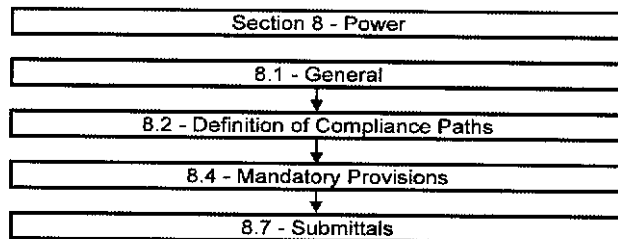


## 8. POWER



**8.1 General.** This section applies to all building power distribution *systems*.

### 8.2 Compliance Path(s)

**8.2.1** Power distribution systems in all projects shall comply with the requirements of Section 8.1, General; Section 8.4, Mandatory Provisions; and Section 8.7, Submittals.

### 8.3 Simplified/Small Building Option (Not Used)

### 8.4 Mandatory Provisions

#### 8.4.1 Voltage Drop

**8.4.1.1 Feeders.** *Feeder conductors* shall be sized for a maximum *voltage drop* of 2% at design load.

**8.4.1.2 Branch Circuits.** *Branch circuit conductors* shall be sized for a maximum *voltage drop* of 3% at design load.

### 8.5 Prescriptive Path (Not Used)

### 8.6 Alternative Compliance Path (Not Used)

### 8.7 Submittals

**8.7.1 Drawings.** Construction documents shall require that within 30 days after the date of system acceptance, record drawings of the actual installation shall be provided to the building owner, including

- a single-line diagram of the building electrical distribution system and
- floor plans indicating location and area served for all distribution.

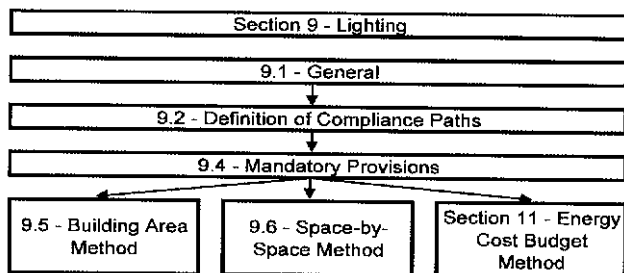
**8.7.2 Manuals.** Construction documents shall require that an operating manual and maintenance manual be provided to the building owner. The manuals shall include, at a minimum, the following:

- Submittal data stating *equipment* rating and selected options for each piece of *equipment* requiring maintenance.
- Operation manuals and maintenance manuals for each piece of *equipment* requiring maintenance. Required routine maintenance actions shall be clearly identified.
- Names and addresses of at least one qualified *service agency*.
- A complete narrative of how each system is intended to operate.

(Enforcement agencies should only check to be sure that the construction documents require this information to be transmitted to the owner and should not expect copies of any of the materials.)

### 8.8 Product Information (Not Used)

## 9. LIGHTING



### 9.1 General

**9.1.1 Scope.** This section shall apply to the following:

- interior spaces of *buildings*
- exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies
- exterior building grounds lighting provided through the *building's* electrical service

#### Exceptions:

- emergency lighting that is automatically off during normal *building* operation
- lighting within *dwelling units*
- lighting that is specifically designated as required by a health or life safety statute, ordinance, or regulation
- decorative gas lighting systems

**9.1.2 Lighting Alterations.** The replacement of lighting *systems* in any building space shall comply with the *LPD* requirements of Section 9 applicable to that space. New lighting *systems* shall comply with the applicable *LPD* requirements of Section 9. Any new *control devices* as a direct replacement of existing *control devices* shall comply with the specific requirements of Section 9.4.1.2(b).

**Exception:** *Alterations* that replace less than 50% of the *luminaires* in a *space* need not comply with these requirements provided that such *alterations* do not increase the installed interior lighting power.

**9.1.3 Installed Interior Lighting Power.** The *installed interior lighting power* shall include all power used by the *luminaires*, including *lamps*, *ballasts*, *transformers*, and *control devices* except as specifically exempted in Section 9.2.2.3.

**Exception:** If two or more independently operating lighting systems in a space are capable of being controlled to prevent simultaneous user operation, the installed interior lighting power shall be based solely on the lighting system with the highest wattage.

**9.1.4 Luminaire Wattage.** Luminaire wattage incorporated into the installed interior lighting power shall be determined in accordance with the following criteria:

- a. The wattage of incandescent or tungsten-halogen luminaires with medium screw base sockets and not containing permanently installed ballasts shall be the maximum labeled wattage of the luminaire.
- b. The wattage of luminaires with permanently installed or remote ballasts or *transformers* shall be the operating input wattage of the maximum lamp/auxiliary combination based on values from the auxiliary *manufacturers'* literature or recognized testing laboratories or shall be the maximum labeled wattage of the luminaire.
- c. For line-voltage lighting track and plug-in busway, designed to allow the addition and/or relocation of luminaires without altering the wiring of the system, the wattage shall be
  - 1. the specified wattage of the luminaires included in the system with a minimum of 30 W/lin ft or
  - 2. the wattage limit of the system's circuit breaker or
  - 3. the wattage limit of other permanent current-limiting device(s) on the system.
- d. The wattage of low-voltage lighting track, cable conductor, rail conductor, and other flexible lighting systems that allow the addition and/or relocation of luminaires without altering the wiring of the system shall be the specified wattage of the transformer supplying the system.
- e. The wattage of all other miscellaneous lighting equipment shall be the specified wattage of the lighting equipment.

## 9.2 Compliance Path(s)

**9.2.1 Lighting systems and equipment** shall comply with Section 9.1, General; Section 9.4, Mandatory Provisions; and the prescriptive requirements of either

- a. Section 9.5, Building Area Method; or
- b. Section 9.6, Space-by-Space Method.

### 9.2.2 Prescriptive Requirements

**9.2.2.1 The Building Area Method** for determining the *interior lighting power allowance*, described in Section 9.5, is a simplified approach for demonstrating compliance.

**9.2.2.2 The Space-by-Space Method**, described in Section 9.6, is an alternative approach that allows greater flexibility.

**9.2.2.3 Interior Lighting Power.** The *interior lighting power allowance* for a *building* or a separately metered or permitted portion of a *building* shall be determined by either the *Building Area Method* described in Section 9.5 or the *Space-by-Space Method* described in Section 9.6. Trade-offs of *interior lighting power allowance* among portions of the *building* for which a different method of calculation has been used are not permitted. The *installed interior lighting power* identified in accordance with Section 9.1.3 shall not exceed the *interior lighting power allowance* developed in accordance with Section 9.5 or 9.6.

**Exceptions:** The following *lighting equipment* and applications shall not be considered when determining the *interior lighting power allowance* developed in accordance with Section 9.5 or 9.6, nor shall the wattage for such lighting be included in the *installed interior lighting*

*power* identified in accordance with Section 9.1.3. However, any such lighting shall not be exempt unless it is an addition to general lighting and is controlled by an independent *control device*.

- a. Display or accent lighting that is an essential element for the function performed in galleries, museums, and monuments.
- b. Lighting that is integral to *equipment* or instrumentation and is installed by its *manufacturer*.
- c. Lighting specifically designed for use only during medical or dental procedures and lighting integral to medical *equipment*.
- d. Lighting integral to both open and glass-enclosed refrigerator and freezer cases.
- e. Lighting integral to food warming and food preparation *equipment*.
- f. Lighting for plant growth or maintenance.
- g. Lighting in spaces specifically designed for use by occupants with special lighting needs including visual impairment and other medical and age-related issues.
- h. Lighting in *retail* display windows, provided the display area is enclosed by ceiling-height partitions.
- i. Lighting in interior spaces that have been specifically designated as a registered interior *historic* landmark.
- j. Lighting that is an integral part of advertising or directional signage.
- k. Exit signs.
- l. Lighting that is for sale or lighting educational demonstration systems.
- m. Lighting for theatrical purposes, including performance, stage, and film and video production.
- n. Lighting for television broadcasting in sporting activity areas.
- o. Casino gaming areas.
- p. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff and complies with Section 9.4.1.4(d).

## 9.3 (Not Used)

## 9.4 Mandatory Provisions

### 9.4.1 Lighting Control

**9.4.1.1 Automatic Lighting Shutoff.** Interior lighting in *buildings* larger than 5000 ft<sup>2</sup> shall be controlled with an *automatic control device* to shut off *building* lighting in all spaces. This *automatic control device* shall function on either

- a. a scheduled basis using a time-of-day operated control device that turns lighting off at specific programmed times—an independent program schedule shall be provided for areas of no more than 25,000 ft<sup>2</sup> but not more than one floor--or
- b. an *occupant sensor* that shall turn lighting off within 30 minutes of an occupant leaving a space or
- c. a signal from another control or alarm system that indicates the area is unoccupied.

**Exceptions:** The following shall not require an *automatic control device*:

- a. Lighting intended for 24-hour operation.
- b. Lighting in spaces where patient care is rendered.
- c. Lighting in spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s).

**9.4.1.2 Space Control.** Each space enclosed by ceiling-height partitions shall have at least one *control device* to independently *control* the *general lighting* within the space. Each manual device shall be readily accessible and located so the occupants can see the controlled lighting.

- a. A control device shall be installed that automatically turns lighting off within 30 minutes of all occupants leaving a space, except spaces with multi-scene control, in
  - 1. classrooms (not including shop classrooms, laboratory classrooms, and preschool through 12th grade classrooms),
  - 2. conference/meeting rooms, and
  - 3. employee lunch and break rooms.

These spaces are not required to be connected to other automatic lighting shutoff controls.

- b. For all other spaces, each *control device* shall be activated either manually by an occupant or automatically by sensing an occupant. Each *control device* shall *control* a maximum of 2500 ft<sup>2</sup> area for a space 10,000 ft<sup>2</sup> or less and a maximum of 10,000 ft<sup>2</sup> area for a space greater than 10,000 ft<sup>2</sup> and be capable of overriding any time-of-day scheduled shutoff *control* for no more than four hours.

**Exception:** Remote location shall be permitted for reasons of safety or security when the remote control device has an indicator pilot light as part of or next to the control device and the light is clearly labeled to identify the controlled lighting.

**9.4.1.3 Exterior Lighting Control.** Lighting for all exterior applications not exempted in Section 9.1 shall have automatic controls capable of turning off exterior lighting when sufficient daylight is available or when the lighting is not required during nighttime hours. Lighting not designated for dusk-to-dawn operation shall be controlled by either

- a. a combination of a photosensor and a time switch or
- b. an astronomical time switch.

Lighting designated for dusk-to-dawn operation shall be controlled by an astronomical time switch or photosensor. All time switches shall be capable of retaining programming and the time setting during loss of power for a period of at least ten hours.

**Exception:** Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security, or eye adaptation.

**9.4.1.4 Additional Control**

- a. *Display/Accent Lighting*—display or accent lighting shall have a separate *control device*.

- b. *Case Lighting*—lighting in cases used for display purposes shall have a separate *control device*.
- c. *Hotel and Motel Guest Room Lighting*—hotel and motel guest rooms and guest suites shall have a master *control device* at the main room entry that *controls* all *permanently installed luminaires* and switched receptacles.
- d. *Task Lighting*—supplemental task lighting, including *permanently installed* undershelf or undercabinet lighting, shall have a *control device* integral to the *luminaires* or be controlled by a wall-mounted *control device* provided the *control device* is readily accessible and located so that the occupant can see the controlled lighting.
- e. *Nonvisual Lighting*—lighting for nonvisual applications, such as plant growth and food warming, shall have a separate *control device*.
- f. *Demonstration Lighting*—*lighting equipment* that is for sale or for demonstrations in lighting education shall have a separate *control device*.

**9.4.2 Tandem Wiring.** Luminaires designed for use with one or three linear fluorescent lamps greater than 30 W each shall use two-lamp tandem-wired ballasts in place of single-lamp ballasts when two or more luminaires are in the same space and on the same control device.

**Exceptions:**

- a. Recessed luminaires more than 10 ft apart measured center to center.
- b. Surface-mounted or pendant luminaires that are not continuous.
- c. Luminaires using single-lamp high-frequency electronic ballasts.
- d. Luminaires using three-lamp high-frequency electronic or three-lamp electromagnetic ballasts.
- e. Luminaires on emergency circuits.
- f. Luminaires with no available pair.

**9.4.3 Exit Signs.** Internally illuminated exit signs shall not exceed 5 W per face.

**9.4.4 Exterior Building Grounds Lighting.** All exterior building grounds luminaires that operate at greater than 100 W shall contain lamps having a minimum efficacy of 60 lm/W unless the luminaire is controlled by a motion sensor or qualifies for one of the exceptions under Section 9.1.1 or 9.4.5.

**9.4.5 Exterior Building Lighting Power.** The total *exterior lighting power allowance* for all exterior building applications is the sum of the individual lighting power densities permitted in Table 9.4.5 for these applications plus an additional unrestricted allowance of 5% of that sum. Trade-offs are allowed only among exterior lighting applications listed in the Table 9.4.5 “Tradable Surfaces” section.

**Exceptions:** Lighting used for the following exterior applications is exempt when equipped with a *control device* independent of the control of the nonexempt lighting:

- a. Specialized signal, directional, and marker lighting associated with transportation.
- b. Advertising signage or directional signage.

**TABLE 9.4.5 Lighting Power Densities for Building Exteriors**

<b>Uncovered parking areas</b>		
	Parking lots and drives	0.15 W/ft <sup>2</sup>
<b>Building grounds</b>		
	Walkways less than 10 ft wide	1.0 W/linear foot
	Walkways 10 ft wide or greater	
	Plaza areas	0.2 W/ft <sup>2</sup>
	Special feature areas	
	Stairways	1.0 W/ft <sup>2</sup>
<b>Tradable Surfaces</b> (LPDs for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs, and outdoor sales areas may be traded.)	<b>Building entrances and exits</b>	
	Main entries	30 W/linear foot of door width
	Other doors	20 W/linear foot of door width
<b>Canopies and overhangs</b>		
	Canopies (free standing and attached and overhangs)	1.25 W/ft <sup>2</sup>
<b>Outdoor sales</b>		
	Open areas (including vehicle sales lots)	0.5 W/ft <sup>2</sup>
	Street frontage for vehicle sales lots in addition to "open area" allowance	20 W/linear foot
<b>Nontradable Surfaces</b> (LPD calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	<b>Building facades</b>	0.2 W/ft <sup>2</sup> for each illuminated wall or surface or 5.0 W/linear foot for each illuminated wall or surface length
	<b>Automated teller machines and night depositories</b>	270 W per location plus 90 W per additional ATM per location
	<b>Entrances and gatehouse inspection stations at guarded facilities</b>	1.25 W/ft <sup>2</sup> of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")
	<b>Loading areas for law enforcement, fire, ambulance, and other emergency service vehicles</b>	0.5 W/ft <sup>2</sup> of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")
	<b>Drive-through windows at fast food restaurants</b>	400 W per drive-through
	<b>Parking near 24-hour retail entrances</b>	800 W per main entry

- c. Lighting integral to *equipment* or instrumentation and installed by its *manufacturer*.
- d. Lighting for theatrical purposes, including performance, stage, film production, and video production.
- e. Lighting for athletic playing areas.
- f. Temporary lighting.
- g. Lighting for industrial production, material handling, transportation sites, and associated storage areas.
- h. Theme elements in theme/amusement parks.
- i. Lighting used to highlight features of public monuments and registered *historic* landmark structures or *buildings*.

## 9.5 Building Area Method Compliance Path

### 9.5.1 Building Area Method of Calculating Interior Lighting Power Allowance. Use the following steps to deter-

mine the interior lighting power allowance by the Building Area Method:

- a. Determine the appropriate building area type from Table 9.5.1 and the allowed *LPD* (watts per unit area) from the "Building Area Method" column. For building area types not listed, selection of a reasonably equivalent type shall be permitted.
- b. Determine the gross lighted floor area (square feet) of the building area type.
- c. Multiply the gross lighted floor areas of the building area type(s) times the *LPD*.
- d. The *interior lighting power allowance* for the building is the sum of the *lighting power allowances* of all building area types. Trade-offs among building area types are permitted provided that the total *installed interior lighting power* does not exceed the *interior lighting power allowance*.

**TABLE 9.5.1 Lighting Power Densities  
Using the Building Area Method**

Building Area Type <sup>a</sup>	LPD (W/ft <sup>2</sup> )
Automotive facility	0.9
Convention center	1.2
Courthouse	1.2
Dining: bar lounge/leisure	1.3
Dining: cafeteria/fast food	1.4
Dining: family	1.6
Dormitory	1.0
Exercise center	1.0
Gymnasium	1.1
Health-care clinic	1.0
Hospital	1.2
Hotel	1.0
Library	1.3
Manufacturing facility	1.3
Motel	1.0
Motion picture theater	1.2
Multifamily	0.7
Museum	1.1
Office	1.0
Parking garage	0.3
Penitentiary	1.0
Performing arts theater	1.6
Police/fire station	1.0
Post office	1.1
Religious building	1.3
Retail	1.5
School/university	1.2
Sports arena	1.1
Town hall	1.1
Transportation	1.0
Warehouse	0.8
Workshop	1.4

<sup>a</sup>In cases where both a general building area type and a specific building area type are listed, the specific building area type shall apply.

**9.6 Alternative Compliance Path: Space-by-Space Method**

**9.6.1 Space-by-Space Method of Calculating Interior Lighting Power Allowance.** Use the following steps to determine the interior lighting power allowance by the Space-by-Space Method:

- Determine the appropriate building type from Table 9.6.1. For building types not listed, selection of a reasonably equivalent type shall be permitted.
- For each space enclosed by partitions 80% or greater than ceiling height, determine the gross interior floor area by measuring to the center of the partition wall. Include the floor area of balconies or other projections. Retail spaces

do not have to comply with the 80% partition height requirements.

- Determine the *interior lighting power allowance* by using the columns designated Space-by-Space Method in Table 9.6.1. Multiply the floor area(s) of the space(s) times the allowed *LPD* for the space type that most closely represents the proposed use of the space(s). The product is the *lighting power allowance* for the space(s). For space types not listed, selection of a reasonable equivalent category shall be permitted.
- The *interior lighting power allowance* is the sum of *lighting power allowances* of all spaces. Trade-offs among spaces are permitted provided that the total *installed interior lighting power* does not exceed the *interior lighting power allowance*.

**9.6.2 Additional Interior Lighting Power.** When using the Space-by-Space Method, an increase in the *interior lighting power allowance* is allowed for specific lighting functions. Additional power shall be allowed only if the specified lighting is installed and automatically controlled, separately from the general lighting, to be turned off during nonbusiness hours. This additional power shall be used only for the specified *luminaires* and shall not be used for any other purpose.

An increase in the *interior lighting power allowance* is permitted in the following cases:

- For spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance, such as chandelier-type luminaires or sconces or for highlighting art or exhibits, provided that the additional lighting power shall not exceed 1.0 W/ft<sup>2</sup> of such spaces.
- For lighting equipment installed in sales areas and specifically designed and directed to highlight merchandise, calculate the additional lighting power as follows:

$$\begin{aligned} \text{Additional Interior Lighting Power Allowance} = & \\ & 1000 \text{ watts} + (\text{Retail Area 1} \times 1.0 \text{ W/ft}^2) \\ & + (\text{Retail Area 2} \times 1.7 \text{ W/ft}^2) \\ & + (\text{Retail Area 3} \times 2.6 \text{ W/ft}^2) \\ & + (\text{Retail Area 4} \times 4.2 \text{ W/ft}^2), \end{aligned}$$

where

- Retail Area 1 = the floor area for all products not listed in Retail Areas 2, 3, or 4;
- Retail Area 2 = the floor area used for the sale of vehicles, sporting goods, and small electronics;
- Retail Area 3 = the floor area used for the sale of furniture, clothing, cosmetics, and artwork; and
- Retail Area 4 = the floor area used for the sale of jewelry, crystal, and china.

**Exception:** Other merchandise categories may be included in Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is approved by the *authority having jurisdiction*.

**9.7 Submittals (Not Used)**

**9.8 Product Information (Not Used)**

**TABLE 9.6.1 Lighting Power Densities Using the Space-by-Space Method**

Common Space Types <sup>a</sup>	LPD, W/ft <sup>2</sup>	Building-Specific Space Types	LPD, W/ft <sup>2</sup>
Office --Enclosed	1.1	Gymnasium/Exercise Center	
Office—Open Plan	1.1	Playing Area	1.4
Conference/Meeting/Multipurpose	1.3	Exercise Area	0.9
Classroom/Lecture/Training	1.4	Courthouse/Police Station/Penitentiary	
For Penitentiary	1.3	Courtroom	1.9
Lobby	1.3	Confinement Cells	0.9
For Hotel	1.1	Judges' Chambers	1.3
For Performing Arts Theater	3.3	Fire Stations	
For Motion Picture Theater	1.1	Engine Room	0.8
Audience/Seating Area	0.9	Sleeping Quarters	0.3
For Gymnasium	0.4	Post Office—Sorting Area	1.2
For Exercise Center	0.3	Convention Center --Exhibit Space	1.3
For Convention Center	0.7	Library	
For Penitentiary	0.7	Card File and Cataloging	1.1
For Religious Buildings	1.7	Stacks	1.7
For Sports Arena	0.4	Reading Area	1.2
For Performing Arts Theater	2.6	Hospital	
For Motion Picture Theater	1.2	Emergency	2.7
For Transportation	0.5	Recovery	0.8
Atrium—First Three Floors	0.6	Nurses' Station	1.0
Atrium—Each Additional Floor	0.2	Exam/Treatment	1.5
Lounge/Recreation	1.2	Pharmacy	1.2
For Hospital	0.8	Patient Room	0.7
Dining Area	0.9	Operating Room	2.2
For Penitentiary	1.3	Nursery	0.6
For Hotel	1.3	Medical Supply	1.4
For Motel	1.2	Physical Therapy	0.9
For Bar Lounge/Leisure Dining	1.4	Radiology	0.4
For Family Dining	2.1	Laundry—Washing	0.6
Food Preparation	1.2	Automotive-- Service/Repair	0.7
Laboratory	1.4	Manufacturing	
Restrooms	0.9	Low Bay (<25 ft Floor to Ceiling Height)	1.2
Dressing/Locker/Fitting Room	0.6	High Bay (≥25 ft Floor to Ceiling Height)	1.7
Corridor/Transition	0.5	Detailed Manufacturing	2.1
For Hospital	1.0	Equipment Room	1.2
For Manufacturing Facility	0.5	Control Room	0.5
Stairs—Active	0.6	Hotel/Motel Guest Rooms	1.1
Active Storage	0.8	Dormitory—Living Quarters	1.1
For Hospital	0.9	Museum	
Inactive Storage	0.3	General Exhibition	1.0
For Museum	0.8	Restoration	1.7
Electrical/Mechanical	1.5	Bank/Office—Banking Activity Area	1.5

**TABLE 9.6.1 Lighting Power Densities Using the Space-by-Space Method (continued)**

Common Space Types <sup>a</sup>	LPD, W/ft <sup>2</sup>	Building-Specific Space Types	LPD, W/ft <sup>2</sup>
Workshop	1.9	Religious Buildings	
Sales Area [for accent lighting, see Section 9.6.2(b)]	1.7	Worship Pulpit, Choir	2.4
		Fellowship Hall	0.9
		Retail	
		Sales Area [for accent lighting, see Section 9.6.3(c)]	1.7
		Mall Concourse	1.7
		Sports Arena	
		Ring Sports Area	2.7
		Court Sports Area	2.3
		Indoor Playing Field Area	1.4
		Warehouse	
		Fine Material Storage	1.4
		Medium/Bulky Material Storage	0.9
		Parking Garage—Garage Area	0.2
		Transportation	
		Airport—Concourse	0.6
		Air/Train/Bus --Baggage Area	1.0
		Terminal—Ticket Counter	1.5

<sup>a</sup> In cases where both a common space type and a building-specific type are listed, the building specific space type shall apply.