NA8.

When using NA8 to determine luminaire power, luminaire classification shall still be determined in accordance with §130.0(c).

Lamp ballast combinations included in Appendix NA8 are:

- Fluorescent U-Tubes
- Fluorescent Linear Lamps T5
- Fluorescent Rapid Start T-8
- Fluorescent Eight foot T-8 High Output (HO) with Rapid Start Ballasts
- High Intensity Discharge (Metal Halide and High Pressure Sodium)
- 12 Volt Tungsten Halogen Lamps Including MR16, Bi-pin, AR70, AR111, PAR36

Example 5-1 Luminaire power

Question

I'm considering replacing tubular fluorescent lamps with tubular LED lamps as part of a larger lighting system alteration. What method can I use to determine the luminaire power for these luminaires?

Answer

Complying with §130.0(c)6: Reference Nonresidential Appendix NA8 can be used to determine luminaire power where fluorescent ballasts are used with tubular LED lamps. Simply find the matching ballast and type/length of linear or U-shaped fluorescent lamp, and use the value given in that table. If more than one value applies, use the smallest appropriate value.

5.4 Mandatory Lighting Controls

§130.1

This section contains information about lighting controls that must be installed, regardless of the method used to comply with the lighting power requirements.

All lighting controls and equipment must comply with the applicable requirements in §110.9, and must be installed in accordance with the manufacturer's instructions (§130.0(d)).

Mandatory nonresidential indoor lighting controls include the following:

1. Area Controls. Manual controls separately controlling lighting in each area.
2. Multi-Level Controls. Providing occupants with the ability to use all of the light, some of the light, or none of the light in an area.
3. Shutoff Controls. Automatically shutting off or reducing light output of lighting when the space is vacant.
4. Automatic Daylighting Controls. Separately controlling some or all of the lights in the daylight area from the lights that are not in the daylight area.
5. Demand Responsive Lighting Controls. Installing controls that are capable of receiving and automatically responding to a demand response signal.

5.4.1 Area Lighting Controls

§130.1(a)

All luminaires in each area enclosed by ceiling-height partitions shall be independently controlled from luminaires in other areas, with fully functional manual ON and OFF lighting controls.

EXCEPTION: The exception to the mandatory area lighting control requirements is that up to 0.2 watts per square foot of lighting in any area within a building may be continuously illuminated during occupied times to allow for means of egress, provided that the following conditions are met:

1. The area is designated for means of egress on the building plans and specifications submitted to the enforcement agency under §10-103(a)2 of Part 1.
2. The controls for the egress lighting are not accessible to unauthorized personnel.

5.4.1.1 Requirements for ON and OFF Controls

The ON and OFF lighting controls shall meet the following requirements:

1. Be readily accessible to occupants/
2. Be operated with a manual control that is located in the same room or area with the lighting that is being controlled by that lighting control.

EXCEPTIONS: There are two exceptions to the requirements for these controls to be readily accessible and located in the same room:

1. In malls and atria, auditorium areas, retail merchandise sales areas, wholesale showroom areas, commercial and industrial storage areas, general commercial and industrial work areas, convention centers, and arenas, the lighting control shall be located so that a person using the lighting control can see the lights or area controlled by that lighting control, or so that the area being lit is annunciated.

Annunciated is defined in §100.1 as a type of visual signaling device that indicates the on, off, or other status of a load.

2. Public restrooms having two or more stalls, parking areas, stairwells, and corridors may use a manual control that is not accessible to unauthorized personnel. However, note that all other lighting controls in accordance with §130.1 are still required.

5.4.1.2 Interaction of Manual ON and OFF Controls with Other Lighting Controls

In addition to the manual area lighting controls, other lighting controls may be installed provided they do not override the functionality of controls installed in accordance with §130.1(a)1 (functionally controlled with a manual ON and OFF lighting control), §130.1(a)2 (readily accessible), or §130.1(a)4 (separately controlled lighting systems).

5.4.1.3 Separately Controlled Lighting System

In addition to the requirements in §130.1(a)1, 2, and 3:

1. General lighting shall be separately controlled from all other lighting systems in an area.
2. Floor and wall display, window display, case display, ornamental, and special effects lighting shall each be separately controlled on circuits that are 20 amps or less.
3. When track lighting is used, general, display, ornamental, and special effects lighting shall each be separately controlled.

5.4.2 Multi-Level Lighting Controls

§130.1(b) & Table 130.1-A

The multi-level lighting control requirements allow a room to be occupied with all of the lights turned on, part of the lights turned on, and none of the lights turned on, whether the room is occupied or vacant. The number of required lighting control steps varies, depending on the type of lighting technology in each installed luminaire, in accordance with Table 5-1 (Table 130.1-A of the Energy Standards). The uniformity requirements in Table 5-1 require that multi-level control occur per luminaire so one cannot meet this requirement by controlling alternate luminaires or alternate rows of luminaires. Note that switching alternate lamps in each luminaire for certain luminaire types, is permitted per Table 5-1 for meeting the illuminance uniformity requirement.

This requirement applies to enclosed spaces larger than 100 square feet and with a connected general lighting load greater than 0.5 W/ square foot. General lighting does not include task lights, display, or ornamental lighting.

These spaces also must comply with the following:

1. Lighting shall have the required number of control steps and meet the uniformity requirements in accordance with Table 130.1-A.
2. Multi-level lighting controls shall not override the functionally of other lighting controls required for compliance with §130.1(a) area controls, (c) automatic shut-off controls (d) daylighting controls. and (e) demand responsive controls.
3. Dimmable luminaires shall be controlled by a dimmer control that is capable of controlling lighting through all required lighting control steps and that allows the manual ON and OFF functionality required by §130.1(a).

5.4.2.1 Exceptions to multi-level lighting controls

The following applications are not required to comply with the requirements in Table 130.1-A of the Energy Standards (Table 5-1).

1. Classrooms with a connected general lighting load of 0.7 watts per square feet or less and public restrooms shall have at least one control step between 30-70 percent of full rated power.
2. An area enclosed by ceiling height partitions that has only one luminaire with no more than two lamps.
3. Areas specified in §130.1(b). These areas include:
   - Aisle ways and open areas in warehouses
   - Library book stack aisles 10 feet or longer that are accessible from only one end and library book stack aisles 20 feet or longer that are accessible from both ends
   - Corridors and stairwells
   - Parking garages, parking areas, and loading and unloading areas
4. The area specified in §130.1(c)6 and 7 are also not required to meet the requirements of §130.1(b).

Table 5-1 – Multi-Level Lighting Controls and Uniformity Requirements

Luminaire Type	Minimum Required Control Steps (percent of full rated power[1])	Uniform level of illuminance shall be achieved by:
Line-voltage sockets except GU-24	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 watts	Continuous dimming 20-100%	
Pin-based compact fluorescent > 20 watts[2]		
GU-24 sockets rated for fluorescent ≤ 20 watts	Minimum one step between 30-70%	Stepped dimming; or Continuous dimming; or Switching alternate lamps in a luminaire
Pin-based compact fluorescent ≤ 20 watts[2]		
Linear fluorescent and U-bent fluorescent ≤ 13 watts		

Linear fluorescent and U-bent fluorescent > 13 watts	Minimum one step in each range:				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
	20-40%	50-70%	75-85%	100%	
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 watts	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 watts					
Other light sources					
1. Full rated input power of ballast and lamp, corresponding to maximum ballast factor *2. Includes only pin based lamps: twin tube, multiple twin tube, and spiral lamps*					

Table 130.1-A of the Energy Standards

5.4.3 Automatic Shut-OFF Controls

§130.1(c)

In addition to lighting controls installed to comply with §130.1(a)(manual ON and OFF controls located in each area); §130.1(b)(multi-level lighting controls); §130.1(d)(automatic daylighting controls); and §130.1(e)(demand responsive controls) - all installed indoor lighting shall be equipped with shut-OFF controls that meet the following requirements (§130.1(c)1):

1. Shall be controlled with one or more of the following automatic shut-OFF controls:
   a. Occupant sensing control.
   b. Automatic time-switch control.
   c. Other control capable of automatically shutting OFF all of the lights when the space is typically unoccupied.
2. Separate controls for lighting on each floor, other than lighting in stairwells.
3. Separate controls for lighting in each room (enclosed space); spaces larger than 5,000 square feet will have more than one separately controlled zone where each zone does not exceed 5,000 square feet.

EXCEPTION: Only in the following function areas, the separately controlled space may exceed 5,000 square feet, but may not exceed 20,000 square feet per separately controlled space, and separately controls the lighting on each floor:

a. Mall
b. Auditorium
c. Single tenant retail
d. Industrial
e. Convention center
f. Arena

4. Separate controls for general, display, ornamental, and display case lighting.

5.4.3.1 General Exceptions to §130.1(c)1:

The following applications are exempted from the automatic shut-OFF requirements of §130.1(c)1:

1. Where the lighting is serving an area that is in continuous use, 24 hours per day/365 days per year.
2. Lighting complying with §130.1(c)5 instead of §130.1(c)1. This exception applies to those areas where occupant sensing controls are required to shut OFF all lighting. These areas include offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms of any size, or conference rooms of any size, in accordance with §130.1(c)5.
3. Lighting complying with §130.1(c)6 in addition to §130.1(c)1. This exception applies only to those areas where full or partial OFF occupant sensing controls are required in addition to the requirements in §130.1(c)1. These areas include aisle ways and open areas in warehouses, library book stack aisles 10 feet or longer that are accessible from only one end, library book stack aisles 20 feet or longer that are accessible from both ends, and corridors and stairwells (§130.1(c)6).
4. Lighting complying with §130.1(c)7 instead of §130.1(c)1. This exception applies to those areas where partial OFF occupant sensing controls are required. These areas include stairwells and common area corridors that provide access to guestrooms and dwelling units, in accordance with §130.1(c)7A; or parking garages, parking areas and loading and unloading areas, in accordance with §130.1(c)7B.
5. Up to 0.1 watts per square foot of lighting may be continuously illuminated, provided that the area is designated for means of egress on the plans and specifications submitted to the enforcement agency under §10-103(a)2 of Part 1.

   Note that the above exception is a change from the previous code version. All building types are permitted up to 0.1 watts per square foot for egress lighting.
6. Electrical equipment rooms subject to Article 110.26(D) of the California Electric Code.
7. Lighting that is designated as emergency lighting, connected to an emergency power source or battery supply, and is intended to function in emergency mode only when normal power is absent.

5.4.3.2 Use of Countdown Timer Switches

Countdown timer switches shall not be used to comply with the automatic shut-OFF control requirements in §130.1(c)1.

EXCEPTIONS: Only the following three function areas may use a countdown timer switch to comply with the automatic shut-OFF control requirements:

1. Single-stall bathrooms smaller than 70 square feet may use countdown timer switches with a maximum setting capability of ten minutes.
2. Closets smaller than 70 square feet may use countdown timer switches with a maximum setting capability of ten minutes.
3. Lighting in a Server Aisle in a Server Room may use countdown timer switches with a maximum setting capability of 30 minutes.
    a. A Server Aisle is defined by §100.1 as an aisle of racks of Information Technology (IT) server equipment in a Server Room. While networking equipment may also be housed on these racks, it is largely a room to manage server equipment.
    b. A Server Room is defined by §100.1 as a room smaller than 500 square feet, within a larger building, in which networking equipment and Information Technology (IT) server equipment is housed, and a minimum of five IT severs are installed in frame racks.

5.4.3.3 Requirements for Automatic Time-Switch Control

A. Override Lighting Controls

When an occupant sensing control is used to comply with the automatic shut-OFF requirements, lighting is automatically controlled in response to the presence or absence of occupants.

However, when an automatic time-switch control is used to comply with the automatic shut-OFF requirements, such a control is not responsive to the presence or absence of occupants. Therefore, when any control other than an occupant sensing control is used (i.e. automatic time-switch control, signal from another building system, or other control capable of automatically shutting OFF all of the lights), the lighting control system shall incorporate an override lighting control that:

1. Complies with §130.1(a) (Manual ON/OFF control located in each room).
2. Allows the lighting to remain ON for no more than 2 hours when an override is initiated.

EXCEPTIONS: In the following function areas, if a captive-key override is utilized, the override time may exceed 2 hours:

a. Malls
b. Auditoriums
c. Single tenant retail
d. Industrial
e. Arenas

B. Holiday "Shut-OFF" Feature

If an automatic time-switch controls installed to comply with §130.1(c)1, it shall incorporate an automatic holiday "shut-OFF" feature that turns OFF all loads for at least 24 hours, and then resumes the normally scheduled operation.

EXCEPTIONS: In only the following function areas, the automatic time-switch control is not required to incorporate an automatic holiday shut-OFF feature:

a. Retail stores and associated malls
b. Restaurants
c. Grocery stores
d. Churches
e. Theaters

5.4.3.4 Areas where Occupant Sensing Controls are required to shut OFF ALL Lighting

§130.1(c)5

1. Lighting in the following function areas shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting when the room is unoccupied. In addition, controls shall be provided that allow the lights to be manually shut-OFF in accordance with §130.1(a) regardless of the sensor status:
   a. Offices 250 square feet or smaller
   b. Multipurpose rooms of less than 1,000 square feet
   c. Classrooms of any size
   d. Conference rooms of any size

In areas required by §130.1(b) to have multi-level lighting controls, the occupant sensing controls shall function either as a:

a. Partial-ON Occupant Sensor capable of automatically activating between 50-70 percent of controlled lighting power.
b. Vacancy Sensor that automatically turns lights OFF after an area is vacated of occupants but requires lights to be turned ON manually.

In areas not required by §130.1(b) to have multi-level lighting controls, the occupant sensing controls may function as either as a:

a. Normal occupant sensor.
b. Partial-ON occupancy sensor.
c. Vacancy sensor.

Note that multipurpose rooms less than 1,000 square feet, classrooms greater than 750 square feet and conference rooms greater than 750 square feet are required to be equipped with an occupancy sensor that controls the HVAC thermostat setup and setback and ventilation (§120.2(e)3). As a result, the occupancy sensor or lighting control system in the space must be capable of triggering the HVAC without fully triggering the lighting load.

The same occupancy sensor used to control the lighting can also control the HVAC system. Besides the cost benefit, the benefit of using the lighting occupancy sensor to control the HVAC unit is that it is immediately apparent that the occupancy sensor has

failed when it is controlling the lighting and it may be less apparent that the sensor has failed if it is controlling only the HVAC system.

This method of controlling cooling, ventilation and lighting satisfies the requirements of §120.2(e)3 and §130.1(c), so no additional shutoff controls are required in these spaces, except in cases of lighting associated with the egress path, which may remain energized until the building is scheduled to normally be unoccupied.

5.4.3.5 Areas where full or partial OFF occupant sensing controls are required in addition to complying with §130.1(c)1

§130.1(c)6

In addition to the basic shutoff requirements in §130.1(c)1, §130.1(c)6 requires a shutoff device (typically a timeswitch) for the lighting system, which may be done in a building-wide manner. Lighting in the listed spaces (warehouses, library book stack aisles, and stairwells and corridors) must have the capability to reduce lighting power by at least 50 percent when they are unoccupied.

Egress lighting equipment is exempted, and may remain at full power until the building is beyond the “normally occupied” schedule, at which time it may be placed on occupancy sensors and turned OFF completely.

A. In aisle ways and open areas in warehouses, lighting shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls must have independent zoning for each aisle, and the aisle zones must not extend beyond the aisle into the open area of the warehouse.

   EXCEPTIONS: The following conditions exempt the lighting system from this requirement, but they must meet the additional listed requirements:

   1. In aisle ways and open areas in warehouses in which the installed lighting power is 80 percent or less of the value allowed under the Area Category Method, occupant sensing controls shall reduce lighting power by at least 40 percent (instead of the 50 percent required above).
   2. When metal halide lighting or high pressure sodium lighting is installed in warehouses, occupant sensing controls shall reduce lighting power by at least 40 percent (instead of the 50 percent required above). This is a limitation of the dimming or bi-level ballast technology for HID light sources.

   Note that even if the exemptions apply, these only result in a lighting power reduction associated with aisles and open areas during “normally occupied” periods. These spaces are still required to comply with the applicable automatic shut-OFF controls in §130.1(c), which will produce deeper savings during the “after hours” periods.

B. In library book stack aisles meeting the following criteria, lighting shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied:

   1. Library book stack aisles 10 feet or longer that are accessible from only one end.
   2. Library book stack aisles 20 feet or longer that are accessible from both ends.

   The occupant sensing controls shall independently control lighting in each aisle way, and shall not control lighting beyond the aisle way being controlled by the sensor.

Note: This lighting is required to comply with the applicable automatic shut-OFF controls in §130.1(c).

C. Lighting installed in corridors and stairwells shall be controlled by occupant sensing controls that separately reduce the lighting power in each space by at least 50 percent when the space is unoccupied. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress.

Note: These subsections indicate that the lighting must turn off the lights *at least* 50 percent, but the decision to turn off the lights fully may be made by the designer. There is no limit on the maximum the lights may be turned off, as there is in some other portions of the code.

The lighting in this section must also comply with the other portions of §130.1(c) that requires a full shutoff capability, which in the case of a partial-OFF sensor, would probably be triggered by a timeswitch.

5.4.3.6 Areas where partial OFF occupant sensing controls are required instead of complying with §130.1(c)1

§130.1(c)7

The listed areas are required to have a Partial-OFF lighting control system INSTEAD of meeting the shutoff requirements of §130.1(c), however, that does not mean that they are not permitted to also meet those basic shutoff requirements, only that they are not required. This means that lighting in stairwells and corridors of hotels/motels and parking garages may operate on a full-time basis at the minimum setback level, and are not required to be shut OFF in the “after hours” periods as the majority of building lighting is required to be.

A. Lighting in stairwells and common area corridors which provide access to guestrooms and dwelling units of high-rise residential buildings and hotel/motels shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress. This permits the lights to remain ON at a setback level continuously. Note that the zoning of the controls require careful consideration of paths of egress to ensure that the sensor coverage in the zone is adequate.

   EXCEPTION: In common area corridors and stairwells in which the installed lighting power is 80 percent or less of the value allowed under the Area Category Method, occupant sensing controls shall reduce power by at least 40 percent (instead of the 50 percent required above).

B. In parking garages, parking areas and loading and unloading areas, the general lighting shall be controlled as follows:

   1. By occupant sensing controls having at least one control step between 20 percent and 50 percent of design lighting power.
   2. No more than 500 watts of rated lighting power shall be controlled together as a single zone.
   3. A reasonably uniform level of illuminance shall be achieved in accordance with the applicable requirements in Table 5-1 (Table 130.1-A of the Energy Standards).

4. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in each separately controlled space.
5. The occupant sensing controls shall be automatically activated from all designed paths of egress.

This states that the lighting power must be reduced by at least 50 percent of the original lighting power, and that the lighting must be reduced while maintaining similar levels of uniformity to the full power conditions. Note that the zoning of the controls require careful consideration of paths of egress to ensure that the sensor coverage in the zone is adequate, and the wattage limits per zone will typically not permit entire floors of a garage to be on a single zone.

EXCEPTION: Metal halide luminaires meeting the following criteria shall be controlled by occupant sensing controls having at least one control step between 20 percent and 60 percent of design lighting power:

- Have a metal halide lamp plus ballast mean system efficacy of greater than 75 lumens per watt, (the lamp/ballast mean system efficacy is the rated mean lamp lumens at 40 percent of lamp life[1] divided by the ballast rated input watts) and
- Are used for general lighting in parking garages, parking areas and loading and unloading areas.

The requirement for metal halide luminaires to have a control step between 20 percent and 60 percent is a limitation of the dimming or bi-level ballast technology for HID light sources.

Note that interior areas of parking garages are classified as indoor lighting for compliance with §130.1(c)7B.

The parking areas on the roof of a parking structure are classified as outdoor hardscape and shall comply with the applicable provisions in §130.2. These controls provisions in §130.1(c)7B do not apply to open rooftop parking.

§130.1(c)7 indicates that the lighting must turn off the lights by at least 50 percent, but the decision to turn the lights off fully may be made by the designer.

The spaces listed in these sections are not required to meet the other requirements in §130.1(c) for full shutoff capability (these do not need to be connected through a timeswitch for unoccupied hours shutoff).

5.4.3.7 Requirements for Hotel and Motel Guest Rooms

§130.1(c)8

In addition to complying with the low-rise residential lighting Standards in accordance with §130.0(b), hotel and motel guest rooms shall have captive card key controls, occupancy sensing controls, or automatic controls such that, no longer than 30 minutes after the guest room has been vacated, lighting power is switched off.

[1] Illuminating Engineering Society. Section 13.3 “Life and Lumen Maintenance” in The Lighting Handbook: 10th Edition Reference and Application. 2011. New York..

EXCEPTION: A luminaire in a hotel or motel guest room meeting all of the following criteria is not required to have captive card key controls, occupancy sensing controls, or automatic controls under the following conditions:

- Applies to one high efficacy luminaire (where high efficacy is defined in §150.0(k) and Table 150.0-A), and
- That is switched separately from the other lighting in the room, and
- The switch for that luminaire is located within 6 feet of the entry door.

This one high efficacy luminaire is exempted so a person can turn on a light switch to find the captive card control.

5.4.4 Automatic Daylighting Controls

§130.1(d)

Daylighting can be used as an effective strategy to reduce electric lighting energy use by reducing electric lighting power in response to available daylight. §130.1(d) addresses mandatory requirements for daylighting.

Additional lighting controls are required in daylit zones to automatically shut off lighting when sufficient daylight is available.

Prescriptive daylighting controls are covered in subchapter 5.5 of this chapter.

5.4.4.1 Description of Terms

The following terms are used to describe the daylighting requirements in §130.1(d).

A. **General Lighting** - Electric lighting that provides a uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect, exclusive of daylighting, and also known as ambient light.

   Typical luminaires used for general lighting are troffers (prismatic, parabolic, or indirect diffusers), pendants (direct, indirect, or direct/indirect), high bay, low bay, and “aisle-lighter” fixtures. General lighting does not include display lighting (typically using directional MR, PAR, flood, spot, or wall washers) or ornamental lighting (such as drum fixtures, chandeliers, or projection lighting.)

B. **Window Head Height** - The vertical distance from the finished floor level to the top of a window

C. **Daylit Zones** - A region of space considered to be close to a source of daylight such as window, clerestory, roof monitor or skylight, where luminaires can be dimmed or switched in response to available daylight.

5.4.4.2 Definitions of Daylit Zones

Areas having skylights and windows are classified according to daylit zones. The three different types of daylit zones are defined as follows:

A. **SKYLIT DAYLIT ZONE** is the rough area in plan view under each skylight, plus 0.7 times the average ceiling height in each direction from the edge of the rough opening of the skylight, minus any area on a plan beyond a permanent obstruction that is taller than the following:

   - A permanent obstruction that is taller than one-half the distance from the floor to the bottom of the skylight.

The bottom of the skylight is measured from the bottom of the skylight well for skylights having wells, or the bottom of the skylight if no skylight well exists.

For the purpose of determining the Skylit Daylit Zone, the geometric shape of the Skylit Daylit Zone shall be identical to the plan view geometric shape of the rough opening of the skylight; for example, for a rectangular skylight the Skylit Daylit Zone plan area shall be rectangular, and for a circular skylight the Skylit Daylit Zone plan area shall be circular.

Note: Modular furniture walls shall not be considered a permanent obstruction.

Figure 5-4 – Skylit Daylit Zone Diagram

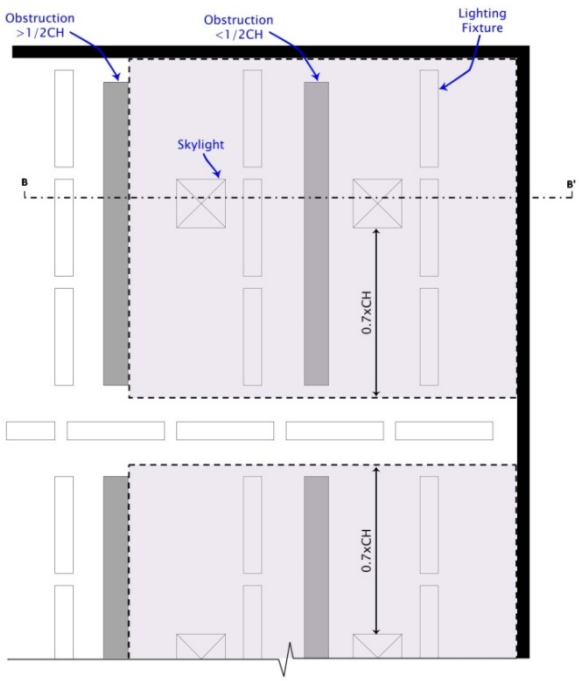
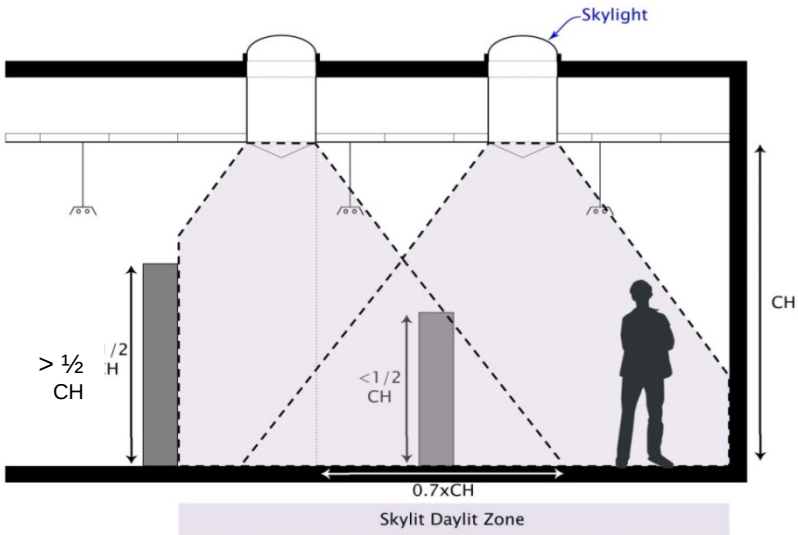


Figure 5-5 – Skylit Daylit Zone Diagram 2



B. **PRIMARY SIDELIT DAYLIT ZONE** is the area in plan view and is directly adjacent to each vertical glazing, one window head height deep into the area, and window width plus 0.5 times window head height wide on each side of the rough opening of the window, minus any area on a plan beyond a permanent obstruction that is 6 feet or taller as measured from the floor.

Note: Modular furniture walls shall not be considered a permanent obstruction.

Figure 5-6 – Primary Sidelit Daylit Zone Diagram 1

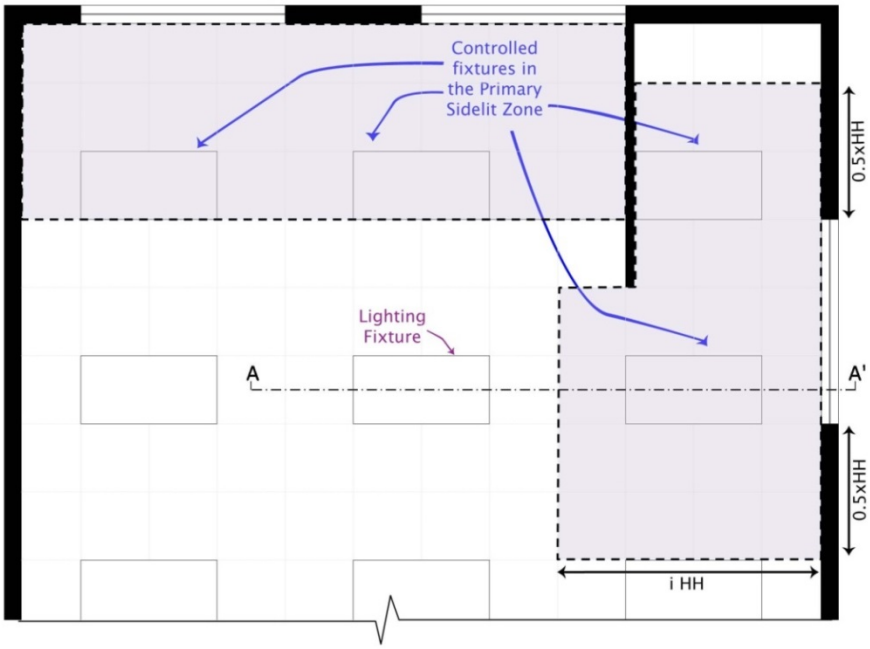
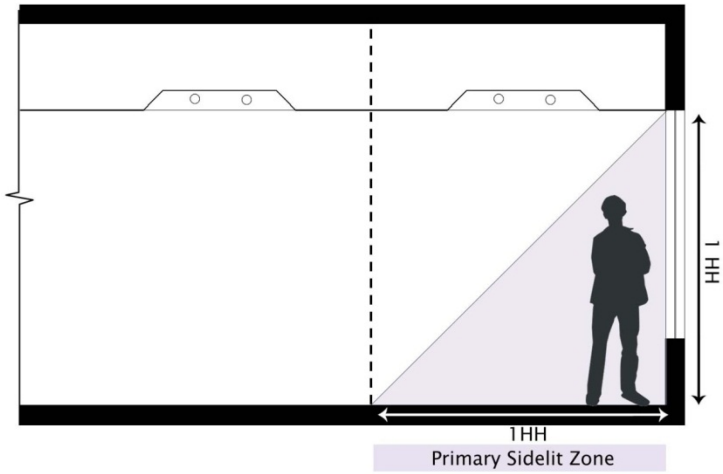


Figure 5-7 – Primary Sidelit Daylit Zone Diagram 2



C. **SECONDARY SIDELIT DAYLIT ZONE** is the area in plan view and is directly adjacent to each vertical glazing, two window head heights deep into the area, and window width plus 0.5 times window head height wide on each side of the rough opening of the window, minus any area on a plan beyond a permanent obstruction that is 6 feet or taller as measured from the floor.

Note: Modular furniture walls shall not be considered a permanent obstruction.

The daylighting controls in the Skylit Daylit Zone and the Primary Sidelit Daylit Zone are mandatory; they cannot be traded away for other efficiency measures when using the performance (whole building energy simulation) approach. The daylighting controls requirements in the Secondary Sidelit Daylit Zone is prescriptive and thus can be traded away for other efficiency measures in the performance approach. If code compliance is accomplished with the prescriptive approach then daylighting controls will be required in both the Primary and Secondary Sidelit Daylit Zones and these two zones must be controlled separately from each other.

Figure 5-8 – Secondary Sidelit Daylit Zone Diagram 1

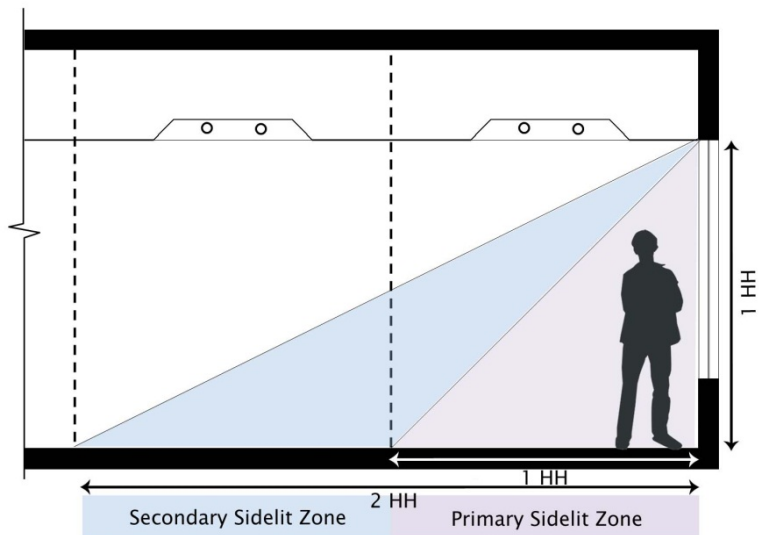
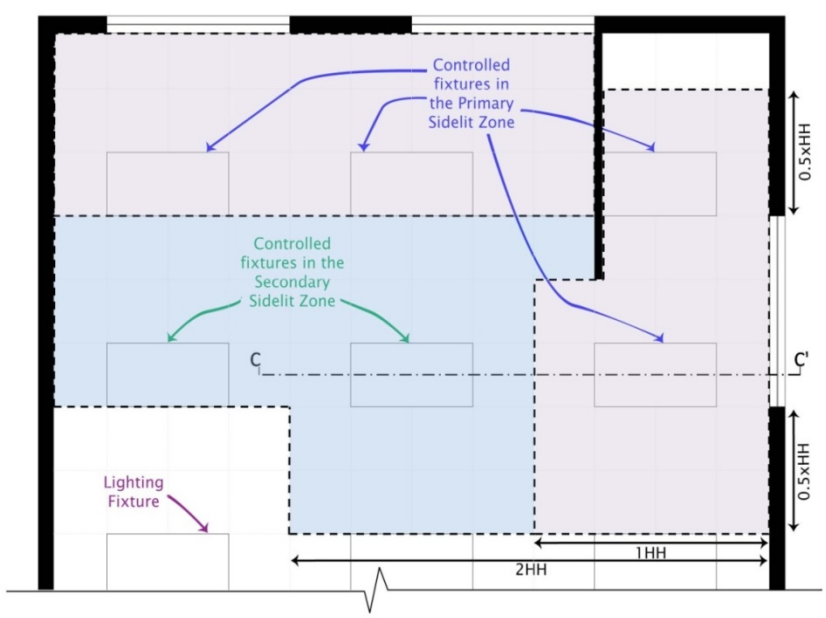


Figure 5-9 – Secondary Sidelit Daylit Zone Diagram 2



5.4.4.3 Controlling Lighting in Daylit Zones

Mandatory daylighting controls for lighting in Skylit Daylit Zones and Primary Sidelit Daylit Zones are covered in this subchapter.

There are also prescriptive controls required for lighting in Secondary Sidelit Daylit Zones. The prescriptive daylighting controls are covered in Section 5.5 of this chapter.

Mandatory daylighting controls are required in the following daylit zones:

A. Luminaires providing general lighting that are in, or at least 50 percent in, the Skylit Daylit Zones or the Primary Sidelit Daylit Zones shall be controlled independently by fully functional automatic daylighting controls that meet the applicable device requirements in §110.9, and meet the applicable requirements below:

   1. All Skylit Daylit Zones and Primary Sidelit Daylit Zones shall be shown on the building plans.
   2. Luminaires in the Skylit Daylit Zone shall be controlled separately from those in the Primary Sidelit Daylit Zones.
   3. Luminaires that fall in both a Skylit and Primary Sidelit Daylit Zone shall be controlled as part of the Skylit Daylit Zone.

There are also prescriptive daylighting control requirements, which are covered in Section 5.5 of this chapter.

5.4.4.4 Automatic Daylighting Control Installation and Operation

For luminaires in Skylit Daylit Zones and Primary Sidelit Daylit Zones, automatic daylighting controls shall be installed and configured to operate according to all of the following requirements:

1. Photosensors shall be located so that they are not readily accessible to unauthorized personnel. The location where calibration adjustments are made to automatic daylighting controls shall be readily accessible to authorized personnel and may be inside a locked case or under a cover which requires a tool for access. Access to controls can be limited by placing locks or screws on enclosures or under a cover plate so a tool or key is needed to gain access. Though not required, commissioning and retro-commissioning of the control is simplified if the calibration adjustments are readily accessible to authorized personnel so that a lift or a ladder is not required to access the location where calibration adjustment are made.

   Some controls have wireless remotes for adjusting settings; this is convenient as one person can be located at the edge of the daylit zone with a light meter and the wireless calibration tool and make the calibration adjustments without having to run back and forth between taking the measurement and making the adjustment.

2. Automatic daylighting controls shall provide functional multi-level lighting levels having at least the number of control steps specified in Table 5-1 (Table 130.1-A of the Energy Standards).

   EXCEPTION: Multi-level lighting controls are not required if the controlled lighting has a lighting power density less than 0.3 W/ft$^{2.}$

   Note that when the requirements of §130.1(d) are triggered by the addition of skylights to an existing building and the lighting system is not recircuited, the daylighting control need not meet the multi-level requirements in §130.1(d). This is in accordance with §141.0(b)2G for alterations.

3. For each space, the combined illuminance from the controlled lighting and daylight shall not be less than the illuminance from controlled lighting when no daylight is available.

   In the darkest portion of the daylit zone (furthest away from windows or skylights) the control should not over-dim the lights; this portion of the daylit area should not get darker as daylight levels increase, due to incorrect calibration of the controls.

4. In areas served by lighting that is daylight controlled, when the daylight illuminance is greater than 150 percent of the design illuminance received from the general lighting system at full power, the general lighting power in that daylight zone shall be reduced by a minimum of 65 percent.

   The best control would fully dim the system when daylight levels in the darkest portion of the daylit zone are at 100 percent of design illuminance, but the 150 percent /65 percent requirement allows some tolerance for error while obtaining most of the energy savings.

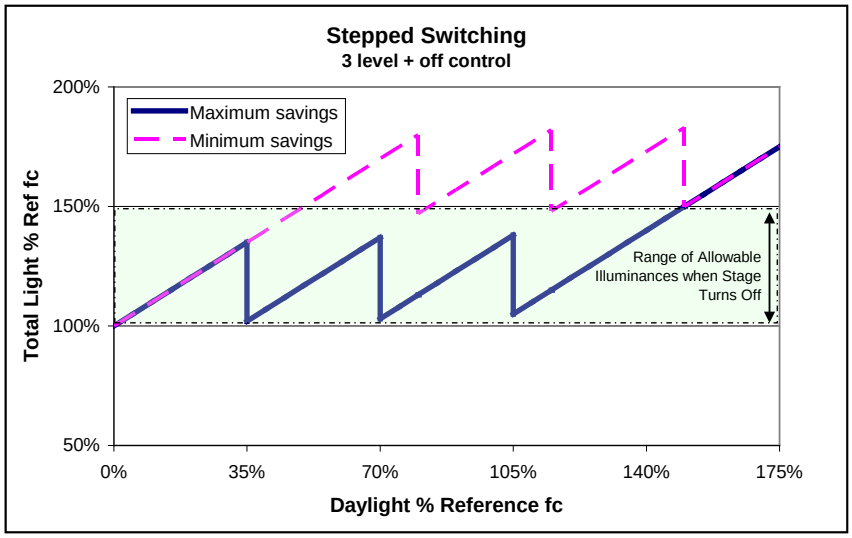
   EXCEPTIONS: Automatic daylighting controls are not required for any of the following conditions:

   - Rooms in which the combined total installed general lighting power in the Skylit Daylit Zone and Primary Sidelit Daylit Zone is less than 120 Watts.
   - Rooms which have a total glazing area of less than 24 square feet.
   - Parking garages complying with §130.1(d)3.

Figure 5-10 and Figure 5-11 plot the performance of switching and dimming automatic daylighting controls (photo controls). The performance is indicated in terms of lighting at the darkest point of the zone served by the controlled lighting.

The total lighting as plotted on the y-axis made up of both daylit and electric lighting contribution to total foot-candles (fc) at this darkest location in the zone served by the controlled lighting. Daylight plotted on the x-axis is just the daylight available at this darkest location.

Figure 5-10 Stepped Switching



In Figure 5-10, the light levels are given as a fraction of the reference or design foot-candles (fc). The bottom points of both controls indicate the total illuminance just after a stage of lighting has switched off. Both controls are compliant because the total illuminance at the darkest location in the zone served by controlled lighting just after

switching off a stage of lighting is between 100 and 150 percent of the reference illuminance. The reference illuminance is the illuminance at this same location when there is no daylight (night time).

Figure 5-11 Dimming Controls

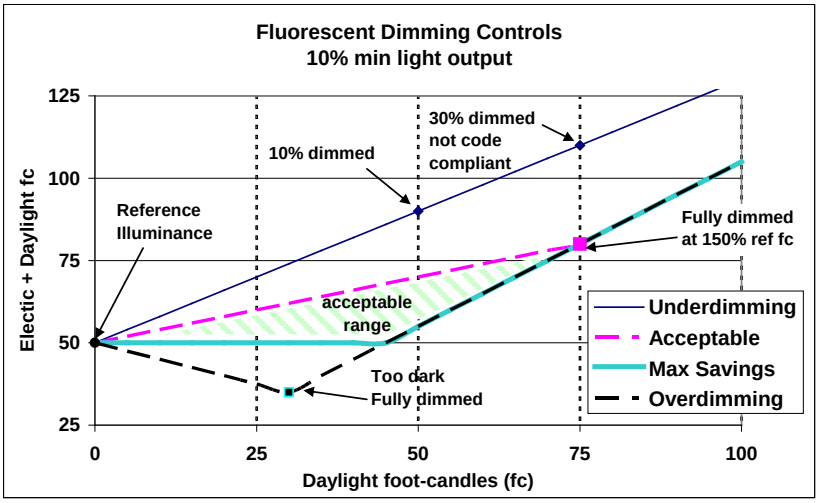


Figure 5-11 plots the performance of complying ("Acceptable" and "Max Savings") and non-complying ("Under-dimming" and "Over-dimming") controls. By fully dimming when daylight is 150 percent of the reference illuminance and also assuring that the total illuminance never falls below the reference illuminance (50 fc), the "Acceptable" control is minimally complaint with the requirements of §130.1(d)2D. Even greater savings are possible with the "Max Savings" control that maintains the 50 fc reference under all partially daylit conditions and is fully dimmed at 150 percent of the reference illuminance.

The "Under-dimming" control is only 30 percent dimmed when the daylight in the darkest portion of the zone served by the controlled lighting is at 150 percent of the reference illuminance (75 fc). The "Under-dimming" control does not save enough energy and thus is not code compliant. The "Over-dimming" condition reduces the electric lighting by more than the amount of daylight that enters the space. As a result, it actually is darker in portions of the space under partial daylight conditions than it is at night. In the short term, the "Over-dimming" control may save the most energy.

However, over the long term it is likely that the occupants may disable the control and the control would save no energy. As a result the "Over-dimming" control is not code compliant.

These performance metrics of complying and non-complying control systems are the basis of the functional performance tests for the Automatic Daylighting Controls acceptance test. This test is described in detail in Chapter 10 – Acceptance Testing.

5.4.4.5 Parking Garage Daylighting Requirements

In a parking garage area having a combined total of 36 square feet or more of glazing or opening, luminaires providing general lighting that are in the combined Primary and Secondary Sidelit Daylit Zones shall be controlled independently from other lighting in the parking garage by automatic daylighting controls, and shall meet the following requirements as applicable:

A. All Primary and Secondary Sidelit Daylit Zones shall be shown on the building plans.

B. Automatic Daylighting Control Installation and Operation.

Automatic daylighting control shall be installed and configured to operate according to all of the following requirements:

1. Automatic daylighting controls shall have photosensors that are located so that they are not readily accessible to unauthorized personnel. The location where calibration adjustments are made to the automatic daylighting controls shall be readily accessible to authorized personnel but may be inside a locked case or under a cover which requires a tool for access.
2. Automatic daylighting controls shall be multi-level, continuous dimming or ON/OFF.
3. The combined illuminance from the controlled lighting and daylight shall not be less than the illuminance from controlled lighting when no daylight is available.
4. When illuminance levels measured at the farthest edge of the Secondary Sidelit Zone away from the glazing of opening are greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power consumption shall be zero.

EXCEPTIONS:

1. Luminaires located in the daylight transition zone and luminaires for dedicated ramps. Daylight transition zone and dedicated ramps are defined in §100.1.
2. When the total combined general lighting power in the Primary Sidelit Daylight Zones is less than 60 watts.

The primary differences between the automatic daylight control requirements in parking garages and the rest of interior lighting spaces are:

- Primary and Secondary Zone are controlled together in parking garages whereas they must be separately controlled in other spaces. However, it is permissible that in either space type, a single sensor is used if the control system is capable of making the appropriate light level adjustments in each individual zone.
- Daylighting controls in parking garages are permitted to use an ON/OFF control strategy, whereas for all other interior spaces the control must be step switching or dimming
- When sufficient daylight is present, controlled lighting in parking garages must be OFF whereas in other interior spaces the lighting power must be reduced by 65 percent. Egress lighting for the parking garage may be controlled, but the controls must employ a failsafe mechanism that ensures that the egress lighting is functioning and stays ON if the photocell fails.

Examples for complying with the mandatory daylighting controls requirements, and the prescriptive daylighting requirements are covered in Section 5.5 of this chapter.

5.4.5 Demand Responsive Controls

§130.1(e)

DEMAND RESPONSE is defined in §100.1 as short-term changes in electricity usage by end-use customers, from their normal consumption patterns. Demand response may be in response to:

1. Changes in the price of electricity.
2. Participation in programs or services designed to modify electricity use in response to wholesale market prices or when system reliability is jeopardized.

A. Buildings larger than 10,000 square feet, excluding spaces with a lighting power density of 0.5 W/ft^2 or less, shall be capable of automatically reducing lighting power in response to a Demand Responsive Signal; so that the total lighting power of the non-excluded spaces can be lowered by a minimum of 15 percent below the total installed lighting power when a Demand Response Signal is received. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in Table 5-1 (Table 130.1-A of the Energy Standards).

   EXCEPTION: Lighting not permitted by a health or life safety statute, ordinance, or regulation to be reduced shall not be counted toward the total lighting power.

B. Demand responsive controls and equipment shall be capable of receiving and automatically responding to at least one standards-based messaging protocol by enabling demand response after receiving a demand response signal.

Example 5-2 Compliance Method 1 – using Centralized Powerline Dimming Control

This method requires the use of luminaires with dimmable ballasts or LED drivers, compatible with powerline controls, and the use of a lighting control panel downstream of the breaker panel. The lighting circuit relays are replaced by circuit controllers, which can send the dimming signal via line voltage wires. The panel could have several dry contact inputs that provide dedicated levels of load shed depending upon the demand response signal received. Different channels can be assigned to have different levels of dimming as part of the demand response. Local controls can be provided by either line voltage or low voltage controls.

Figure 5-12 - Potential inputs to receive Demand Response signal

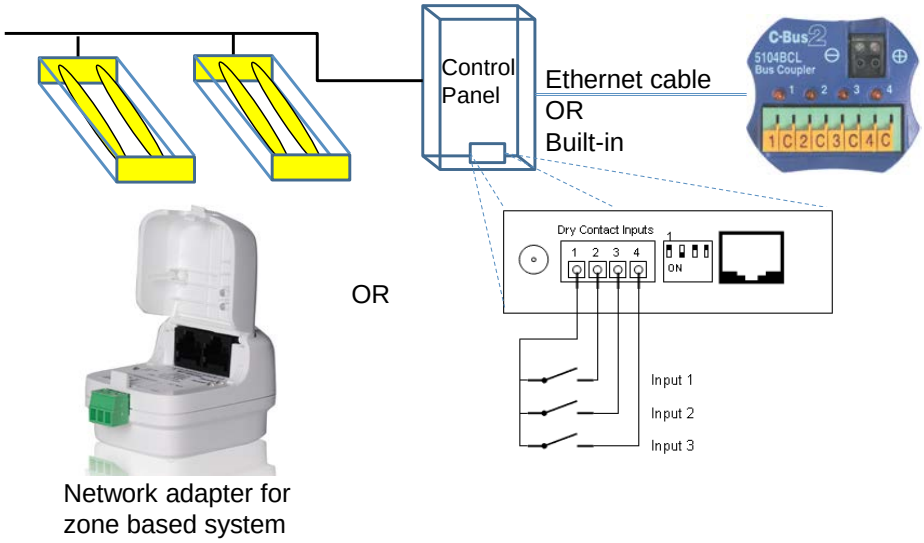


Figure 5-12 illustrates example inputs that could be used to receive demand response signals. The inclusion of one of these types of control inputs, along with the proper design of the lighting system, will result in a lighting system that complies with the requirements of §130.1(e).There are several ways in which the lighting can be designed to meet the demand responsive requirements; outlined below are three specific compliance scenarios.

Example 5-3 Compliance Method 2 – using Addressable Lighting System

The addressable lighting system is similar in design to that of a centralized control panel, but with additional granularity of control. With an addressable system, each fixture can be addressed individually, whereas a centralized control panel is limited to an entire channel, or circuit, being controlled in unison. The cost of enabling demand response on a system with a centralized control panel is less dependent on building size or number of rooms than an addressable zone based system.

Enabling demand response for the addressable lighting system entails making a dry contact input available to receive an electronic signal. This is a feature that is included in the base model of most lighting control panels. Some smaller scale addressable lighting systems may have a limited number of inputs dedicated for alternative uses, such as a time clock. If this is the case, an I/O input device can be added to the network to provide an additional closed contact input.

Example 5-4 Demand Response for Select Zones

Enabling demand response for a zoned system would entail adding a network adapter to each room to be controlled for purposes of demand response. The network adapter allows for each room to be monitored and controlled by an energy management control system (EMCS). These types of systems are commonly used for HVAC systems, and to respond to demand response signals. The assumption is that if the building is installing an EMCS, the preference would be to add the lighting network to that existing demand response system. There is additional functionality that results from adding the lighting system to an EMCS. In addition to being able to control the lighting for demand response, the status of the lighting system can then be monitored by the EMCS. For example, occupancy sensors would be able to be used as triggers for the HVAC system, turning A/C on and off when people entered and leave the room. Therefore the potential for savings from this type of system is higher than the value of the lighting load shed for demand response.

5.4.6 Lighting Control Acceptance Requirements (§130.4)

Before an occupancy permit shall be granted for a newly constructed building or area, or a new lighting system serving a building, area, or site is operated for normal use, indoor and outdoor lighting controls serving the building, area, or site shall be certified as meeting the Acceptance Requirements for Code Compliance.

A Certificate of Acceptance shall be submitted to the enforcement agency under §10-103(a) of Part 1 and §130.4(a), that:

1. Certifies that all of the lighting acceptance testing necessary to meet the requirements of Part 6 is completed
2. Certifies that the applicable procedures in Reference Nonresidential Appendix NA7.6 and NA7.8 have been followed
3. Certifies that automatic daylight controls comply with §130.1(d) and Reference Nonresidential Appendix NA7.6.1
4. Certifies that lighting shut-OFF controls comply with §130.1(c) and Reference Nonresidential Appendix NA7.6.2
5. Certifies that demand responsive controls comply with §130.1(e) and Reference Nonresidential Appendix NA7.6.3

6. Certifies that outdoor lighting controls comply with the applicable requirements of §130.2(c) and Reference Nonresidential Appendix NA7.8
7. Certifies that lighting systems receiving the Institutional Power Adjustment Factor comply with §140.6(a)2J and Reference Nonresidential Appendix NA7.7.6.2

5.4.7 Lighting Certificate of Installation Requirements

Before any of the following applications will be recognized for compliance with the lighting requirements, the person who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices shall sign and submit the Certificate of Installation for installation of the following items:

1. Lighting Control System
2. Energy Management Control System
3. Track lighting integral current limiter
4. Track lighting supplementary overcurrent protection panel
5. Interlocked lighting systems service a single space
6. Lighting controls installed to earn a lighting Power Adjustment Factor (PAF)
7. Additional lighting wattage available for a videoconference studio

If any of the requirements in the Certificate of Installation fail the installation requirements, that application shall not be recognized for compliance with the Energy Standards.

5.4.8 Summary of Mandatory Controls

Table 5-2 - Summary of Mandatory Nonresidential Lighting Control Requirements

Bldg/Space Type	Application	LPD	Control	Additional Exception
All except industrial and arenas	All except sales floors, auditoriums, malls with remote controls in view of lighting or annunciated.	------	Manual light switch in each enclosed space separately controlling general, display ornamental and special effects lighting.	1
All	Enclosed spaces > 100 square foot and > 1 luminaire with > 2 lamps	> 0.5 W/ square foot	Multi-level control of each luminaire	2
All except parking garage	All except hotel/motel high-rise res common area corridors and stairwells	All	Automatic full shut off controls (timeclock and timed override switch or occupancy sensor)	3
All	Offices < 250 square foot, multi-purpose rooms < 1,000 square foot, classrooms, conference rooms	All	Automatic full shut off occupancy sensors that also must operate as either partial-ON sensors or vacancy sensors	------
Warehouse	Aisles and open areas	All	Occupant sensor per aisle and for open areas, reduce power by at least 50 percent	4
Library	Single ended stacks > 10 ft or double ended stacks > 20 ft	All	Occupant sensor per aisle, reduce power by at least 50 percent	------
All except hotel/motel, high rise residential	Corridors and stairwells	All	Occupant sensor per space, reduce power by at least 50 percent, turn lights on from all paths of egress	------
Hotel/motel, high rise residential	Corridors and stairwells	All	Occupant sensor per space, reduce power by at least 50 percent. No additional shut-off controls are required	5
Parking garages	------	All	Partial off occupancy sensor with one sensor per 500 W of lighting and with control step between 20 percent and 50 percent or rated power.	6
Hotel/motel	Guest room	All	Captive card key or occupancy sensing on/off control	7
All except parking garage	> 24 square foot of glazing per room and more than 120 W in skylit and primary sidelit daylight zones	> 0.3 W square foot	Multi-level daylighting controls separately controlling skylit, primary sidelit and secondary sidelit daylight zones	8
All except parking garage	> 24 square foot of glazing per room and more than 120 W in skylit and primary sidelit daylight zones	< 0.3 W square foot	Multi-level or On/off daylighting controls separately controlling skylit, primary sidelit and secondary sidelit daylight zones	8
Parking garage	> 36 square foot of opening or glazing, > 60 watts in combined primary and sidelit daylight zone		Multi-level or On/off daylighting controls controlling combined primary and secondary sidelit daylight zones.	9
All bldg > 10,000 square foot	Habitable spaces	> 0.5 W/ square foot	Demand responsive control to lower building lighting power by 15 percent	------

1. Egress lighting up to 0.2 W/ square foot. Switch accessible to authorized personnel for multi-stall bathrooms.
2. Classrooms <0.7 W/ square foot and bi-level lighting with step between 30 percent and 70 percent of rated power.
3. Continuously occupied areas or egress lighting < 0.05 W/ square foot.
4. If HID or LPD < 80 percent of area category LPD, reduce power by at least 40 percent.
5. LPD < 80 percent of area category LPD, reduce power by at least 40 percent.
6. HID lighting with mean efficacy > 75 lm/W, control step between 20 percent and 60 percent of rated power.
7. One high efficacy luminaire controlled by a switch and within 6 ft of entry door.
8. Skylights added to existing lighting system, ON/OFF control acceptable.
9. Luminaires located in the daylight transition zone or dedicated ramps.

Most spaces will have more than one overlapping control system controlling the lighting. Examples include:

- **Small offices** will have a switch by the door and a Partial-ON occupancy sensor or Vacancy Sensor. If there is more than one luminaire in the office it will be required to be multi-level – most easily accomplished by a dimming luminaire. Typically these small offices will not have more than 120 Watts within one head height of the windows and thus often will not be required to have daylighting controls. For those offices within buildings greater than 10,000 square feet, an added demand control will also be required.
- **Large open plan offices** are not required to use occupancy sensors to provide automatic off control. These spaces are required to have light switches (or manual dimmer) by the entrances and could either use occupancy sensors or a time switch with a timed override manual switch. Because the general lighting power density is likely greater than 0.5 W/ square foot, the lighting must be multi-level and likely dimming ballasts will be used. In large office spaces with perimeter windows it is likely that there will be more than 120 Watts of lighting in the primary Sidelit zone and thus the lights in the Primary Sidelit zone (within 1 head height of the windows) must be separately controlled by a daylighting control. If the building complies prescriptively the lighting in the Secondary Sidelit zone (between 1 and 2 window head heights from the perimeter windows) must also be controlled separately with daylighting controls. For those offices in buildings greater than 10,000 square feet, an added demand control will also be required.
- **Classrooms** are required to have a manual switch by the entry and a Partial-ON occupancy sensor or Vacancy Sensor to automatically turn off lights when the space is unoccupied. Classrooms that have lighting power densities less than 0.7 W per square foot can meet the multi-level control requirements with a bi-level control. However, the lights that are within the Primary Sidelit zone must be controlled as in Table 130.1-A which requires at least 4 step of control for fluorescent luminaires. If the school is complying prescriptively, the lights in the Secondary Sidelit Zone are also required to control lighting as pre Table 130.1-A. In addition this space must have demand response controls which also be controlled according to Table 130.1-A. As a result, many classroom lighting systems will comply with dimming ballasts controlled by a daylighting and demand response signal in the Sidelit Zones and by a manual dimming and demand response signal in the rest of the classroom. All of the lights will be controlled to turn off by an occupancy sensor when the room is vacated.
- **Warehouses** that prescriptively comply with the standards will have enough skylights so that the at least 75 percent of the floor area will be in the skylight daylight zone before accounting for partitions and other obstructions that reduce the fraction of general lighting that is controlled. If the LPD of the warehouse lighting system is less than 0.5 W per square foot, the multi-level control and the demand responsive control requirements do not apply. However the lighting in the skylit daylight Zone must be controlled by a multi-level daylighting control. If the lighting is HID (metal halide or high pressure sodium) the multi-level daylighting controls are only required to be 2 level (high and low) plus off. In addition, open area and aisle lighting must be controlled by occupancy sensors that reduce lighting power by at least 50 percent (or 40 percent if the lighting is HID). The multi-level control can be accomplished with step dimming or continuous dimming ballasts though it is possible to accomplish the control with a 2 lamp HID luminaire or a 4 or more lamp fluorescent luminaire.

- **Retail spaces** typically will have the area switches in a location that is not accessible to the general public. General lighting, display lighting and ornamental lighting are required to be separately switched. Automatic shut-off controls will typically be time switch based with local timed override switches. With the prescriptive daylighting requirements applying to large open spaces with floor areas greater than 5,000 square feet and ceiling heights greater than 15 feet, many retail spaces are prescriptively required to daylight at last 75 percent of the space. Only the general lighting is required to be controlled with automatic daylighting controls; display lighting and ornamental lighting are allowed to be fully on regardless of how much daylight is entering the space.

5.5 Prescriptive Daylighting Requirements

This section contains information about the prescriptive nonresidential indoor daylighting control requirements in the Secondary Sidelit Daylit Zone, and the prescriptive requirements for minimum daylight area in large enclosed spaces directly under a roof.

The prescriptive daylighting requirements are in addition to the mandatory daylighting controls, which are covered in Section 5.4 of this chapter.

The end of this subchapter also has examples for complying with the mandatory daylighting requirements.

5.5.1 Automatic Daylighting Control Requirements – in Secondary Daylit Zones

§140.6(d)

All luminaires providing general lighting that is in, or at least 50 percent in, a Secondary Sidelit Daylit Zone as defined in §130.1(d)1C (see Section 5.4.4.2C of this chapter), and that is not in a Primary Sidelit Daylit Zone shall comply with the following:

1. The general lighting shall be controlled independently from all other luminaires (including those in the Primary Sidelit Zone, the Daylit Zone under skylights and lights that are not in Daylit Zones) by automatic daylighting controls that meet the applicable requirements of §110.9.
2. The general lighting shall be controlled in accordance with the applicable requirements in §130.1(d)2 (see Section 5.4.2 of this chapter).
3. All Secondary Sidelit Daylit Zones shall be shown on the plans submitted to the enforcing agency.

   EXCEPTIONS:

   - Luminaires in Secondary Sidelit Daylit Zone(s) in areas where the total wattage of general lighting is less than 120 Watts.
   - Luminaires in parking garages complying with §130.1(d)3.

5.5.2 Minimum Daylighting Requirements – for Large Enclosed Spaces

§140.3(c)

§140.3 has prescriptive requirements for building envelopes, including minimum daylighting for large enclosed spaces directly under roofs. Lighting installed in spaces complying with these prescriptive envelope measures are also required to comply with all lighting control requirements, including the mandatory and prescriptive lighting control requirements.

The mandatory daylighting control requirements are covered in Section 5.4.4 of this chapter.

Thus if one prescriptively complies by installing daylight openings in large enclosed spaces directly under roofs, the daylit areas could have electric lighting systems with high enough lighting power to trigger the mandatory requirements for daylighting controls. However if one complies using the performance approach it is possible to displace the daylighting openings and daylighting controls with other building efficiency options

5.5.2.1 Large Enclosed Spaces Requiring Minimum Daylighting – Qualifying Criteria

The minimum prescriptive daylighting requirements for large enclosed spaces apply to both conditioned and unconditioned nonresidential spaces that meet the following qualifying criteria:

1. Space is directly under a roof.
2. Is located in climate zones 2 through 15.
3. Has a floor area greater than 5,000 ft^2.
4. Has a ceiling height greater than 15 ft.

EXCEPTIONS:

1. Auditoriums, churches, movie theaters, museums, or refrigerated warehouses.
2. Enclosed spaces having a designed general lighting system with a lighting power density less than 0.5 W/ft^2.
3. In buildings with unfinished interiors, future enclosed spaces in which there are plans to have one of the following:
   a. A floor area of less than or equal to 5,000 ft^2.
   b. Ceiling heights less than or equal to 15 feet. This exception shall not be used for S-1 or S-2 (storage) or F-1 or F-2 (factory) occupancies.
4. Enclosed spaces where it is documented that permanent architectural features of the building, existing structures or natural objects block direct beam sunlight on at least half of the roof over the enclosed space for more than 1,500 daytime hours per year between 8 a.m. and 4 p.m.

5.5.2.2 The Prescriptive Daylighting Requirements

In Climate Zones 2 thru 15, enclosed spaces larger than 5000 square feet shall have at least 75 percent of spaces in daylit zones and the 75 percent spaces shall be within Primary Sidelit Daylit Zone or Skylit Daylit Zone.

For large enclosed spaces that are required to comply, following are details of the minimum prescriptive daylighting requirements:

1. A combined total of at least 75 percent of the floor area, as shown on the plans, shall be within the Skylit Daylit Zone or Primary Sidelit Daylit Zone. The calculation of the Daylit Zone area to show compliance with this minimum daylighting requirement does not need to account for the presence of partitions, stacks or racks other than those that are ceiling high partitions. The design of the envelope may be developed before there is any knowledge of the location of the partial height partitions or shelves as is often the case for core and shell buildings. Thus the architectural daylit zone requirement of 75 percent of the area of the enclosed space indicates the possibility of the architectural space being mostly daylit.

   The daylit zone and controls specification in §130.1(d) describe which luminaires are controlled. The obstructing effects of tall racks, shelves and partitions must be taken into consideration while determining the specifications. There is a greater likelihood that the electrical design will occur later than the architectural design and thus greater planning for these obstructions can be built in to the lighting circuiting design. With addressable luminaires, the opportunity is available to the contractor to incorporate the latest as built modifications into the daylight control grouping of luminaires according to unobstructed access to daylight.

2. The total skylight area is at least 3 percent of the total floor area in the space within a horizontal distance of 0.7 times the average ceiling height from the edge of the rough opening of the skylights; or the product of the total skylight area and the average skylight visible transmittance is no less than 1.5 percent of the total floor area in the space within a horizontal distance of 0.7 times the average ceiling height from the edge of the rough opening of skylights.

   The above two requirements can be translated and represented by the following equations.

$$\frac{Skylight\ Area}{Daylit\ Zone\ under\ skylights} \geq 3\ percent \quad (Equation\ 1)$$

$$Skylight\ Area \times VT \geq 1.5\ percent\ \times Daylit\ Zone\ under\ skylights \quad (Equation\ 2)$$

   Definitions of the above equation terms:

   Skylight Area = total skylight area on the roof

   Daylit Zone under skylights = total floor area in the space within a horizontal distance of 0.7 times the average ceiling height from the edge of the rough opening of skylights

   VT = Visible Transmittance

3. General lighting in daylit zones shall be controlled in accordance with §130.1(d).

4. Skylights shall have a glazing material or diffuser that has a measured haze value greater than 90 percent, tested according to ASTM D1003, or a Commission approved test method.

   Skylights must also meet the maximum glazing area, thermal transmittance (U-factor), solar heat gain coefficient (SHGC), and visible transmittance (VT) requirements of §140.3(a). Plastic skylights are required to have a VT of 0.64 and glass skylights are

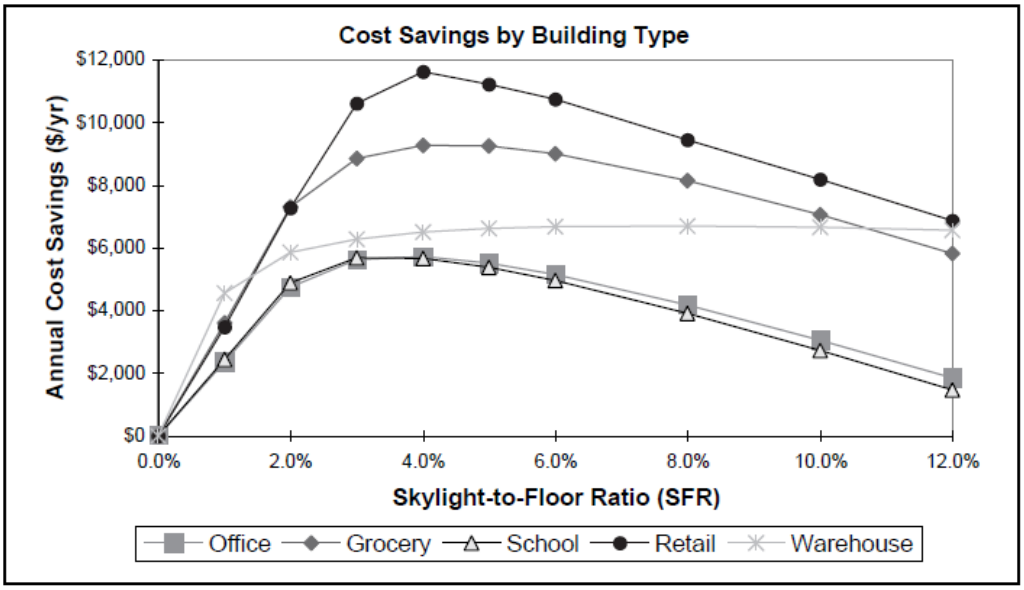
required to have a VT of 0.49. Currently plastics are not accompanied by low emissivity films which transmit light but block most of the rest of the solar spectrum. As a result, there is not maximum SHGC for plastic skylights. Glass skylights are required to have a maximum SHGC of 0.25. With a minimum VT of 0.49 and a maximum SHGC of 0.25, glass skylights must utilize low emissivity films or coatings that have a high light to solar gain ratio.

5. All Skylit Daylit Zones and Primary Sidelit Daylit Zones shall be shown on building plans.

In large buildings which must meet the minimum daylighting requirement, the core zone of many of these spaces will be daylit with skylights. Skylighting 75 percent of the floor area is achieved by evenly spacing skylights across the roof of the zone. A space can be fully skylit by having skylights spaced so that the edges of the skylights are not further apart than 1.4 times the ceiling height. Thus in a space having a ceiling height of 20 feet, the space will be fully skylit if the skylights are spaced so the there is no more than 28 feet of opaque ceiling between the skylights.

The total skylight area on the roof a building is prescriptively limited to a maximum of 5 percent of the gross roof area (§140.3(a)). A number of simulation studies have identified that the optimal skylight area that balances heat gain, heat loss and lighting energy cost savings. These studies have found that savings can be optimized if the product of the VT of the skylight and the skylight to daylit area ratio is greater than 2 percent (this figure accounts for a light well factor of 75 percent and a skylight dirt depreciation factor of 85 percent).[2] If one fully daylights the space with skylights and the skylights meet the prescriptive requirements of 64 percent visible light transmittance, a minimum skylight area of at least 3 percent of the roof area is needed to optimize energy cost savings (see Figure 5-13).

Figure 5-13 – Skylighting Savings by Skylight to Floor Ratio and Building Type in San Bernardino, CA (Climate Zone 10)



[2] Energy Design Resources *Skylighting Guidelines*. 1999. http://www.energydesignresources.com/resources/publications/design-guidelines/design-guidelines-skylighting-guidelines.aspx

Example 5-5

Warehouse 40,000 square feet area and 30 foot tall ceiling (roof deck)

Maximum skylight spacing distance and recommended range of skylight area

The maximum spacing of skylights that results in the space being fully skylit is:

Maximum skylight spacing = 1.4 x Ceiling Height + Skylight width

Spacing skylights closer together results in more lighting uniformity and thus better lighting quality – but costs more as more skylights are needed. However as a first approximation one can space the skylights 1.4 times the ceiling height. For this example skylights can be spaced 1.4 x 30 = 42 feet. In general the design will also be dictated by the size of roof decking materials (such as 4' by 8' plywood decking) and the spacing of roof purlins so the edge of the skylights line up with roof purlins. For this example we assume that roof deck material is 4' by 8' and skylights are spaced on 40 foot centers.

Each skylight is serving a 40 foot by 40 foot area of 1,600 square foot. A standard skylight size for warehouses is often 4' by 8' (so it displaces one piece of roof decking). The ratio of skylight area to daylit area is 2 percent (32/1600 = 0.02). Assuming this is a plastic skylight and it has a minimally compliant visible light transmittance of 0.65 the product of skylight transmittance and skylight area to daylit area ratio is;

(0.65)(32/1,600) = 0.013 = 1.3 percent

This is shy of the 2 percent rule of thumb described earlier for the product of skylight transmittance and skylight area to daylit area ratio. If one installed an 8 ft by 8 ft skylight (two 4 ft by 8 ft skylights) on a 40 foot spacing would yield a 2.6 percent product of skylight transmittance and skylight area to daylit area ratio. With 64 square feet of skylight area for each 1,600 square feet of roof area, the skylight to roof area ratio (SRR) is 4 percent which is less than the maximum SRR of 5 percent allowed by §140.3(a).

An alternate approach would be to space 4 ft by 8 ft skylights closer together which would provide more uniform daylight distribution in the space and could more closely approach the desired minimum VT skylight area product. By taking the product of the skylight VT and the skylight area and dividing by 0.02 (the desired ratio) yields the approximate area the skylight should serve. In this case with a VT of 0.65 and a skylight area of 32 square feet, each skylight should serve around (0.65*32 /0.02) = 1,040 square feet. A 32 foot center to center spacing of skylights results in (32*32) = 1,024 square feet of daylit area per skylight.

For the minimally compliant 4 ft by 8 ft plastic skylight with a visible light transmittance of 0.65 the product of skylight transmittance and skylight area to daylit area ratio is;

(0.65)(32/1,024) = 0.0203 = 2.03 percent

Example 5-6

Methods for complying with the mandatory daylight control requirements for a space with linear fluorescent luminaires

The Energy Standards require that automatic daylighting controls shall provide functional multi-level lighting levels having at least the number of control steps specified in Table 130.1-A. A minimum of 4 control steps are needed. These steps are identified as:

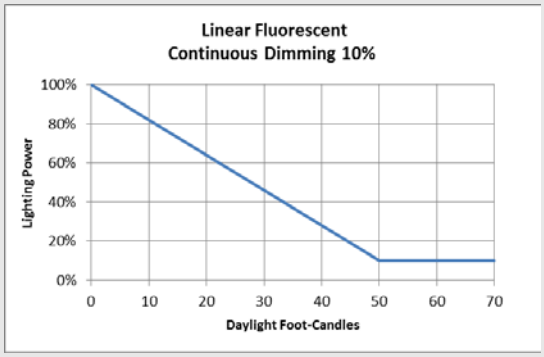
1 - 20-40 percent; 2 - 50-70 percent; 3 - 80-85 percent; 4 - 100 percent

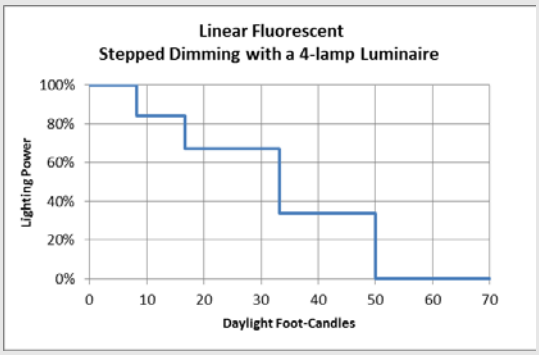
This can be achieved in one of three ways, using:

1. Continuous dimming - Here the photocontrol gradually dims all luminaires in the daylit zone in response to the available daylight.
2. Stepped dimming with a 4-lamp luminaire - The required control steps can be achieved using a 4-lamp fixture and with two lamps powered by an ON/OFF

Stage	On/Off Switching Ballast - power level	2-Stepped Dimming Ballast - power level	**Result**
1 - Full ON	100%	100%	**100%**
2	100%	67%	**84%**
3	100%	33%	**67%**
4	0%	67%	**34%**
5 - Full OFF	0%	0%	**0%**

3. Switching alternate lamps in each luminaire, having a minimum of 4 lamps per luminaire. Here the lamps may be tandem-wired such that power to each of the 4 lamps can be controlled separately by the photocontrol based on available daylight.





Example 5-7

Methods for complying with the mandatory daylight control requirements for a space with HID lighting

The Standards require that automatic daylighting controls shall provide functional multi-level lighting levels having at least the number of control steps specified in Table 130.1-A.

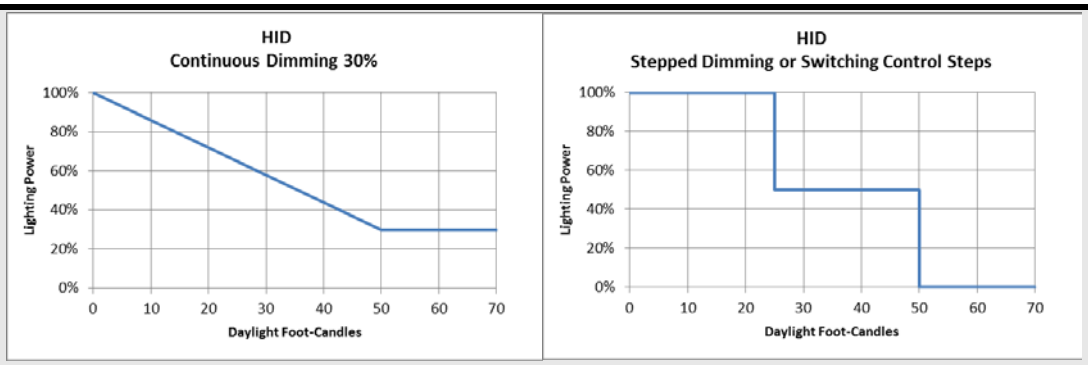
A space with HID lamps that are greater than 20 Watts installed power per lamp, shall have a minimum of 1-step between 50 percent and 70 percent.

This can be achieved in one of three ways, using:

A. Continuous dimming - Here the photocontrol gradually dims all luminaires in the daylit zone in response to the available daylight.

B. Stepped dimming - Here the photocontrol signals the stepped dimming ballast to reduce power in incremental steps such there is one control step between 50 percent and 70 percent as noted above.

C. Switching alternate lamps in each luminaire, having a minimum of 2 lamps per luminaire. Here the lamps may be tandem-wired such that power to each lamp in the luminaire can be controlled separately by the photocontrol based on available daylight.



Example 5-8

Complying with the 150 percent of the design illuminance daylighting requirement

When the illuminance received from the daylight is greater than 150 percent of the design illuminance (or nighttime electric lighting illuminance), the general lighting power in the daylight zone must reduce by a minimum of 65 percent.

For example, a space has 500 Watts of installed lighting power in daylit zones. The design illuminance for the space is 50 foot-candle (fc). When the available daylight in the space reaches 75 fc (i.e. 150 percent of 50 fc), then the power consumed by the general lighting in the daylit zones should be 175 Watts or lower.

Without checking all points in the daylit zone served by controlled lighting, verifying that the requirements are met at a worst case location far away from windows or skylights is sufficient. This location is called the "Reference Location"

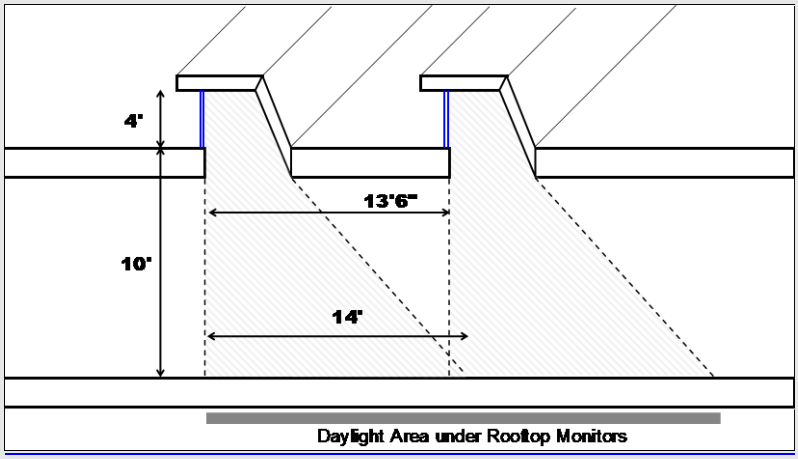
Example 5-9

Question

Draw the daylit zone for two roof top monitors with four 4 foot long windows projecting over a 10 ft tall roof. The two monitors are 13.5 ft apart.

Answer

Standards currently define skylights as glazing having a slope less than 60 degrees from the horizontal with conditioned or unconditioned space below. Because rooftop monitors have a slope greater than 60 degrees, they are therefore considered to be windows.



5.6 General Requirements for Prescriptive Lighting

See Section 5.5 of this chapter for the prescriptive daylighting requirements.

5.6.1 Requirements for a Compliant Building

A building complies with §140.6 if:

1. The Calculation of Actual Indoor Lighting Power of all proposed building areas combined, when calculated in accordance with §140.6(a) is no greater than the Calculation of Allowed Indoor Lighting Power, Specific Methodologies calculated under §140.6(c).
2. The Calculation of Allowed Indoor Lighting Power, General Rules comply with §140.6(b).
3. General lighting complies with the Automatic Daylighting Controls in Secondary Daylit Zone requirements in §140.6(d).

5.6.2 Calculation of Actual Indoor Lighting Power

The actual indoor Lighting Power of all building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building.

Some adjustments are available to reduce the actual indoor lighting power that must be reported. These adjustments are discussed in Section 5.6.5.

5.6.3 Portable Office Lighting

The Energy Standards (§140.6(a)) require that all planned portable lighting be counted toward the building's lighting energy use, regardless of the function area in which it is planned for.

Because office furniture is typically not installed until after the building inspection is complete, there are special provisions for portable lighting in office areas. Up to 0.3 watts per square foot of portable lighting for office areas shall not be required to be included in the calculation of actual indoor Lighting Power. However, if more than 0.3 watts per square foot of portable lighting is installed in office areas, any portable lighting wattage above 0.3 watts per square foot shall be required to be included in the calculation of actual indoor Lighting Power.

The Energy Standards define portable lighting as lighting with plug-in connections for electric power, that is: table and freestanding floor lamps; attached to modular furniture; workstation task luminaires; luminaires attached to workstation panels; attached to movable displays; or attached to other personal property.

5.6.4 Two interlocked lighting systems

A. Within the following five function areas, as defined in §100.1, two different interlocking lighting systems may be installed. All other function areas are permitted to install only one lighting system.
    1. Auditorium
    2. Convention center
    3. Conference room
    4. Multipurpose room
    5. Theater

B. No more than two lighting systems may be used for these five specifically defined function areas, and if there are two lighting systems, they must be interlocked.

C. Where there are two interlocked lighting systems, the watts of the lower wattage system may be excluded from determining the actual indoor Lighting Power if:

1. Before two interlocked lighting systems will be recognized for compliance with the lighting requirements in Part 6 of Title 24, the person who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices shall sign and submit the Certificate of Installation.

   If any of the requirements in the Certificate of Installation fail the installation tests, the two interlocked lighting systems shall not be recognized for compliance with the lighting Standards.

2. The two lighting systems shall be interlocked with a Nonprogrammable Double-Throw Switch to prevent simultaneous operation of both systems.

3. For compliance with the Energy Standards a Nonprogrammable Double-Throw Switch is an electrical switch commonly called a "single pole double throw" or "three-way" switch that is wired as a selector switch allowing one of two loads to be enabled. It can be a line voltage switch or a low voltage switch selecting between two relays. It cannot be overridden or changed in any manner that would permit both loads to operate simultaneously.

5.6.5 Power Adjustment Factors (PAFs)

The Energy Standards provide an option for a lighting power reduction credit when specific lighting controls are installed, provided those lighting controls are not required.

A Power Adjustment Factor (PAF) is an adjustment to the installed lighting power in an area so that some of the installed lighting power is not counted toward the building's total installed lighting load.

In calculating actual installed indoor Lighting Power, the installed watts of a luminaire providing general lighting in a function area listed in Table 140.6-C may be reduced by multiplying the number of watts controlled by the applicable Power Adjustment Factor (PAF), per Table 140.6-A.

To qualify for a PAF, the following conditions are required to be met:

1. Before a Power Adjustment Factor will be allowed for compliance with §140.6, the person who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices shall sign and submit the Certificate of Installation.

   If any of the requirements in this Certificate of Installation fail the Power Adjustment Factor installation tests, the installation shall not be eligible for using the PAF.

2. Luminaires and controls meet the applicable requirements of §110.9, and §130.0 through §130.5.

3. The controlled lighting is permanently installed general lighting systems and the controls are permanently installed nonresidential-rated lighting controls. (Thus, for example, portable lighting, portable lighting controls, and residential rated lighting controls shall not qualify for PAFs.)

There are furniture mounted lighting systems that are installed to provide general lighting. When used for determining PAFs for general lighting in offices, furniture mounted luminaires that comply with all of the following conditions shall qualify as permanently installed general lighting systems:

a. The furniture mounted luminaires shall be permanently installed no later than the time of building permit inspection.

b. The furniture mounted luminaires shall be permanently hardwired.

c. The furniture mounted lighting system shall be designed to provide indirect general lighting. It may also have elements that provide direct task lighting.

d. Before multiplying the installed watts of the furniture mounted luminaire by the applicable PAF, 0.3 watts per square foot of the area illuminated by the furniture mounted luminaires shall be subtracted from installed watts of the furniture mounted luminaires to account for portable lighting.

e. The lighting control for the furniture mounted luminaire complies with all other applicable requirements in §140.6(a)2.

4. At least 50 percent of the light output of the controlled luminaire is within the applicable area listed in Table 140.6-A. Luminaires on lighting tracks shall be within the applicable area in order to qualify for a PAF.

5. Only one PAF from Table 140.6-A may be used for each qualifying luminaire. PAFs shall not be added together unless specifically allowed in Table 140.6-A.

6. Only lighting wattage directly controlled in accordance with §140.6(a)2 shall be used to reduce the calculated actual indoor Lighting Power as allowed by §140.6(a)2. If only a portion of the wattage in a luminaire is controlled in accordance with §140.6(a)2, then only that portion of controlled wattage may be reduced in calculating actual indoor Lighting Power.

7. Lighting controls used to qualify for a PAF shall be designed and installed in addition to manual, multi-level, and automatic lighting controls required in §130.1, and in addition to any other lighting controls required by the Energy Standards.

8. To qualify for the PAF for daylight dimming plus OFF control, the following requirements must be met:

   a. The lighting controls system shall meet all of the requirements of §130.1(d)

   b. The lighting control system shall turn lights completely OFF when the daylight available in the daylit zone is greater than 150 percent of the illuminance received from the general lighting system at full power.

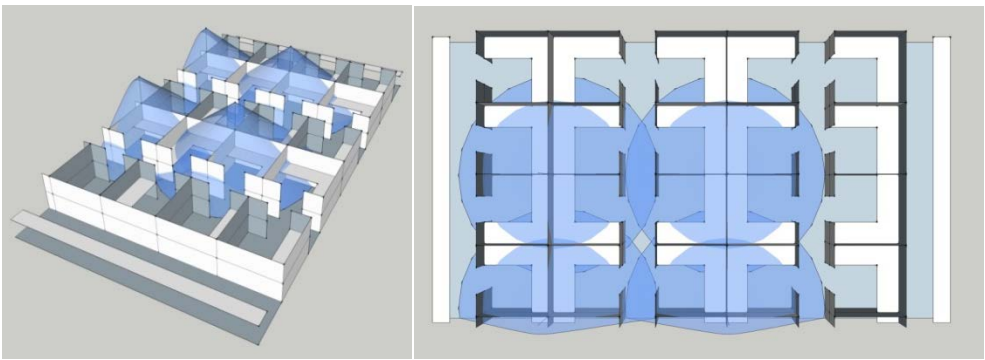
   c. The lighting equipment must be included in the Skylit Daylit or Primary Sidelit Daylit lighting zones only.

   d. This PAF shall not be available for atria or any other areas that operate with a photocell ON/OFF control that does not include intermediate steps.

   e. The OFF step must be demonstrated in the acceptance testing of the daylight zone controls.

9. To qualify for the PAF for an occupant sensing control controlling the general lighting in large open plan office areas above workstations, in accordance with Table 140.6-A, the following requirements shall be met:
    a. The total open plan office area shall be greater than 250 square feet.
    b. This PAF shall be available only in office areas which contain workstations.
    c. Controlled luminaires shall only be those which provide general lighting directly above the controlled area, or furniture mounted luminaires that comply with §140.6(a)2 and provide general lighting directly above the controlled area.
    d. Qualifying luminaires shall be controlled by occupant sensing controls that meet all of the following requirements, as applicable:
        i. Infrared sensors shall be equipped by the manufacturer, or fitted in the field by the installer, with lenses or shrouds to prevent them from being triggered by movement outside of the controlled area.
        ii. Ultrasonic sensors shall be tuned to reduce their sensitivity to prevent them from being triggered by movements outside of the controlled area.
        iii. All other sensors shall be installed and adjusted as necessary to prevent them from being triggered by movements outside of the controlled area.
    e. The PAF shall be applied only to the portion of the installed lighting power that is controlled by the occupant sensors, not to the total installed lighting power.
    f. The value of the PAF (0.2, 0.3 or 0.4) depends on how many workstations are controlled together by the same occupant sensor.

Figure 5-14 To Qualify for the PAF for Occupancy Sensing Controls in Open-Plan Offices, Sensors Must be Tuned to the Controlled Area



10. To qualify for the PAF for Institutional Tuning, the following requirements must be met:
    a. The lighting controls shall limit the maximum output or maximum power draw of the controlled lighting to 85 percent or less of full light output or full power draw.
    b. The means of setting the limit is accessible only to authorized personnel.
    c. The setting of the limit is verified by the acceptance test required by §130.4(a)7.
    d. The construction documents specify which lighting systems shall have their maximum light output or maximum power draw set to no greater than 85 percent of full light output or full power draw.
11. To qualify for the PAF for a Demand Responsive Control in Table 140.6-A, a Demand Responsive Control shall meet all of the following requirements:

a. Because buildings larger than 10,000 square feet are required to have demand responsive controls, to qualify for the PAF, the building shall be 10,000 square feet or smaller.

b. The controlled lighting shall be capable of being automatically reduced in response to a demand response signal.

c. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in Table 140.6-A.

d. Spaces that are non-habitable shall not be used to comply with this requirement, and spaces with a lighting power of less than 0.5 watts per square foot shall not be counted toward the building's total lighting power.

5.6.6 Lighting Wattage Not Counted Toward Building Load

The Energy Standards do not require lighting power of certain types of luminaires in specific function areas, or for specific purposes, to be counted toward a building's installed lighting power.

Any nonresidential indoor lighting function not specifically listed below shall comply with all applicable nonresidential indoor lighting requirements. For example, lighting in guestrooms of hotels is not required to be counted for compliance with §140.6, however, lighting in all other function areas within a motel are required to comply with all applicable requirements in §140.6. Also, lighting in within the guestrooms is regulated by the low-rise residential lighting Standards.

The watts of the following indoor lighting applications are not required to be counted toward the actual installed indoor Lighting Power:

- In theme parks: Lighting for themes and special effects.
- Studio lighting for film or photography provided that these lighting systems are in addition to and separately switched from a general lighting system.
- Lighting for dance floors, lighting for theatrical and other live performances, and theatrical lighting used for religious worship, provided that these lighting systems are additions to a general lighting system and are separately controlled by a multiscene or theatrical cross-fade control station accessible only to authorized operators.

  Lighting intended for makeup, hair, and costume preparation in performance arts facility dressing rooms, provided that the lighting is separately switched from the general lighting system, switched independently at each dressing station, and is controlled with a Vacancy Sensor.
- In civic facilities, transportation facilities, convention centers, and hotel function areas: Lighting for temporary exhibits, if the lighting is an addition to a general lighting system and is separately controlled from a panel accessible only to authorized operators.
- Lighting installed by the manufacturer in walk-in freezers, vending machines, food preparation equipment, and scientific and industrial equipment.
- In medical and clinical buildings: Examination and surgical lights, low-ambient night-lights, and lighting integral to medical equipment, provided that these lighting systems are additions to and separately switched from a general lighting system.
- Lighting for plant growth or maintenance, if it is controlled by a multi-level astronomical time-switch control that complies with the applicable provisions of §110.9.

- Lighting equipment that is for sale.
- Lighting demonstration equipment in lighting education facilities.
- Lighting that is required for exit signs subject to the CBC. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.
- Exitway or egress illumination that is normally off and that is subject to the CBC.
- In hotel/motel buildings: Lighting in guestrooms (lighting in hotel/motel guestrooms shall comply with §130.0(b). (Indoor lighting not in guestrooms shall comply with all applicable nonresidential lighting requirements in Part 6.)
- In high-rise residential buildings: Lighting in dwelling units (Lighting in high-rise residential dwelling units shall comply with §130.0(b).) (Indoor lighting not in dwelling units shall comply with all applicable nonresidential lighting requirements in Part 6.)
- Temporary lighting systems. *Temporary Lighting is defined in §100.1 as a lighting installation with plug-in connections, which does not persist beyond 60 consecutive days or more than 120 days per year.*
- Lighting in occupancy group U buildings less than 1,000 square feet.
- Lighting in unconditioned agricultural buildings less than 2,500 square feet.
- Lighting systems in qualified historic buildings, as defined in the State Historic Building Code (Title 24, Part 8), are exempt from the Lighting Power allowances, if they consist solely of historic lighting components or replicas of historic lighting components. If lighting systems in qualified buildings contain some historic lighting components or replicas of historic components, combined with other lighting components, only those historic or historic replica components are exempt. All other lighting systems in qualified historic buildings shall comply with the Lighting Power allowances.
- Lighting in nonresidential parking garages for seven or less vehicles: Lighting in nonresidential parking garages for seven or less vehicles shall comply with the applicable residential parking garage provisions of §150.0(k).
- Lighting for signs: Lighting for signs shall comply with §140.8.
- Lighting in refrigerated cases less than 3,000 square feet. (Lighting in refrigerated cases less than 3,000 square feet shall comply with the Title 20 Appliance Efficiency Regulations).
- Lighting in elevators where the lighting meets the requirements in §120.6(f).

5.7 Prescriptive Methods for Determining Lighting Power Allowances

This section contains information on the three prescriptive approaches available for complying with the Lighting Standards:

1. Complete Building Method
2. Area Category Method
3. Tailored Method

5.7.1 Complete Building Method

§140.6(c)1

The Complete Building Method shall only be applied when lighting will be installed throughout the entire building under the permit is prepared. The building must consist of one type of use for a minimum of 90 percent of the floor area of the entire building.

The Allowed Indoor Lighting Power allotment for general lighting for the entire building shall be calculated as follows:

1. For a conditioned building that qualifies to use the Complete Building Method of compliance, multiply the square feet of conditioned space of the building times the applicable allotment of watts per square foot described in Table 140.6-B.
2. For an unconditioned building that qualifies to use the Complete Building Method of compliance, multiply the square feet of unconditioned space of the building times the applicable allotment of watts per square feet described in Table 140.6-B.

5.7.1.1 Requirements for Using the Complete Building Method

The Complete Building Method shall be used only for building types, as defined in §100.1, that are specifically listed in Table 140.6-B. (For example, retail and wholesale stores, hotel/motel, and high-rise residential buildings shall not use this method.)

The Complete Building Method shall be used only on projects involving:

A. Entire buildings with one type of use occupancy.

   EXCEPTION to §140.6(c)1Bi: If a parking garage plus another type of use listed in Table 140.6-B are part of a single building, the parking garage portion of the building and other type of use portion of the building shall each separately use the Complete Building Method.

B. Mixed occupancy buildings where one type of use makes up at least 90 percent of the entire building (in which case, when applying the Complete Building Method, it shall be assumed that the primary use is 100 percent of the building).

C. A tenant space where one type of use makes up at least 90 percent of the entire tenant space (in which case, when applying the Complete Building Method, it shall be assumed that the primary use is 100 percent of the tenant space).

The Complete Building Method shall be used only when the applicant is applying for a lighting permit and submits plans and specifications for the entire building or the entire tenant space.

Only the lighting power allotment in Table 140.6-B is available for the entire building when using the Complete Building Method. There are no additional lighting power allowances available when using Complete Building Method. Also, there are no mounting height multipliers available when using the Complete Building Method.

5.7.1.2 Definitions of Complete Building Types

When using the Complete Building Method, qualifying building types shall be only those in which a minimum of 90 percent of the building floor area functions as one of the building types listed in Table 140.6-B, as defined below, which do not qualify as any other Building Occupancy Types more specifically defined in §100.1, and which do not have a combined total of more than 10 percent of the area functioning as any Nonresidential Function Areas specifically defined in §100.1:

- **Auditorium Building** is a public building in which a minimum of 90 percent of the building floor area are rooms with fixed seating that are primarily used for public meetings or gatherings
- **Classroom Building** is a building for an educational institution in which a minimum of 90 percent of the building floor area are classrooms or educational laboratories
- **Commercial and Industrial Storage Building** is a building for which a minimum or 90 percent of the building floor area is used for storing items
- **Convention Center Building** is a building in which a minimum of 90 percent of the building floor area are rooms for meetings and conventions, which have neither fixed seating nor fixed staging.
- **Financial Institution Building** is a building in which a minimum of 90 percent of the building floor area are rooms used for an institution which collects funds from the public and places them in financial assets, such as deposits, loans, and bonds.
- **General Commercial and Industrial Work Building** is a building in which a minimum of 90 percent of the building floor area are rooms for performing a craft, assembly or manufacturing operation.
- **Grocery Store Building** is a building in which a minimum of 90 percent of the building floor area is sales floor for the sale of foodstuffs.
- **Library Building** is a building which is in which a minimum of 90 percent of the building floor area are rooms use as a repository of literary materials, such as books, periodicals, newspapers, pamphlets and prints, are kept for reading or reference.
- **Medical Buildings and Clinic Buildings** are non “I” occupancy buildings in which a minimum of 90 percent of the building floor area are rooms where medical or clinical care is provided, does not provide overnight patient care, and is used to provide physical and mental care through medical, dental, or psychological examination and treatment.
- **Office Building** is a building of CBC Group B Occupancy in which a minimum of 90 percent of the building floor area are rooms in which business, clerical or professional activities are conducted.
- **Parking Garage Building** is a building in which a minimum of 90 percent of the building floor area is for the purpose of parking vehicles, which consists of at least a roof over the parking area enclosed with walls on all sides. The building includes areas for vehicle maneuvering to reach designated parking spaces. If the roof of a parking structure is also used for parking, the portion without an overhead roof is considered an outdoor parking lot instead of a parking garage.
- **Religious Facility Building** is a building in which a minimum of 90 percent of the floor area in the building floor area are rooms for assembly of people to worship.
- **Restaurant Building** is a building in which a minimum of 90 percent of the building floor area are rooms in which food and drink are prepared and served to customers in return for money.
- **School Building** is a building in which a minimum of 90 percent of the building floor area is used for an educational institution, but in which less than 90 percent of the building floor area is classrooms or educational laboratories, and may include an auditorium, gymnasium, kitchen, library, multi-purpose room, cafeteria, student union, or workroom. A maintenance or storage building is not a school building.

- **Theater Building** is a building in which a minimum of 90 percent of the building floor area are rooms having tiers of rising seats or steps for the viewing of motion pictures, or dramatic performances, lectures, musical events and similar live performances.

Example 5-10 Finding Lighting Power Density Allotments

Question

A 10,000-ft² medical clinic building is to be built. What is its Lighting Power Density Allotment under the complete building approach?

Answer

From Table 140.6-B, medical buildings and clinics are allowed 1.0 W/ft². The Lighting Power Density Allotment is 10,000 x 1.0 = 10,000 W.

5.7.2 Area Category Method

§140.6(c)2

5.7.2.1 Area Category Method General Lighting Power Allotment

The Area Category Method is more flexible than the Complete Building Method because it can be used for multiple tenants or partially completed buildings. For purposes of the Area Category Method, an "area" is defined as all contiguous spaces that accommodate or are associated with a single primary function as listed in Table 140.6-C. Areas not covered by the current permit are ignored. When the lighting in these areas is completed later under a new permit, the applicant may show compliance with any of the lighting options except the Complete Building Method.

The Area Category Method divides a building into primary function areas. Each function area is defined under occupancy type in §100.1. The Lighting Power Allotment is determined by multiplying the area of each function times the lighting power density for that function. Where areas are bounded or separated by interior partitions, the floor space occupied by those interior partitions shall be included in any area. The total allowed watts is the summation of the Lighting Power Allotment for each area covered by the permit application.

When using this method, each function area in the building must be included as a separate area. Boundaries between primary function areas may or may not consist of walls or partitions. For example, kitchen and dining areas within a fast food restaurant may or may not be separated by walls. For purposes of compliance they must still be separated into two different function areas. However, it is not necessary to separate aisles or entries within primary function areas. When the Area Category Method is used to calculate the allowed total lighting power for an entire building however, the main entry lobbies, corridors, restrooms, and support functions shall each be treated as separate function areas.

A. Requirements for using the Area Category Method include all of the following:

1. The Area Category Method shall be used only for primary function areas, as defined in §100.1, that are listed in Table 140.6-C.
2. Primary Function Areas in Table 140.6-C shall not apply to a complete building. Each primary function area shall be determined as a separate area.
3. For purposes of compliance with §140.6(c)2, an "area" shall be defined as all contiguous areas which accommodate or are associated with a single primary function area listed in Table 146.0-C.

4. Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a Primary Function Area.
5. If at the time of permitting for a newly constructed building, a tenant is not identified for a multi-tenant area, a maximum of 0.6 watts per square foot shall be allowed for the lighting in each area in which a tenant has not been identified. The area shall be classified as Unleased Tenant Area.
6. Under the Area Category Method, the allowed indoor Lighting Power Density for each primary area is the Lighting Power Density value in Table 140.6-C times the square feet of the primary function. The total allowed indoor Lighting Power Density for the building is the sum of all allowed indoor Lighting Power Densities for all areas in the building.

5.7.2.2 **Additional Lighting Power - Area Category Method**

In addition to the allowed indoor Lighting Power calculated according to §140.6(c)2, additional lighting power allowances for specialized task work, ornamental, precision, accent, display, decorative, and white boards and chalk boards, may be added in accordance with the footnotes in Table 140.6-C under the following conditions:

1. Only primary function areas having a footnote next to the allowed Lighting Power Density allotments in Table 140.6-C shall qualify for the added lighting power allowances in accordance with the correlated footnote listed at the bottom of the table.
2. The additional lighting power allowances shall be used only if the plans clearly identify all applicable task areas and the lighting equipment designed to illuminate these tasks.
3. Tasks that are performed less than two hours per day or poor quality tasks that can be improved are not eligible for the additional lighting power allowances.
4. The additional lighting power allowances shall not utilize any type of luminaires that are used for general lighting in the building.
5. The additional lighting power allowances shall not be used when using the Complete Building Method, or when the Tailored Method is used for any area in the building.
6. The additional lighting power allowed is the smaller of lighting power listed in the applicable footnote in Table 140.6-C, or the actual design wattage.
7. In addition to the lighting power allowed under §140.6(c)2G(i through vi), up to 1.5 watts per square foot of additional lighting power shall be allowed in a videoconferencing studio, as defined in §100.1, provided the following conditions are met:
    a. Before the Additional Videoconference Studio Lighting power allotment will be allowed for compliance with §140.6 of the Energy Standards, the person who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices shall sign and submit the Certificate of Installation.

        If any of the requirements in this Certificate of Installation fail the Additional Videoconference Studio Lighting installation tests, the installation shall not be eligible for the additional lighting power allotment.

    b. The Videoconferencing Studio is a room with permanently installed videoconferencing cameras, audio equipment, and playback equipment for both

audio-based and video-based two-way communication between local and remote sites.

c. General lighting is controlled in accordance with Table 130.1-A.

d. Wall wash lighting is separately switched from the general lighting system.

e. All of the lighting in the studio, including general lighting and additional lighting power allowed by §140.6(c)2Gvii is controlled by a multiscene programmable control system (also known as a scene preset control system).

Example 5-11 Calculating allowed lighting power

Question

A small bank building has the following area distribution:

Corridors	800 ft²
Main Entry Lobby	200 ft²
Financial Transactions	1,200 ft²
Manager's Office	200 ft²

What is the allowed lighting power for this building under the Area Category Method?

Answer

The following Lighting Power Densities apply (from Table 140.6-C):

Space	LPD	Area	Allowed Watts
Corridors	0.6 W	800 ft²	480
Main Entry	0.95 W	200 ft²	190
Financial Transactions	1.0 W	1,200 ft²	1,200
Manager's Office	1.0 W	200 ft²	200
Total			2,070 W

Financial Transactions in this example are assumed to include all the spaces in which financial transactions for the public are taking place. The allowed lighting power for this building is 2,070 W

Example 5-12 Allowed lighting power including decorative lighting

Question:

What is the allowed maximum lighting power if the small bank in example 5-11 above incorporates decorative chandeliers and wall sconces as part of their lighting design?

Answer:

Provided the decorative lighting occurs in either the Financial Transaction area or Main Lobby and is, in addition to the general lighting, up to 0.5W/ft² added power is allowed for these areas. Therefore the added maximum power is as follows:

Main Entry 0.5 W X 200 ft² = 100 W

Financial Transactions 0.5 W X 1,200 ft² = 600 W

The maximum total of added watts allowed for the ornamental lighting (Chandeliers and sconces) is 100 + 600 = 700 W.

With the addition of these 700 W is revised allowed maximum watts for the small bank is 2,770 W (2,070 + 700 = 2,770).

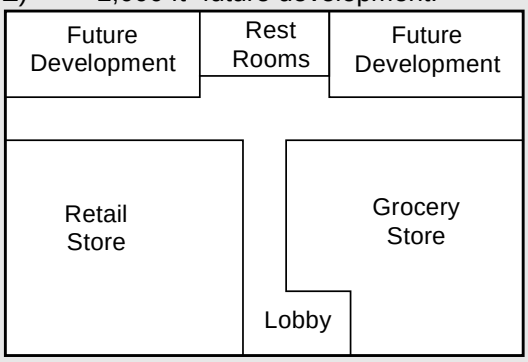
Note that ornament lighting is “use-it–loose” therefore actual allowed maximum watts for the small bank is the base 2,070 W + the smaller of the actual power of the ornamental lighting or 700W. Therefore if the ornamental lighting uses 300 W the total allowed maximum is 2,370 W for the bank not 2,770 W. (2,070 + 300 = 2,370)

Example 5-13 Allowed lighting power for multi-use spaces

Question

A 10,000-ft² multi-use building is to be built consisting of:

A) 500 ft² main entry lobby,
B) 2,000 ft² corridors and restroom,
C) 3,000 ft² grocery store,
D) 2,500 ft² retail, and
E) 2,000 ft² future development.



What is the allowed lighting power under the area category method?

Answer

Space		LPD	Area	Allowed Watts
A)	Main Entry	0.95 W/ft²	500 ft²	475
B)	Corridors and Restrooms	0.6 W/ft²	2,000 ft²	1,200
C)	Grocery Sales	1.2 W/ft²	3,000 ft²	3,600
D)	Retail Store	1.2 W/ft²	2,500 ft²	3,000
	TOTAL		8,000 ft²	8,275

With 2,000 ft² for future development

Example 5-14 Maximum allowed wattage for spaces within a multiuse building

Question

What if in the multi-use building (example 5-13), the retail store is planning floor displays and wall displays, as well as decorative chandeliers. How do you determine the allowed maximum watts for this store?

Answer

A) As in the above example, determine the total square feet of the retails store (2,500 feet)

B) As in the above example multiply the allowed LPD (1.2 W/ft²) X 2,500 = 3,000 W (base allowance)

C) Determine the maximum allowed display and accent allowance by multiplying the retail stores 2,500 feet by 0.3 W/ft² (Footnote 6 from Table 140.6-C) = 750 W

D) Determine the maximum allowed ornamental lighting allowance (for chandeliers) by multiplying the retail stores 2,500 feet by 0.2 W/ft² (Footnote 7 from Table 140.6-C) = 500 W

E) Add the 3,000 W base plus 750 W for display and 500 W for ornamental = 4,250 W

The maximum allowed watts for this retail store, under the area method, is therefore 4,250W or 1.7 W/ft²

Note: The allowed maximum is usually somewhat less than the theoretical maximum of 1.7 W/ft² as the display/accent lighting and ornamental lighting components are "use-it-lose it" with the lower luminaire lighting power becoming the allowed power. Also for the added power to be allowed, it must be in addition to general lighting and must use the appropriate luminaires for the task as defined the luminaires

Example 5-15 Decorative lighting

Question

What is the wattage allowance for a 10 ft^3 chandelier with five 50 W lamps in a 300 ft² bank entry lobby?

Answer

The wattage based on the task space is 0.5 W/ft² x 300 ft² = 150 W (0.5 W/ft² is based on Footnote 3 of Table 140.6-C.)

The wattage based on actual design watts is 250 W.

The wattage allowance for the chandelier is the smaller of the two values, or 150 W

Example 5-16 Decorative LED lighting

Question

What is the wattage allowance for a LED chandelier with five 10 W LED lamps in a 300 ft² bank entry lobby?

Answer

The wattage based on the task space is 0.5 W/ft² x 300 ft² = 150 W

The wattage based on actual design watts is 50 W.

The wattage allowance for the chandelier is the smaller of the two values, or 50 W

5.7.3 Tailored Method

§140.6(c)3

5.7.3.1 Tailored Method Application

The Tailored Method is a lighting compliance approach which establishes an allowed lighting power budget on a room-by-room or area-by-area basis. In addition to providing a lighting power budget for general illumination, this compliance approach provides additional lighting power budgets for illuminating wall displays, floor displays, task lighting, and ornamental/special effects lighting.

These additional layers of lighting power have been informally referred to as "use-it or lose-it" lighting power allowances because these additional allowances cannot be traded-off to other areas or applications. If a lighting design does not include these additional layers of lighting power, the total lighting power budget using the Tailored Method may be less than if the Area Category Method or Whole Building Method of compliance is used.

Use of Tailored Method may also be helpful when a function area has a high room cavity ratio (RCR).

The Energy Standards allow the Tailored Method to be used for only a limited number of primary function areas. The primary function area shall only be one of the following:

1. As specifically listed in Table 140.6-D (Table 140.6-D).
2. As specifically listed in §140.6(c)3H.

5.7.3.2 **Tailored Method General Rules**

1. There shall be no lighting power allotment trade-offs between the separate conditioned and unconditioned indoor function areas. Indoor conditioned and indoor unconditioned lighting power allotments must each be separately determined on compliance documentation
2. There shall be no lighting power allotment trade-offs between the separate indoor and outdoor function areas. Indoor and outdoor lighting power allotments must each be separately determined on compliance documentation.
3. Some areas of a building may use the Tailored Method, while other areas of the same building may use the Area Category Method. However, no single area in a building shall be allowed to use both the Tailored Method and the Area Category Method.
4. The Tailored Method shall not be used in any building using the Complete Building method for compliance.

5.7.3.3 **Room Cavity Ratio (RCR)**

1. The room cavity ratio must be determined for any primary function area using the Tailored Lighting Method.
2. The lighting level in a room is affected in part by the configuration of the room, expressed as the room cavity ratio (RCR). Rooms with relatively high ceilings typically are more difficult to light and have a high RCR. Because luminaires are not as effective in a room with a high RCR, §140.6 allows a greater LPD to compensate for this effect.
3. The RCR is based on the entire space bounded by floor-to-ceiling partitions. If a task area within a larger space is not bounded by floor to ceiling partitions, the RCR of the entire space must be used for the task area. The exception to this rule allows for imaginary or virtual walls when the boundaries are established by “high stack” elements (close to the ceiling structure and high storage shelves) or high partial walls defined as “permanent full height partitions” described in §140.6(c)3Iiv wall display. These permanent full height partitions are only applicable when claiming additional lighting power for wall display lighting.

   Note: For use in calculating the RCR of the space, the walls are not required to be display walls as is required under §140.6(c)3Iiv.

   The RCR is calculated from one of the following formulas:

Equation 5-1 (Table 140.6-F) Rectangular Shaped Rooms

$$RCR = \frac{5 \times H \times (L + W)}{A}$$

Where:

RCR = The room cavity ratio
H = The room cavity height, vertical distance measured from the work plane to the center line of the luminaire
L = The room length using interior dimensions
W = The room width using interior dimensions
A = The room area

Equation 5-2 (Table 140.6-F) Non-Rectangular Shaped Rooms

$$RCR = \frac{[2.5 \times H \times P]}{A}$$

Where:

RCR = The room cavity ratio
H = The room cavity height (see equation above)
A = The room area
P = The room perimeter

4. For rectangular rooms, these two methods yield the same result and the second more general form of calculating RCR may be used in all instances, if desirable.
5. It is not necessary to document RCR values for rooms with an RCR less than 2.0. Rooms with a RCR higher than 2.0 are allowed higher LPDs under the Tailored Method. The figure below gives example RCR values calculated for rooms with the task surface at desk height (2.5 ft above the floor). This is useful in assessing whether or not a room is likely to have an RCR greater than 2.0.
6. A special situation occurs when illuminating stacks of shelves in libraries, warehouses, and similar spaces. In this situation, the lighting requirements are to illuminate the vertical stack rather than the horizontal floor area. In stack areas the RCR is assumed to be greater than seven. The non-stack areas are treated normally.

Table 5-3 Typical RCRs based on Equation 5-1

Room Length (ft)	Room Height (ft)															
	8	**12**	**16**	**20**	**24**	**30**	**36**	**40**	**8**	**12**	**16**	**20**	**24**	**30**	**36**	**40**
	8 feet from floor to ceiling and task is 2.5 ft above floor, so **H=5.5** (8 – 2.5)								10 feet from floor to ceiling and task is 2.5 ft above floor, so **H=7.5** (10 – 2.5)							
5	8.9	7.8	7.2	6.9	6.6	6.4	6.3	6.2	12.2	10.6	9.8	9.4	9.1	8.8	8.5	8.4
8	6.9	5.7	5.2	4.8	4.6	4.4	4.2	4.1	9.4	7.8	7.0	6.6	6.3	5.9	5.7	5.6
12	5.7	4.6	4.0	3.7	3.4	3.2	3.1	3.0	7.8	6.3	5.5	5.0	4.7	4.4	4.2	4.1
16	5.2	4.0	3.4	3.1	2.9	2.6	2.5	2.4	7.0	5.5	4.7	4.2	3.9	3.6	3.4	3.3
20	4.8	3.7	3.1	2.8	2.5	2.3	2.1	2.1	6.6	5.0	4.2	3.8	3.4	3.1	2.9	2.8
24	4.6	3.4	2.9	2.5	2.3	2.1	**1.9**	**1.8**	6.3	4.7	3.9	3.4	3.1	2.8	2.6	2.5
30	4.4	3.2	2.6	2.3	2.1	**1.8**	**1.7**	**1.6**	5.9	4.4	3.6	3.1	2.8	2.5	2.3	2.2
36	4.2	3.1	2.5	2.1	**1.9**	**1.7**	**1.5**	**1.5**	5.7	4.2	3.4	2.9	2.6	2.3	2.1	2.0
40	4.1	3.0	2.4	2.1	**1.8**	**1.6**	**1.5**	**1.4**	5.6	4.1	3.3	2.8	2.5	2.2	2.0	**1.9**

5.7.3.4 Determining Allowed General Lighting Power for Tailored Method

§140.6(c)3G; §140.6(c)3H

A. Tailored Method Trade-Off Allowances

Compliance forms shall be used to document trading-off Tailored Method Lighting Power allotments. Trade-offs are available only for general lighting, and only under the following circumstances:

1. From one conditioned primary function area using the Tailored Method, to another conditioned primary function area using the Tailored Method.
2. From one conditioned primary function area using the Tailored Method, to another conditioned primary function area using the Area Category Method.
3. From one unconditioned primary function area using the Tailored Method, to another unconditioned primary function area using the Tailored Method.
4. From one unconditioned primary function area using the Tailored Method, to another unconditioned primary function area using the Area Category Method.

B. Determine Lighting Power Allotments for Conditioned and Unconditioned Primary Function Areas

The allowed Tailored Method Indoor Lighting Power allotment for general lighting shall be separately calculated for conditioned and unconditioned primary functions are as follows:

1. For a conditioned primary function area, multiply the conditioned square feet of that area times the applicable allotment of watts per square feet for the area shown in Table 140.6-D.
2. For an unconditioned primary function area, multiply the unconditioned square feet of that area times the applicable allotment of watts per square feet for the area shown in Table 140.6-D.

An "area" is defined as all contiguous areas which accommodate or are associated with a single primary function area. Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a primary function area.

C. Calculating Tailored Method General Lighting Power Allotments

The Energy Standards define general lighting as installed electric lighting that provides a uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect, exclusive of daylighting. To qualify as general lighting for the Tailored Method, the lighting system shall NOT use narrow beam direction lamps, wall-washers, valance, direct cove or perimeter linear slot types of lighting systems.

Table 140.6-D or §140.6(c)3H shall be used to determine the general lighting power density allotments as follows:

1. Using Table 140.6-D to Determine General Lighting Power Allotments:

a. Find the appropriate Primary Function Area in column 1 that fits one of the Nonresidential Function Area definitions in §100.1.

b. Find the corresponding General Illumination Level (Lux) in column 2.

c. Determine the room cavity ratio (RCR) for that primary function area, according to the applicable equation in Table 140.6-F. Use the RCR compliance form to document the RCR calculation.

d. Refer to Table 140.6-G, using the General Illumination Level (Lux, determined according to item ii),and the RCR (determined according to item iii),to determine the allowed Power Density Value.

e. Multiply the allowed Lighting Power Density Value times the square feet of the primary function areas. The product is the Allowed Indoor Lighting Power allotment for general lighting for that primary function area.

2. Using §140.6(c)3H to Determine General Lighting Power Allotments:

a. This section shall be used to determine general lighting power allotments ONLY for the following primary function areas, as defined in §100.1:

1. Exercise Center, Gymnasium
2. Medical and Clinical Care
3. Police Stations and Fire Stations
4. Public rest areas along state and federal roadways
5. Other primary function areas that are listed in neither Table140.6-C nor Table 140.6-D

b. Determine the illuminance values (Lux) for one of the primary function areas listed above as found in the Tenth Edition IES Lighting Handbook (IES HB), using the IES Recommended Horizontal Maintained Illuminance Targets for Observers 25-65 years old for illuminance.

c. Determine the room cavity ratio (RCR) for that primary function area, according to the applicable equation in Table 140.6-F. Use the RCR compliance form to document the RCR calculation.

d. Refer to Table 140.6-G, using the General Illumination Level (Lux, determined according to item b), and the RCR (determined according to item c), to determine the allowed Power Density Value.

e. Multiply the allowed Lighting Power Density Value times the square feet of the primary function areas. The product is the Allowed Indoor Lighting Power Density allotment for general lighting for that primary function area.

5.7.3.5 Determine Additional Allowed Power for Tailored Method

§140.6(c)3I thru §140.6(c)3L; Table 140.6-D

When using the Tailored Method for lighting compliance, in addition to the general lighting power allowance determined in accordance with Table 140.6-D, F, and G, additional allowed lighting power is available for wall display, floor display, task, ornamental/special effects, and very valuable display case lighting.

These additional layers of lighting power are not available when using §140.6(c)3H to determine the general Lighting Power allotment, and are not available for any primary function areas using the Complete Building or Area Category methods of compliance.

All of the additional lighting power allowances are “use it or lose it” allowances that cannot be traded-off. That is, if the installed watts are less than the allowed watts, the difference in watts is not available to trade-off anywhere else in the building.

A. Additional Wall Display Lighting Power:

Wall display lighting is defined by §100.1 as supplementary lighting required to highlight features such as merchandise on a shelf, which is displayed on perimeter walls; and that provides a higher level of illuminance to a specific area than the level of surrounding ambient illuminance.

Additional allowed power for wall display lighting is available only for lighting that illuminates walls having wall displays, only when there is a watt per linear foot allowance in column 3 of Table 140.6-D for the primary function area.

1. The wall display lighting power is NOT available for the following:
    a. When using §140.6(c)3H for determining the Allowed Indoor Lighting Power Density allotment for general lighting for the area.
    b. For any function areas using the Complete Building or Area Category methods of compliance.
    c. Floor displays shall not qualify for wall display lighting power allowances.
2. To qualify for the additional wall display lighting power, the lighting system shall be a type that is appropriate for creating a higher level of illuminance on the wall display.
    a. Lighting systems appropriate for wall lighting are lighting track adjacent to the wall, wall-washer luminaires, luminaires behind a wall valance or wall cove, or accent light. (Accent luminaires are adjustable or fixed luminaires with PAR, R, MR, AR, or other directional lamp types.)
    b. General lighting systems shall not qualify for this allowance.
3. Qualifying wall display lighting shall be mounted within 10 feet of the wall having the wall display.
    a. When track lighting is used for wall display, and where portions of that lighting track are more than 10 feet from the wall and other portions are within 10 feet of the wall, only those portions of track within 10 feet from the wall shall qualify for the wall display allowance.
4. The length of display walls shall include the length of the perimeter walls, including but not limited to closable openings, and permanent full height interior partitions.
    a. Permanent full height interior partitions are those that meet the following conditions:
        i. Extend from the floor to no more than two feet below the ceiling or are taller than ten feet.
        ii. Are permanently anchored to the floor, provided that neither commercial industrial stacks nor industrial storage stacks are permanent full height interior partitions.
5. Column 3 of Table 140.6-D shall be used to determine the additional allowed power for wall display lighting as follows:
    a. Use the same Primary Function Area Category row in column 1 that was used to determine the general lighting power density allotments for the area.
    b. Find the corresponding Wall Display Power (W/linear ft) in column 3.
    c. Determine the length of qualifying display walls in a single room or area.

d. Multiply the Wall Display Power times the length of qualifying display walls, to calculate Wall Display lighting power allowance.

6. A mounting height multiplier is available in Table 140.6-E for wall display luminaires mounted 12 feet or higher, where mounting height is the distance from the finished floor to the bottom of the luminaire.

   a. The mounting height multiplier is NOT available for the general lighting power density allotment.

   b. The mounting height multiplier in Table 140.6-E shall be used to reduce the input wattage of luminaires (adjusted input wattage).

   c. Wall display lighting with varying mounting heights shall be separately determined.

   In a single room, or single area having wall display lighting, using § 130.0(c) to determine luminaire classification and input wattage, do the following:

   1. Separately add together the input wattage of all wall display luminaires mounted lower than 12 feet. These luminaires do not qualify for a height multiplier.

   2. Separately add together the input wattage of all wall display luminaires mounted between 12 feet to 16 feet. Multiply the total input wattage of these luminaires times 0.87. This will be your adjusted input wattage for these luminaires.

   3. Separately add together the input wattage of all wall display luminaires mounted higher than 16 feet. Multiply the total input wattage of these luminaires times 0.77. This will be your adjusted input wattage for these luminaires.

7. The additional allowed power for wall display lighting shall be the smaller of the calculated Wall Display Power allowance, or the sum total of the adjusted input wattage of all luminaires used for the wall display lighting systems in that room or area. Use the smaller of the two calculated allowances as follows:

   a. The additional allowed power for wall display lighting determined in accordance with Column 3 of Table 140.6-D, or

   b. The sum total of:

      i. Sum total input wattage of all wall display luminaires mounted lower than 12 feet, plus

      ii. Sum total adjusted input wattage of all wall display luminaires mounted 12 feet to 16 feet, plus

      iii. Sum total adjusted input wattage of all wall display luminaires mounted higher than 16 feet.

8. Use the appropriate compliance form, NRCC-LTI-04-E, to document the additional allowed power for wall display lighting.

B. Additional Floor Display and Task Lighting Power:

1. Floor display lighting is defined by §100.1 as supplementary lighting required to highlight features, such as merchandise on a clothing rack, which is not displayed against a wall; and provides a higher level of illuminance to this specific area than the level of surrounding ambient illuminance.
2. Task Lighting is defined by §100.1 as lighting that is not general lighting and that specifically illuminates a location where a task is performed.
3. Additional allowed power for floor display lighting and additional allowed power for task lighting may be used only for qualifying floor display lighting systems, qualifying task lighting systems, or a combination of both, only when there is a watt per square foot allowance in column 4 of Table 140.6-D for the primary function area.
4. For floor areas qualifying for both floor display and task lighting power allowances, the additional allowed power shall be used only once for the same floor area, so that the allowance shall not be additive.
5. Additional allowed power for a combination of floor display lighting and task lighting shall be available only for:
    a. Floors having floor displays; or
    b. Floors not having floor displays but having tasks having illuminance recommendations that appear in the Tenth Edition of the IES Lighting Handbook and that are higher than the general lighting level in column 2 of Table 140.6-D.
6. Floor display and task lighting shall be separately switched from the general lighting system.
7. The additional power for floor display and task lighting are NOT available for the following:
    a. When using §140.6(c)3H for determining the Allowed Indoor Lighting Power Density allotment for general lighting for the area.
    b. For any function areas using the Complete Building or Area Category methods of compliance.
    c. Displays that are installed against a wall shall not qualify for the floor display lighting power allowances.
    d. Any floor area designed to not have floor displays or tasks, such as floor areas designated as a path of egress, shall not be included for the floor display allowance.
8. Lighting internal to display cases shall be counted either as floor display lighting in accordance with §140.6(c)3J; or as very valuable display case lighting in accordance with §140.6(c)3Liii and iv.
9. To qualify for the additional power for floor display and task lighting, the lighting system shall be a type that is appropriate for creating a higher level of illuminance on the floor display or task. Floor display and task lighting shall be of a type different from the general lighting system.
    a. Lighting systems appropriate for floor display and task lighting consist of only directional lighting types, such as PAR, R, MR, AR; or of lighting employing optics providing directional display light from non-directional lamps.

b. If track lighting is used, only track heads that are classified as directional lighting types qualify.

10. Qualifying floor display lighting shall be mounted no closer than 2 feet to a wall, and shall be located immediately adjacent to and capable of illuminating the task for which it is installed.

    a. When track lighting is used for floor or task lighting, and where portions of that lighting track are more than 2 feet from the wall and other portions are within 2 feet of the wall, only those portions of track more than 2 feet from the wall shall qualify for the floor display and task lighting power allowance.

11. Column 4 of Table 140.6-D shall be used to determine the additional allowed power for floor display and task lighting as follows:

    a. Use the same Primary Function Area Category row in column 1 that was used to determine the general lighting power density allotments for the area.

    b. Find the corresponding Allowed Combined Floor Display Power and Task Lighting Power (W/ft2) in column 4.

    c. Determine the square feet of the qualifying area.

    d. Multiply the Allowed Combined Floor Display Power and Task Lighting Power Floor Display/Task Lighting Power allowance.

12. A mounting height multiplier is available in Table 140.6-E for floor display and task luminaires mounted 12 feet or higher, where mounting height is the distance from the finished floor to the bottom of the luminaire.

    a. The mounting height multiplier is NOT available for the general lighting power density allotment.

    b. The mounting height multiplier in Table 140.6-E shall be used to reduce the input wattage of luminaires (adjusted input wattage),

    c. Floor display lighting and task lighting luminaires with varying mounting heights shall be separately determined.

In a single room having floor display lighting and/or task lighting luminaires, using § 130.0(c) to determine luminaire classification and input wattage, do the following:

- Separately add together the input wattage of all floor display lighting and task lighting luminaires mounted lower than 12 feet. These luminaires do not qualify for a height multiplier.
- Separately add together the input wattage of all floor display lighting and task lighting luminaires mounted between 12 feet to 16 feet. Multiply the total input wattage of these luminaires times 0.87. This will be your adjusted input wattage for these luminaires.
- Separately add together the input wattage of all floor display lighting and task lighting luminaires mounted higher than 16 feet. Multiply the total input wattage of these luminaires times 0.77. This will be your adjusted input wattage for these luminaires.

13. The additional allowed power for all floor display lighting and task lighting luminaires lighting shall be the smaller of the calculated Floor Display/Task Lighting Power allowance, or the sum total of the adjusted input wattage of all luminaires used for floor display and task lighting systems in that room or area. Use the smaller of the two calculated allowances:
    a. The additional allowed power for wall display lighting determined in accordance with Column 4 of Table 140.6-D, or
    b. The sum total of:
        i. Sum total input wattage of all floor display luminaires and task lighting luminaires mounted lower than 12 feet, plus
        ii. Sum total of adjusted input wattage of all floor display luminaires and task lighting luminaires mounted from 12 feet to 16 feet, plus
        iii. Sum total adjusted input wattage of all floor display luminaires and task lighting luminaires mounted higher than 16 feet.
14. Use the appropriate compliance form, NRCC-LTI-04-E, to document the additional allowed power for Floor Display/Task Lighting Power lighting.

C. Additional Ornamental/Special Effects Lighting Power:

1. §140.6(c)3K(ii) defines qualifying ornamental lighting to include luminaires such as chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights, and light color panels when any of those lights are used in a decorative manner that does not serve as display lighting or general lighting.
2. Special effects lighting is defined as lighting installed to give off luminance instead of providing illuminance.
3. Additional allowed power for ornamental/special effects lighting may be used only for qualifying ornamental lighting systems, qualifying special effects lighting systems, or a combination of both, only when there is a watts per square foot allowance in column 5 of Table 140.6-D for the primary function area.
4. Additional ornamental and special effects lighting power is NOT available for the following:
    a. When using §140.6(c)3H for determining the Allowed Indoor Lighting Power Density allotment for general lighting for the area.
    b. For any function area using the Complete Building or Area Category methods of compliance.
5. For floor areas qualifying for both ornamental and special effects lighting power allowances, the additional allowed power shall be used only once for the same floor area, so that the allowance shall not be additive.
6. Any floor area not designed to have ornamental or special effects lighting shall not be included for the ornamental/special effects lighting allowance.
7. Column 5 of Table 140.6-D shall be used to determine the additional allowed power for ornamental/special effects lighting as follows:
    a. Use the same Primary Function Area Category row in column 1 that was used to determine the general lighting power density allotments for the area.

b. Find the corresponding Allowed Ornamental/Special Effects Lighting Power (W/ft2) in column 5.

c. Determine the square feet of the qualifying area.

d. Multiply the Allowed Ornamental/Special Effects Lighting Power, times the square feet of the qualifying area, to determine calculated Allowed Ornamental/Special Effects Lighting Power allowance.

8. A mounting height multiplier is NOT available for ornamental/special effects lighting.

9. The additional allowed power for Ornamental/Special Effects Lighting shall be the smaller of the calculated Allowed Ornamental/Special Effects Lighting Power allowance, or the actual power used for the Allowed Ornamental/Special Effects Lighting systems;

10. Use the appropriate compliance form, NRCC-LTI-04-E, to document the additional allowed power for Ornamental/Special Effects Lighting.

D. Additional Very Valuable Display Case Lighting Power:

1. Case lighting is defined by §100.1 as lighting of small art objects, artifacts, or valuable collections which involves customer inspection of very fine detail from outside of a glass enclosed display case.

2. To qualify for additional allowed power for very valuable display case lighting, a case shall contain jewelry, coins, fine china, fine crystal, precious stones, silver, small art objects and artifacts, and/or valuable collections the display of which involves customer inspection of very fine detail from outside of a locked case.

3. Additional allowed power for very valuable display case lighting shall be available only for display cases in retail merchandise sales, museum, and religious worship areas.

4. Qualifying lighting includes internal display case lighting or external lighting employing highly directional luminaires specifically designed to illuminate the case or inspection area without spill light, and shall not be fluorescent lighting unless installed inside of a display case.

5. Any floor area designed to not have very valuable display case lighting shall not be included for the very valuable display case lighting allowance.

6. The valuable display case lighting power is NOT available for the following:

   a. When using §140.6(c)3H for determining the Allowed Indoor Lighting Power Density allotment for general lighting for the area.

   b. For any function areas using the Complete Building or Area Category methods of compliance.

7. A mounting height multiplier is NOT available for very valuable display case lighting.

8. The very valuable display case lighting allowance shall be the smallest of the following:

   a. The product of the area of the primary function and 0.8 watt per square foot.

   b. The product of the area of the display case and 12 watts per square foot.

   c. The actual power of lighting for very valuable displays.

9. Use the appropriate compliance form, Form NRCC-LTI-04-E, to document the additional allowed power for valuable display case lighting.

Example 5-17 Room Cavity Ratio

Question

A small retail shop "Personal Shopper" room is 14 ft wide by 20 ft long by 8 ft high. The lighting system uses recessed ceiling fixtures. The task surface is at desk height (2.5 ft above the floor). What is the room cavity ratio?

Answer

The room cavity height is the distance from the ceiling (center line of luminaires) to the task surface (desk height). This is 8 ft -2.5 ft = 5.5 ft

RCR = 5 x H x (L + W) / Area

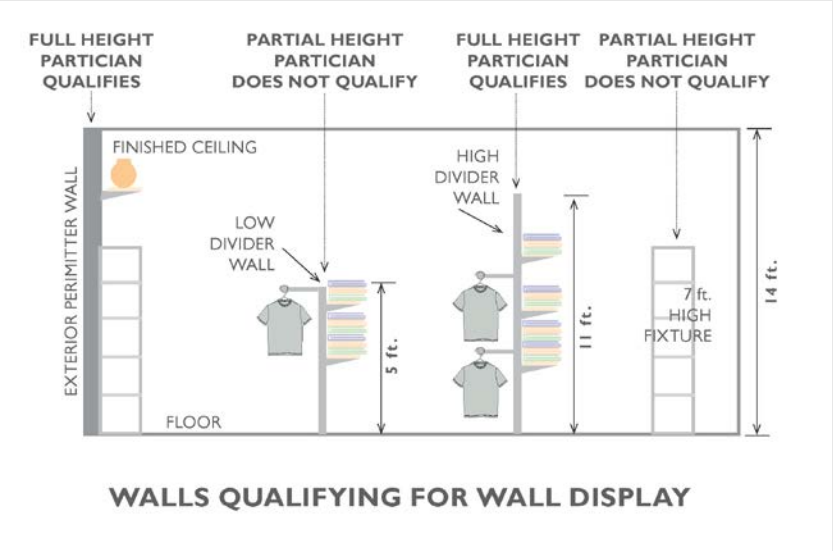
RCR = 5 x 5.5 (14+20) / (14 x 20) = 3.34

Example 5-18 Retail space lighting allocation

Question

A large retail store with a sales area that has a 14 ft high ceiling and full height perimeter wall also has several other walls and a high fixture element in the space. Based on the definition of "full-height" partitions (per §140.6(c)3Iiv), which components qualify for the wall display allocation?

Answer

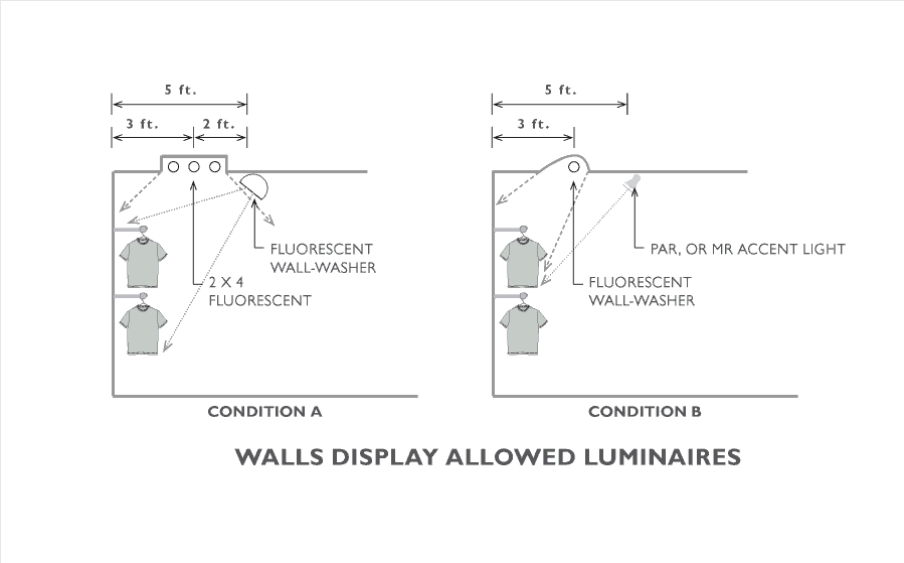


Example 5-19 Wall display lighting – Tailored Method

Question

In this question, condition A has 2X4 troffers placed 3 ft from a perimeter sales wall as well as fluorescent wall-washers 5 ft from the sales wall. Condition B has fluorescent wall-washers 3 ft from the wall and PAR adjustable accent lights 5 ft from the wall. Which luminaires qualify for the wall display lighting allocation?

Answers



Per §140.6(c)3Iiia, qualifying lighting must be mounted within 10 ft of the wall and appropriate wall lighting luminaires. (Luminaires with asymmetric distribution toward the wall or adjustable –directed toward the wall)

CONDITION A

While both luminaires are within ten feet of the wall only the wall-washer qualifies for the wall display allocation. The 2X4 is a general lighting luminaire with symmetric versus asymmetric distribution and does not qualify for the allocation.

CONDITION B

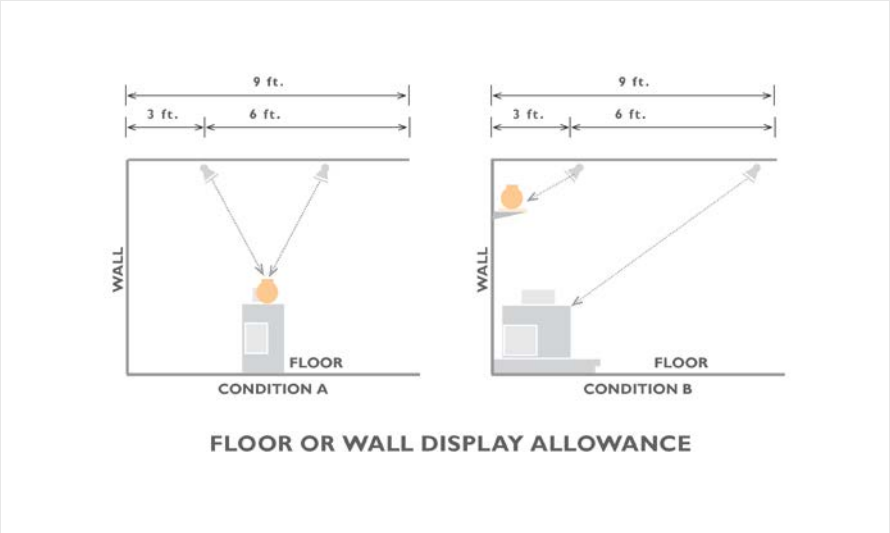
Both luminaires are within ten feet of the wall and both qualify for the wall display allocation. The fluorescent wall-washer has an asymmetric distribution and the PAR accent light at 5 ft from the wall is directional and is lamped with a projetor lamp.

Example 5-20 Museum lighting – Tailored Method

Question

A museum space has directional accent lighting luminaires on a track mounted to the ceiling. The first track is three feet from the perimeter wall of the exhibit space and the second track is nine feet from the wall. There is a third track (not shown) that is fifteen feet into the space. To what display category should these luminaires be assigned under §140.6(c) 3I and 3J

Answers



Per §140.6(c)3Iiv& 3Jv wall display luminaires must be within 10 ft of the wall and directional and floor displays must be at least two feet away from the wall and also directional. Using these criteria, the allocations for the two conditions shown are as follows:

CONDITION A

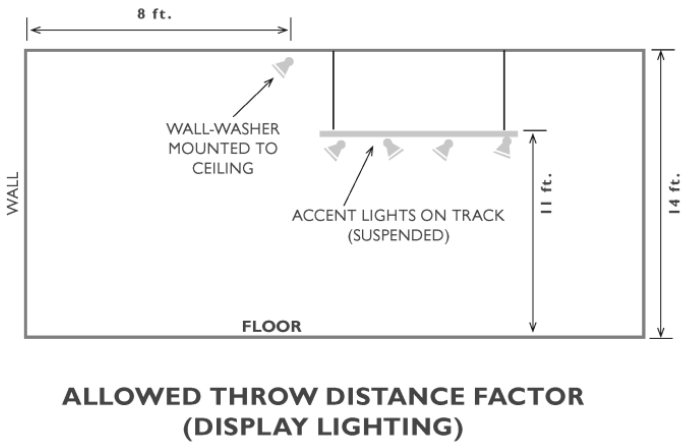
Both sets of luminaires shown are at least 2 ft away from the wall and are directed onto a floor exhibit (display) therefore they both qualify for the floor display allocation. The third track with directional luminaires also qualifies as floor display.

CONDITION B

Both sets of luminaires shown are also closer than 10 ft to the wall and are directed onto a wall exhibit (display) therefore they both, when directed toward the wall qualify for the wall display allocation. The third track with directional luminaire (15 ft from the wall) does not qualify for wall display, only floor display.

Note: Luminaires within a 2 ft to 10 ft zone may be assigned to either wall or floor display depending on the focus direction of the luminaires. However only one classification, either wall or floor can be used for luminaire compliance, not both.

Example 5-21 Adjustments for luminaire mounting height – Tailored Method



ALLOWED THROW DISTANCE FACTOR (DISPLAY LIGHTING)

Question

A high ceiling space with allowed display lighting has wall-washers mounted on the ceiling near the wall and accent lights mounted on suspended track in the center of the space. Because of the 18 ft high ceiling, does the display lighting qualify for a mounting height factor adjustment?

Answer

Per §140.6(c) 3Iv and 3Jix, some but not all of the display lighting qualifies for the mounting height adjustment. The wall directional lighting that mounted at the ceiling is above 12 ft which then qualifies it for an adjustment factor of 0.87 in accordance with Table 140.6-E. However the track that is suspended at 11 ft is excluded from an adjustment factor. It must use the default factor of 1 with the allowed LPD as shown in column 4 in Table 140.6-E.

Example 5-22 Tailored Method lighting power allowance

Question

The customer area of a bank building includes financial transaction counters, wall displays and seating. The size of the space is 20 ft wide by 50 ft long and 11 ft high. Transaction counters are 3-feet off the floor and there is 75 ft of wall display. Proposed luminaires used for general illumination are recessed down lights and for wall display lighting are wall-washer luminaires. Under the Tailored Method, what is the maximum allowed Lighting Power Density (LPD) (excluding any control credits)?

Answer

From Table 140.6-D in the EnergyStandards, target general illumination of 300 lux is recommended for financial transaction area. Using the dimensions given (20 ft x 50 ft x 11 ft and a task height of 3-feet), the room cavity ratio (RCR) is calculated to be 2.8. Using Table 140.6-G, 0.82 W/ft^2 of LPD is allowed for the 300 lux target and RCR of 2.8 . Therefore, the general lighting allowance is 820 W (= 20 ft x 50 ft x 0.82 W/ft^2).

For the wall display lighting, 3.15 W/ft of LPD is allowed (per Table 140.6-D Column 3) . The wall display lighting power allowance is 236 W (=75 ft X 3.15 W/ft).

For floor display and task lighting, 0.2 W/ft^2 of LPD is allowed (per Table 140.6-D Column 4). The combined floor display and task lighting power allowance is 200 W (= 20 ft x 50 ft x 0.2 W/ft^2).

Total allowed lighting power for this financial transaction area is 1,256 W (= 820 W + 236 W + 200W).

Example 5-23 Tailored Method lighting power allowance

Question

If, in the previous question, the design used only down lights or 2X2 fluorescent troffers, what is the maximum allowed power *(excluding any control credits)?*

Answer

Since the proposed downlights or 2X2 fluorescent troffers provide general illumination only and there are no luminaires providing wall display lighting, the wall display lighting power allowance cannot be applied here as there are no qualifying luminaires in the design. Display lighting is a use-it-loose-it component and the lighting equipment used must meet the optical characteristics of display and focal lighting.

The maximum allowed power 1,020 W (= 820W + 200W).

The 1,020 W comprises 820W for the allowed general lighting and 200 watts for the task lighting.

Example 5-24 Decorative lighting - Tailored Method

Question

The bank from the previous question wants to add chandeliers in addition to down lights and wall-washers. What is the maximum allowed power under Tailored Method *(excluding any control credits)?*

Answer

1,756W (=1256W + 500W) is the maximum allowed lighting power. See below for details.

In addition to the 1,256 W allowed for the combination of general lighting display lighting and task lighting, a maximum of 500 W (per Table 140.6-D column 5) of Ornamental/Special effects lighting is allowed. Note: for this wattage to be allowed the decorative lighting must be in addition to general lighting and the luminaire must meet the ornamental lighting criteria. The actual allowed Ornamental lighting power will be the lower of the maximum allowed or total ornamental lighting power.

Example 5-25 Ornamental lighting and very valuable display lighting - Tailored Method

Question

A 5,500-ft² retail store has:

- 5,000 ft² of gross sales floor area with a RCR of 2.5
- 200 ft² of restrooms (with a RCR of 6.0)
- 300 ft² of corridors (with a RCR of 6.5)
- 100 ft² of very valuable merchandise case top with 1,200 W of actual lighting

There are 300 linear ft of perimeter wall including closeable openings and Ornamental/special effects lighting is being used as part of the retail scheme.

What are the allowed lighting power for general lighting, wall display, floor display, ornamental/special effect, and very valuable display lighting in this store using the Tailored Method?

Answer

The general illumination for retail is 400 Lux per Standards Table 140.6-D. The Lighting Power Density (LPD) is 0.98 W/ft² for a 400 Lux space with an RCR of 2.5 per Table 140.6-G. Therefore, the allowed general lighting power for the retail store is 0.98 W/ft² X 5,000 ft² = **4,900 W**.

Corridors and restrooms are not included in the Tailored Method tables and therefore must comply under the area category method. Look up Table 140.6-C for the allowed LPD for these spaces. Table 140.6-C contains LPD values for primary functional areas and it allows 0.6 W/ft^2 of LPD for corridors and restrooms. *(RCR is not relevant in looking up LPD values in Table 140.6-C. This is different from how to look up values from Table 140.6-G)*

The allowed power for the restrooms is 200 ft² x 0.6 W/ft² = **120 W**. The allowed power for the corridors is 300 ft² x 0.6 W/ft² = **180 W**.

The wall display lighting is computed from the entire wall perimeter, including all closeable openings, times the wall display power allowance. Therefore, the allowed wattage is 300 ft x 14 W/ft = **4,200 W**. The allowance is taken from column three of Standards Table 140.6-D.

The floor display allowance is computed from the area of the entire space with floor displays times the floor display lighting power density. Therefore, the allowed wattage is 5,000 ft² x 1.0 W/ft² = **5,000 W**. The allowance is taken from column four of Table 140.6-D.

The ornamental/special effect allowance is computed from the area of the entire space with floor displays times the ornamental/special effect lighting power density. Therefore, the allowed wattage is 5,000 ft² x 0.5 W/ft² = **2,500 W**. The allowance is taken from column five of Table 140.6-D.

The allowed wattage for very valuable display case top is smaller of the product of 0.8 W/ft² and the gross sales area (5,000 ft²) or the product of 14 W/ft² and the actual area of the case tops (100 ft²). The maximum allowed power is the smaller of 0.8 W/ft² X 5,000 ft² = 4,000 watts, or 14 W/ft² X 100 ft² = 1,200 watts. 0.8 W/ft² for very valuable display case lighting, is allowed per §140.6(c)3Lv. Therefore, the maximum allowed power is **1,200 W**.

Therefore, the total allowed lighting power is 4,900 + 120 + 180 + 4,200 + 5,000 + 2,500 + 1,200 = **18,100 W**. Note that in the Tailored Method, the allowed wattage for each lighting task other than general lighting is of the use-it-or-lose-it variety, which prohibits trade-offs among these wattages and different tasks or areas. Only the General Lighting component of the Tailored Method is tradable between areas using tailored compliance or areas using Area compliance.

Example 5-26 Very valuable display lighting – Tailored method

Question

If in the question above, the actual design wattages for floor display and very valuable display are 4,500 W and 1,000 W respectively, what are the maximum allowed floor display and very valuable display power allowances?

Answer

Because the floor display and very valuable display allowances are use-it-or-lose-it allowances, the maximum power allowed is the smaller of allowed watts for floor display (5,000 W) and very valuable display (1,200 W) or the actual design watts for floor display (4,500 W) and very valuable display (1,000 W). Therefore, the maximum allowed watts for floor display and very valuable display lighting are 4,500 W and 1,000 W actual design watts, not 5,000 W and 1,400 W maximum allowed watts.

Example 5-27 Retail store lighting - Tailored Method

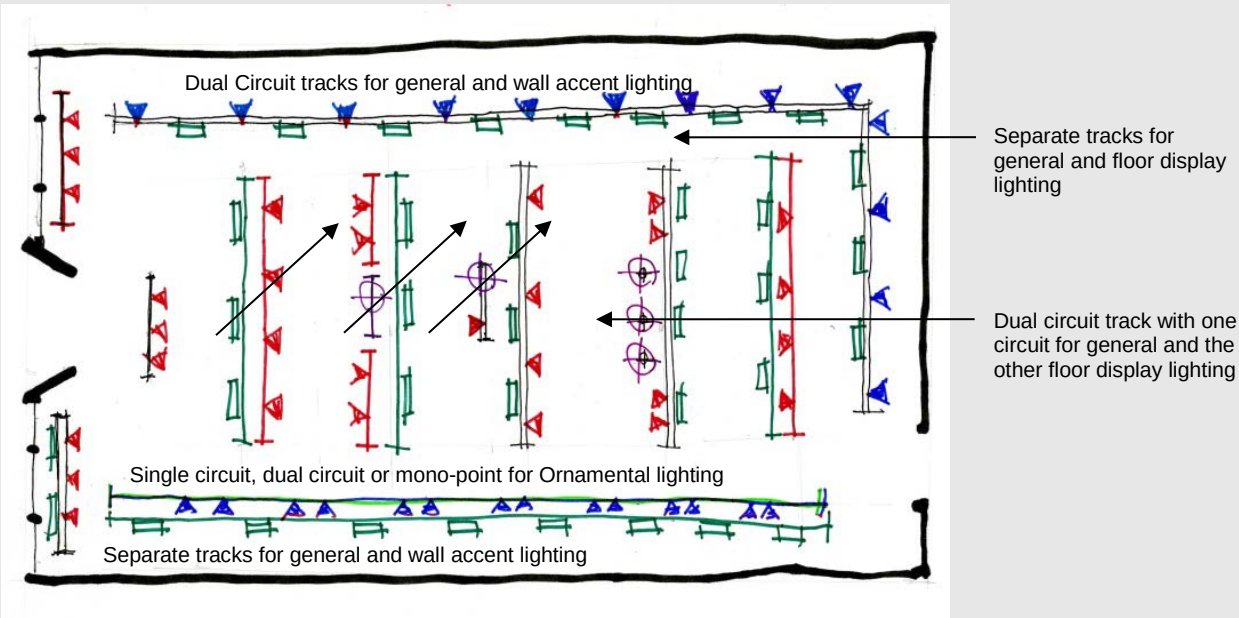
Question (Two Parts – Part 1 and 2)

Owners of a retail store want to use track lights for all the sales floor lighting. The sales floor is 50 ft x 100 ft with 10 ft high ceilings. There are 125 ft of sales wall and decorative pendants for ornamental effect lighting

also mounted on track. All the merchandise is on open sell racks, tables or on wall shelves and hangers. There will be no casework or high-end valuable merchandise lighting required in the design.

Part 1: using tailored compliance, what is the maximum allowed lighting power?

Part 2: based on the design description, what other compliance requirements are unique to this approach?



Answer – Part 1

The allowed maximum wattage is **13,150 W** which is determined as follows:

From Standards Table140.6-D, Column 2, the general illumination for retail is 400 lux. From Standards Table 141.0-G, the LPD for 400 lux in a space with the RCR determined as <2.0 is 0.78W/ft². Therefore, the allowed general lighting power is 0.78 W/ft² X 5,000 ft² = 3,900 W along with the allowed floor display lighting from Table 140.6-D column 4 which is 1.0W/ft² X 5,000 ft² = 5,000 W and the allowed wall display lighting from the same table column 3 which is 14 W/ft X 125 ft = 1,750 W. Plus an ornamental lighting adder from column 5 of 0.5 W/ft² X 5,000 ft² = 2,500 W. [3900 + 5000 +1750 + 2500 =13,150]

Answer – Part 2

Dual circuit track, multiple independently circuited tracks or combination of both will be required for an all track design to conform to Title 24-2016 Tailored Method lighting compliance.

Retail stores or other spaces using the Tailored Method that use track lighting exclusively for the layered lighting approach as defined in the Tailored Method must provide a system for separately switching and controlling the layered lighting components (general, floor display, wall display and ornamental lighting). One solution is the use of dual circuit track with one circuit dedicated to general lighting and the other to wall display or floor display, based on where the track is located and on its assigned function. If/when ornamental lighting is also powered by track; it must also be separately circuited using dual circuit track or a separate dedicated track.

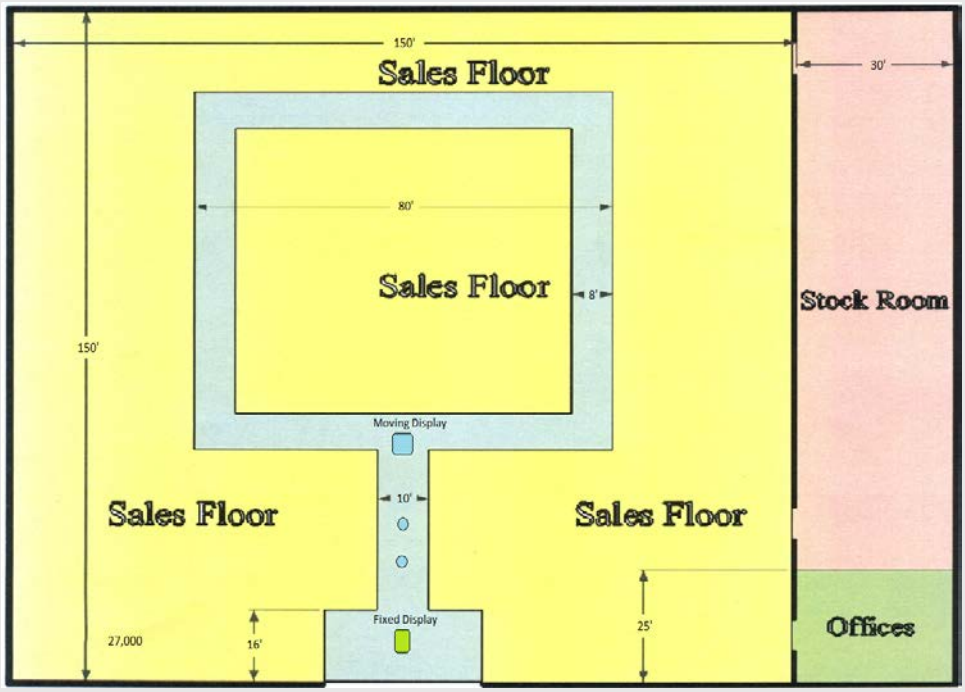
Another solution is to use multiple, single circuit tracks, as needed, with each track circuited for its specific task (general, display or ornamental lighting).

Note: each lighting task; general, display and/or ornamental lighting must be separately circuited and controlled. Therefore, in an application that has an area with general lighting, wall and floor display and ornamental lighting all occurring multiple adjacent dual circuit tracks or a combination of tracks and other power connections (such as mono-points) may be needed.

Example 5-28 Retail store lighting - Tailored Method

Question

How are the task spaces and allowed LPD's determined for a 27,000 square foot retail store with sales areas, stockrooms and offices using Tailored Method?



Answer

Determine square footage allowances by space type, as well as allowed maximum watts, for each area as follows:

1) First, identify spaces allowed to use the Tailored Method and those requiring the Area Category Method. Only the sales area can use the Tailored Method (per Table 140.6-D of the standards). Stock rooms and offices are not in the Tailored table and therefore must comply under the Area Category Method (Table 140.6-C).

2). The area of offices and stockrooms are determined by multiplying the length and width of each space (25 X 30 = **750 ft²** for offices) (30 X 125 = **3,750 ft²** for stockrooms). The allowed maximum watts for offices and stockrooms are then determined by multiplying the allowed LPD of the space (Table 140.6-C) by the area of the space.

3) The area of the sales floor is also determined by multiplying the length and width of the space. However the gross sales area also includes major circulation paths that are required by code (evacuation egress). Therefore these egress areas must be deducted from the total sales floor footprint to determine allowed sales area when using the Tailored Method. Note: the same is also true for a sales area complying under the Area Category Method. The allowed sales floor square footage is therefore **19,980 ft²** (150 X 150 = 22,500 minus 2,520 total egress area shown in pale blue on the plan).

To determine maximum allowed lighting power for the sales floor it is also necessary to identify the lineal foot of qualifying walls eligible for wall display. Total maximum watts for the sales floor is then determined by using the allowed LPD (from Table 140.6-G) for general lighting based on the RCR of the space and the LPD for allowed floor display, wall display and ornamental effect lighting (columns 2, 3, 4 from Table 140.6-D).

4) LPD for the 2,520 ft² of egress space is determined by using the Area Category Method, as egress space is not in the Tailored table (Table 140.6-D). Table 140.6-C of the Area Category Method will determine the

allowed LPD as egress space falls under the category of corridor. Multiply the LPD for corridor by the egress area for the allowed maximum watts.

Example 5-29 Exercise center lighting – Tailored method

Question

Using provisions as defined under §140.6(c)3H Tailored Compliance, what is the Allowed Lighting Power for an exercise center with two separate rooms? One room is 40 ft wide X 60 ft long with a 16 ft ceiling. The other room is 16 ft wide X 30 ft long with a 12 ft ceiling. The luminaires are mounted at the ceiling for both rooms.

Answer

2,995 W total for the two room Exercise Center. This allowed wattage is determined by:

1) Illuminance values (Lux) for an Exercise Center according to the IESNA Lighting Handbook Tenth Edition using the horizontal illuminance targets for observers in the 25-65 age bracket. From the handbook, the horizontal illumination target is determined to be a maximum of **400 lux** measured at 4 to 5 ft above the floor.

2) The RCR in accordance with Table 140.6-F. Because there are two different rooms, each will need to have its RCR determined.

a) The RCR for the 40’ X 60’ with 16‘ ceiling has an RCR of **2.4** (5 X 12 X 100 ÷ 2400 =2.4)

b) The RCR for the 16’ X 30’ with 12‘ ceiling has an RCR of **3.83** (5 X 8 X 46 ÷ 480 = 3.83)

3) The allowed lighting power density (LPD) in Table 140.6-G.

a) The first room with an RCR of 2.4 and a lux target of 400 is allowed 0.98 W/ft²

b) The second room with an RCR of 3.83 and a lux target of 400 is allowed 1.34 W/ft²

4) The square feet of the areas; One room is 40 ft wide X 60 ft long = 2,400 feet and the other 16 ft wide X 30 ft long = 480 feet. Therefore the allowed watts are as follows:

a) 2,400 X 0.98 = 2,352 W

b) 480 X 1.34 = 643 W

5) The total allowed lighting power in watts is 2352 W + 643 W or a total of **2,995 W** for the two room exercise center.

Example 5-30 Decorative lighting in exercise center - Tailored Method

Question

Using provisions as defined under §140.6(c)3H, what is the Allowed Lighting Power for the exercise center if a portion of the lighting will use decorative chandeliers?

Answer

2,995 W total for the two room exercise center using the same procedure as outlined in Example 5-29 above.

Although some of the lighting is being created with use of decorative chandeliers, Table 140.6-D column 5 doesn’t apply when using §140.6(c)3H.

A provision of §140.6(c)3Hii requires that when calculating allowed indoor Lighting Power Density allotments for general lighting using §140.6(c)3H, the building shall not add additional lighting power allowances for any other use, including but not limited to wall display, floor display and task, ornamental/special effects, and very valuable display case lighting.

5.8 Performance Approach

The performance approach provides an alternative method to the prescriptive approach for establishing the allowed lighting power for the building.

Under the performance approach, the energy use of the building is modeled using a compliance software program approved by the Energy Commission. In this energy analysis, the standard lighting power density for the building is determined by the compliance software program based on occupancy type, in accordance with either the complete building, area category, or tailored method described above. This standard lighting power density is used to determine the energy budget for the building.

When a lighting permit is sought under the performance approach, the applicant uses a proposed lighting power density to determine whether or not the building meets the energy budget. If it does, this proposed lighting power density is automatically translated into the allowed lighting power for the building (by multiplying by the area of the building).

If the building envelope or mechanical systems are included in the performance analysis (because they are part of the current permit application), then the performance approach allows energy trade-offs between systems that can let the allowed lighting power go higher than any other method. Alternatively, it allows lighting power to be traded away to other systems, which would result in a lower allowed lighting power. This flexibility in establishing allowed lighting power is one of the more attractive benefits of the performance approach.

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

Trade-offs in general lighting power are allowed between all spaces using the Area Category Method, between all spaces using the Tailored Method, and between all spaces using the Area Category and Tailored Methods.

Also, with the Area Category Method and the Tailored Method, the Energy Standards provide an additional lighting power allowance for special cases. Each of these lighting system cases are treated separately as “use-it-or-lose-it” lighting: the user receives no credit (standard design matches proposed), but there is a maximum power allowance for each item).

See the 2016 Nonresidential ACM Reference Manual for additional information.

5.9 Additions and Alterations

This section will be included at a later time.

5.10 Indoor Lighting Compliance Documents

5.10.1 Overview

This subchapter describes the documentation (compliance forms) recommended for compliance with the nonresidential indoor lighting requirements of the 2016 Energy Standards.

5.10.2 Submitting Compliance Documentation

At the time a building permit application is submitted to the enforcement agency, the applicant also submits plans and energy compliance documentation. This section describes the recommended compliance documentation (forms) for complying with the nonresidential indoor lighting Energy Standards. It does not describe the details of the requirements.

This section is addressed to the person preparing construction and compliance documents, and to the enforcement agency plan checkers who are examining those documents for compliance.

5.10.3 Separately Documenting Conditioned and Unconditioned Spaces

The nonresidential indoor lighting requirements are the same for conditioned and unconditioned spaces. However, the Energy Standards do not allow lighting power trade-offs to occur between conditioned and unconditioned spaces. Therefore, most nonresidential indoor lighting compliance documents are required to be separately completed for conditioned and unconditioned spaces.

5.10.4 Varying Number of Rows per Document

The paper prescriptive compliance documents have a limited number of rows per section for entering data. Some designs may need fewer rows, and some designs may need additional rows. If additional rows are required for a particular design, then multiple copies of that page may be used.

5.10.5 Compliance Documentation Numbering

Following is an explanation of the 2016 nonresidential lighting compliance documentation numbering:

- NRCC Nonresidential Certificate of Compliance
- NRCA Nonresidential Certificate of Acceptance
- NRCI Nonresidential Certificate of Installation
- LTI Lighting, Indoor
- LTO Lighting, Outdoor
- LTS Lighting, Sign
- 01 The first set of compliance documents in this sequence
- E Primarily used by enforcement authority
- A Primarily used by acceptance tester

5.10.6 Certificate of Compliance Documents

Nonresidential indoor lighting Certificate of Compliance documents are listed below:

- NRCC-LTI-01-E; Certificate of Compliance; Indoor Lighting
- NRCC-LTI-02-E; Certificate of Compliance; Indoor Lighting Controls
- NRCC-LTI-03-E; Certificate of Compliance; Indoor Lighting Power Allowance
- NRCC-LTI-04-E; Certificate of Compliance; Tailored Method Worksheets
- NRCC-LTI-05-E; Certificate of Compliance; Line Voltage Track Lighting Worksheet

LTI-01-E through LTI-03-E are required for all projects; LTI-04-E is required when the tailored method is used for prescriptive compliance, and LTI-05-E is required when line voltage track lighting is installed.

5.10.7 Certificates of Installation Documents

There are six different Certificates of Installation listed as follows. See Section 5.4.7 of this chapter for additional information.

- NRCI-LTI-01-E, Certificate of Installation, Indoor Lighting
- NRCI-LTI-02-E, Certificate of Installation, EMCS Lighting Control System
- NRCI-LTI-03-E, Certificate of Installation, Line Voltage Track Lighting
- NRCI-LTI-04-E, Certificate of Installation, Two Interlocked Lighting Systems
- NRCI-LTI-05-E, Certificate of Installation, Power Adjustment Factors
- NRCI-LTI-06-E, Certificate of Installation, Additional Video Conference Studio Lighting

The Certificates of Installation are primarily used as declarations, signed by a person with an approved license, that what was claimed on the Certificates of Compliance is actually what was installed.

The required nonresidential indoor lighting Certificates of Installation include the following:

- NRCI-LTI-01-E - must be submitted for all buildings. This is the general Certificate of Installation used to declare that what was proposed in the Certificates of Compliance is actually what was installed.

  In addition to the NRCI-LTI-01-E, the following Certificates of Installation are also required if the job includes any of the measures covered by these Certificates of Installation. If any of the requirements in any of these Certificates of Installation fail the respective installation requirements, then that application shall not be recognized for compliance with the lighting Standards.

  These additional Certificates of Installation are different than Certificates of Acceptance, in that Certificates of Installation consist primarily of declarations that each of the minimum requirements has been met, while Certificates of Acceptance include tests which must be conducted.

- NRCI-LTI-02-E - Must be submitted whenever a lighting control system, and whenever an Energy Management Control System (EMCS), has been installed to comply with any of the lighting control requirements.

- NRCI-LTI-03-E - Must be submitted whenever a line-voltage track lighting integral current limiter, and whenever a supplementary overcurrent protection panel, has been installed and used to determine the installed wattage of any line-voltage track lighting system.

  Note that a supplementary overcurrent protection panel shall be recognized for use only with line-voltage track lighting,

  See Section 5.2.3 of this chapter for requirements of track lighting current limiters and track lighting protection panels.

  Note: In addition to submitting the NRCI-LTI-03-E after installation, the NRCC-LTI-05-E (Line-Voltage Track Lighting Worksheet) must be included with the Certificates of Compliance whenever any type of line-voltage track lighting is installed in a project.

- NRCI-LTI-04-E - Must be submitted for two interlocked systems serving an auditorium, a convention center, a conference room, a multipurpose room, or a theater to be recognized for compliance.

  See Section 5.6.4 of this chapter for two interlocked system requirements.

- NRCI-LTI-05-E - Must be submitted for a Power Adjustment Factor (PAF) to be recognized for compliance.

  See Section 5.6.5 of this chapter for requirements of PAFs.

- NRCI-LTI-06-E - Must be submitted for additional wattage installed in a video conferencing studio to be recognized for compliance

5.10.8 Certificate of Acceptance

Acceptance requirements ensure that equipment, controls, and systems operate as required and specified. There are three steps to acceptance testing:

- Visual inspection of the equipment and installation
- Review of the certification requirements
- Functional tests of the systems and controls

Third-party review of the information provided on the Certificate of Acceptance forms is not required for lighting.

Individual acceptance tests may be performed by one or more Field Technicians under the responsible charge of a licensed contractor or design professional, (Responsible Person) eligible under Division 3 of the Business and Professions Code, in the applicable classification, to accept responsibility for the scope of work specified by the Certificate of Acceptance document. The Responsible Person must review the information on the Certificate of Acceptance form and sign the form to certify compliance with the acceptance requirements. Typically, the individuals who participate in the acceptance testing/verification procedures are contractors, engineers, or commissioning agents. The individuals who perform the field testing/verification work and provide the information required for completion of the acceptance form (Field Technicians) are not required to be licensed contractors or licensed design professionals. Only the Responsible Person who signs the Certificate of Acceptance form to certify compliance must be licensed.

The acceptance tests required for nonresidential indoor lighting include the following:

- Lighting controls
- Automatic daylighting controls
- Demand responsive lighting controls
- Institutional Tuning for Power Adjustment Factor

Instructions for completing the Certificates of Acceptance are imbedded in the certificates. See Chapter 13 of this manual for additional information about acceptance requirements.