Proposal Summary

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

2022 California Energy Code (Title 24, Part 6)

Multifamily Restructuring

Updated: May 6, 2020

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Introduction

The document summarizes proposed revisions to the California Energy Code (Title 24, Part 6) that will be discussed during Round 2 of the utility-sponsored stakeholder meeting on May 7, 2020. The Statewide Utility Codes and Standards Enhancement (CASE) Team is seeking input and feedback. To provide your comments, email info@title24stakeholders.com.

Measure Description

The Statewide CASE Team proposes additional chapters for Title 24, Part 6, specific to multifamily buildings. The three chapters will cover mandatory requirements, Prescriptive and Performance requirements, and addition and alteration requirements for multifamily dwelling units and common use areas. The content for each chapter will include portions of Title 24, Part 6 currently housed under the low-rise residential and nonresidential sections, marked-up for specific application to multifamily buildings. The chapters will include unified requirements that apply to multifamily buildings of all heights, with categorization by assembly or system type, application to dwelling units or common use areas, and by systems serving individual dwelling units or central systems serving multiple dwelling units. Generally, the unification will apply low-rise residential and nonresidential requirements to multifamily buildings as follows:

- The more stringent of the residential or nonresidential requirements for roofs, walls, floors, and windows, by assembly type, apply to multifamily building envelopes.
- Residential HVAC requirements of sections 150.0, 150.1, and 150.2 apply to HVAC systems serving individual dwelling units. Nonresidential requirements of sections 120, 140, and 141 apply to HVAC systems serving common areas and central systems serving multiple dwelling units.
- Residential domestic hot water requirements apply to individual and central systems serving dwelling units. (No change in application.)
- Residential lighting requirements apply to dwelling unit lighting and outdoor fixtures controlled from within dwelling units. Nonresidential lighting requirements apply to common area and outdoor spaces. (No change in application.)
- Nonresidential covered processes for elevators and garages apply to all multifamily buildings. (No change in application.)

- Nonresidential electric power distribution requirements will apply to all multifamily buildings. (No change in application.)

For changes related to unification of multifamily requirements which result in increased stringency for a specific multifamily building type, the Statewide CASE Team is conducting feasibility, market, and energy, and cost analysis. These measures include:

- **Roof Products** – Extend the most stringent prescriptive requirements by slope type (low or steep) and climate zone, as cost-effective. This change would:
    - Increase aged solar reflectance for low slope roofs in buildings four stories and taller in Climate Zones 13 and 15 from 0.55 to 0.63.
    - Add 0.55 aged solar reflectance and 0.75 thermal emittance requirements in climate zones 9 through 11 and 14 for low slope roofs in buildings fewer than four stories.
    - Add 0.20 aged solar reflectance and 0.75 thermal emittance requirements in climate zones 2 through 9 for steep slope roofs in buildings fewer than four stories.
- **Roof/Ceiling Insulation** – Extend most stringent requirement by assembly type. This change would:
    - Apply mandatory low-rise residential maximum U-factor of 0.043 to multifamily buildings with attics.
    - Apply mandatory nonresidential maximum U-factors of 0.098 for metal roofs and 0.075 for wood framed and other roofs to non-attic roofs in buildings fewer than four stories.
    - Extend equivalent U-factor of prescriptive low-rise residential requirements from Table 150.1-B to buildings four stories and greater with wood framing. (0.024 for Climate Zones 1 and 11 through 16 and 0.030 for Climate Zones 2 through 10).
    - Extend high-rise residential prescriptive U-factor of 0.041 to all multifamily metal buildings.
- **Wall U-Factor** - Combine wall-U-factor requirements from the 2019 residential and nonresidential chapters into a single table of requirements, by wall assembly type, for all multifamily buildings. The approach references fire-ratings for select wall assemblies in response to stakeholder feedback on code compliance and enforcement complications resulting from the intersection between fire code (Title 24, Part 7) and energy code (Title 24, Part 6). Fire rating references within the energy code would allow less stringent U-factor requirements for high fire-rating wall types that have constructability limitations and are more costly to insulate to higher U-factor requirements.

  The proposed wall assembly categories, with varied prescriptive requirements by climate zone, are the following:
    - Metal buildings
    - Curtain wall and spandrel panels
    - Metal framed, with >1-hour fire rating
    - Wood framed, with > 1-hour fire rating
    - Framed (wood or metal), with ≤ 1-hour fire rating, and other
    - Heavy mass (<15 Btu/ft2-F)
    - Light mass (7-15 Btu/ft2-F)
    - Below grade walls

- **Fenestration Properties** - Extend low-rise residential mandatory maximum U-factor of 0.58 to multifamily buildings four stories and greater. There are currently no mandatory requirements for fenestration properties in nonresidential and high-rise residential buildings. Apply low-rise residential prescriptive U-factor and solar heat gain coefficient (SHGC) to multifamily buildings four stories and greater, with exceptions for curtain wall fenestration and AW Performance Class products. The proposed code language removes prescriptive Visible Transmittance (VT) requirements for all multifamily buildings, where the 2019 nonresidential code has VT minimums for high-rise buildings. The proposed measure will use the relative solar heat gain coefficient (RSHGC) methodology for prescriptive compliance with all multifamily windows.
- **Fenestration Area** - Extend the prescriptive low-rise residential 20 percent window-to-floor area maximum to high-rise buildings and the prescriptive high-rise residential 40 percent window-to-wall area maximum to low-rise buildings. This measure would result in a dual metric.
- **Duct Insulation R-Values** – Extend mandatory high-rise R-8.0 duct insulation requirement to multifamily buildings with ducts in unconditioned space. Low-rise multifamily buildings have a less stringent mandatory requirement of R-6.0 when ducts are in unconditioned space. High-rise residential buildings do not have a prescriptive duct insulation requirement. Extend low-rise prescriptive R-6.0 duct insulation requirements to all multifamily buildings with ducts and air handlers in conditioned spaces. Extend low-rise climate zone-specific duct insulation requirements (R-.60 or R-8.0) to all multifamily buildings where ducts and air handlers are not completely within conditioned spaces.
- **Duct Leakage Testing** - Extend HERS verification of duct sealing of HVAC systems serving individual dwelling units in multifamily buildings four stories and greater. Note that ducts serving common use areas will be required to meet duct leakage testing requirements consistent with nonresidential requirements. This is not a change from current requirements.
- **Space Conditioning Airflow Rate and Fan Efficacy** - Extend HERS verification of airflow and fan efficacy of HVAC systems serving individual dwelling units in multifamily buildings four stories and greater.
- **Refrigerant Charge Verification or Fault Indicator Display** - Extend HERS verification of refrigerant charge for split air conditioning systems serving individual dwelling units in multifamily buildings four stories and greater.

Draft Code Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2019 documents are marked with red underlining (new language) and ~~strikethroughs~~ (deletions).

Standards

SECTION 100.0 – SCOPE

(e) **Sections Applicable to Particular Buildings.** TABLE 100.0-A and this subsection list the provisions of Part 6 that are applicable to different types of buildings covered by Section 100.0(a).

1. **All buildings.** Sections 100.0 through 110.12apply to all buildings.

   EXCEPTION to Section 100.0(e)1: Spaces or requirements not listed in TABLE 100.0-A.

2. **Newly constructed buildings.**

A. **All newly constructed buildings.** Sections 110.0 through 110.12apply to all newly constructed buildings within the scope of Section 100.0(a). In addition, newly constructed buildings shall meet the requirements of Subsections B, C, D or E, as applicable.

B. **Nonresidential~~, high-rise residential,~~ and hotel/motel buildings** that are mechanically heated or mechanically cooled.

i. Sections applicable. Sections 120.0 through 140.8 apply to newly constructed nonresidential buildings, high-rise residential buildings, and hotels/motels that are mechanically heated or mechanically cooled.

ii. Compliance approaches. In order to comply with Part 6 newly constructed nonresidential buildings, high-rise residential buildings, and hotels/motels that are mechanically heated or mechanically cooled must meet the requirements of:

a. Mandatory measures: The applicable provisions of Sections 120.0 through 130.5; and

b. Either:

(i) Performance approach: Section 140.1; or

(ii) Prescriptive approach: Sections 140.2 through 140.9.

C. **Unconditioned nonresidential buildings and process space.** Sections 110.9, 110.10, 120.6, 130.0 through 130.5, 140.3(c), 140.6, 140.7, and 140.8 apply to all newly constructed unconditioned buildings and 140.1, and 140.3(c), for process spaces within the scope of Section 100.0(a).

D. Multifamily buildings.

i. Sections 160.0 through 170.2 apply to newly constructed multifamily buildings.

ii. Compliance approaches. In order to comply with Part 6 newly constructed multifamily buildings must meet the requirements of:

a. Mandatory measures: The applicable provisions of Sections 110.0 through 110.10, and 160.0; and through 160.7

b. Either:

(i) Performance approach: Section 170.1(a) and (b); or

(ii) Prescriptive approach: Section 170.1(a) and (c).

~~D~~E. ~~**Low-rise residential**~~ **Single family buildings.**

i. Sections applicable. Sections 150.0 through 150.1 apply to newly constructed low-rise residential buildings.

ii. Compliance approaches. In order to comply with Part 6 newly constructed low-rise residential buildings must meet the requirements of:

a. Mandatory measures: The applicable provisions of Sections 110.0 through 110.10, and 150.0; and

b. Either:

(i) Performance approach: Section 150.1(a) and (b); or

(ii) Prescriptive approach: Section 150.1(a) and (c).

EXCEPTION to Section 100.0(e)2Diib: Seasonally occupied agricultural housing limited by state or federal agency contract to occupancy not more than 180 days in any calendar year.

~~E~~F. **Covered Processes.**

i. Sections applicable. Sections 110.2, 120.6 and 140.9 apply to covered processes.

ii. Compliance approaches. In order to comply with Part 6 covered processes must meet the requirements of:

a. The applicable mandatory measures in Section 120.6; and

b. Either:

(i) The Performance approach requirements of Section 140.1; or

(ii) The Prescriptive approach requirements of Section 140.9.

Note: If covered processes do not have prescriptive requirements, then only the applicable mandatory measures in Section 120.6 must be met.

3. **New construction in existing buildings (additions, alterations and repairs).**

A. **Nonresidential~~, high-rise residential,~~ and hotel/motel buildings.** Section 141.0 applies to new construction in existing nonresidential, high-rise residential, and hotel/motel buildings. New construction in existing buildings includes additions, alterations and repairs. Section 141.0 specifies requirements that uniquely apply to additions, alterations or repairs to existing buildings, and specify which requirements in other sections also apply. For alterations that change the occupancy classification of the building, the requirements specified in Section 141.0 apply to the occupancy after the alterations.

B. **Multifamily buildings**. Section 180 applies to new construction in existing multifamily buildings. New construction in existing buildings includes additions, alterations and repairs. Section 180 specifies requirements that uniquely apply to additions, alterations or repairs to existing buildings, and specifies which requirements in other sections also apply. For alterations that change the occupancy classification of the building, the requirements specified in Section 180 apply to the occupancy after the alterations.

~~B~~C. ~~**Low-rise residential**~~ **Single family buildings.** Section 150.2 applies to new construction in existing low-rise residential buildings. New construction in existing buildings includes additions, alterations and repairs. Section 150.2 specifies requirements that uniquely apply to additions, alterations or repairs to existing buildings, and specify which requirements in other sections also apply. For alterations that change the occupancy classification of the building, the requirements specified in Section 150.2 apply to the occupancy after the alterations.

4. **Installation of insulation in existing buildings.** Section 110.8(d) applies to buildings in which insulation is being installed in existing attics, or on existing water heaters, or existing space conditioning ducts.

5. **Outdoor Lighting.** Sections 110.9, 130.0, 130.2, 130.4, 140.7, and 150.0 apply to newly constructed outdoor lighting systems, and Section 141.0 applies to outdoor lighting that is either added or altered.

6. **Signs.** Sections 130.0, 130.3 and 140.8 apply to newly constructed signs located either indoors or outdoors and Section 141.0 applies to sign alterations located either indoors or outdoors.

(f) **Mixed Occupancy.** When a building is designed and constructed for more than one type of occupancy (~~residential~~ multifamily and nonresidential), the space for each occupancy shall meet the provisions of Part 6 applicable to that occupancy.

EXCEPTION 1 to Section 100.0(f): If one occupancy constitutes at least 80 percent of the conditioned floor area of the building, the entire building envelope, HVAC, and water heating may be designed to comply with the provisions of Part 6 applicable to that occupancy, provided that the applicable lighting requirements in Sections 140.6 through 140.8 or 150.0(k) are met for each occupancy and space and mandatory measures in Sections 110.0 through 130.5, and 150.0 are met for each occupancy and space.

~~**EXCEPTION 2 to Section 100.0(f)**: If one occupancy constitutes at least 90 percent of the combined conditioned plus unconditioned floor area of the building, the entire building indoor lighting may be designed to comply with only the lighting provisions of Part 6 applicable to that occupancy.~~

(g) **Administrative Requirements.** Administrative requirements relating to permit requirements, enforcement by the Commission, locally adopted energy standards, interpretations, claims of exemption, approved calculation methods, rights of appeal, and certification and labeling requirements of fenestration products and roofing products are specified in California Code of Regulations, Title 24, Part 1, Sections 10-101 to 10-114.

(h) **Certification Requirements for Manufactured Equipment, Products, and Devices.** Part 6 limits the installation of manufactured equipment, products, and devices to those that have been certified as specified by sections 110.0 and 110.1. Requirements for manufactured equipment, products, and devices, when not specified in Title 24 Part 6, are specified in California Code of Regulations, Title 20, Sections 160.1 to 160.9.

TABLE 100.0-A APPLICATION OF STANDARDS

<table>
<tr><th>Occupancies</th><th>Application</th><th>Mandatory</th><th>Prescriptive</th><th>Performance</th><th>Additions/Alterations</th></tr>
<tr><td colspan="2">General Provisions for All Buildings</td><td colspan="4">100.0, 100.1, 100.2, 110.0</td></tr>
<tr><td rowspan="8">Nonresidential, ~~High-Rise Residential,~~ And Hotels/Motels</td><td>General</td><td>120.0</td><td>140.0, 140.2</td><td rowspan="7">140.0, 140.1</td><td rowspan="8">141.0</td></tr>
<tr><td>Envelope (conditioned)</td><td>110.6, 110.7, 110.8,120.7</td><td>140.3</td></tr>
<tr><td>Envelope (unconditioned process spaces)</td><td>N.A.</td><td>140.3(c)</td></tr>
<tr><td>HVAC (conditioned)</td><td>110.2, 110.5, 120.1, 120.2, 120.3, 120.4, 120.5, 120.8</td><td>140.4</td></tr>
<tr><td>Water Heating</td><td>110.3, 120.3, 120.8, 120.9</td><td>140.5</td></tr>
<tr><td>Indoor Lighting (conditioned, process spaces)</td><td>110.9, 120.8, 130.0, 130.1, 130.4</td><td>140.3(c), 140.6</td></tr>
<tr><td>Indoor Lighting (unconditioned and parking garages)</td><td>110.9, 120.8, 130.0, 130.1, 130.4</td><td>140.3(c), 140.6</td><td>N.A.</td></tr>
</table>

Occupancies	Application	Mandatory	Prescriptive	Performance	Additions/Alterations
	Outdoor Lighting	110.9, 130.0, 130.2, 130.4	140.7		
	Electrical Power Distribution	110.11, 130.5	N.A.		
	Pool and Spa Systems	110.4, 110.5, 150.0(p)	N. A.		141.0
	Solar Ready Buildings	110.10	N.A.		141.0(a)
Covered Processes[1]	Envelope, Ventilation, Process Loads	110.2, 120.6	140.9	140.1	120.6, 140.9, 141.1
Signs	Indoor and Outdoor	110.9, 130.0, 130.3	140.8	N.A.	141.0, 141.0(b)2H
Multifamily	General	160.0	170.2	170.1	180.1(a,b), 180.2(a,b)
	Envelope (conditioned)	110.6, 110.7, 110.8, 160.1	170.2(a)		
	HVAC (conditioned)	110.2, 110.5, 160.2, 160.3	170.2(b)		
	Water Heating	110.3, 160.4	170.2(d)		
	Indoor Lighting (conditioned, unconditioned and parking garages)	110.9, 160.5	170.2(e)		
	Outdoor Lighting			N.A.	
	Electric Power Distributions	160.6	N.A.		
	Pool and Spa Systems	110.4, 160.7	N. A.		
	Solar Ready Buildings	110.10	N. A.		N.A.
~~Low-Rise Residential~~ Single family	General	150.0	150.1(a, c)	150.1(a), 150.1(b)	150.2(a), 150.2(b)
	Envelope (conditioned)	110.6, 110.7, 110.8, 150(a), 150.0(b), 150.0(c), 150.0(d), 150.0(e), 150.0(g), 150.0(q)			
	HVAC (conditioned)	110.2, 110.5, 150.0(h), 150.0(i), 150.0(j), 150.0(m), 150.0(o)			
	Water Heating	110.3, 150.0(j, n)			

Occupancies	Application	Mandatory	Prescriptive	Performance	Additions/Alterations
	Indoor Lighting (conditioned, unconditioned and parking garages)	110.9, 130.0, 150.0(k)			
	Outdoor Lighting	110.9, 130.0,150.0(k)			
	Pool and Spa Systems	110.4, 150.0(p)	N. A.	N.A.	150.2(a), 150.2(b)
	Solar Ready Buildings	110.10	N. A.	N.A.	N.A.
[1] Nonresidential~~, high-rise~~ and hotel/motel buildings that contain covered processes may conform to the applicable requirements of both occupancy types listed in this table.					

NOTE: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, Public Resources Code. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, and 25943, Public Resources Code

SECTION 100.1 – DEFINITIONS AND RULES OF CONSTRUCTION

COMMON USE AREA is a private use area, interior or exterior, within a multifamily residential facility where use is limited exclusively to owners, residents and their guests.

MULTIFAMILY BUILDING is a building, other than a hotel/motel, of Occupancy Group R-2 or R-4.

~~**HIGH-RISE RESIDENTIAL BUILDING** is a building, other than a hotel/motel, of Occupancy Group R-2 or R-4 with four or more habitable stories.~~

~~**LOW-RISE RESIDENTIAL**~~ **SINGLE FAMILY** **BUILDING** is a building, other than a hotel/motel, that is Occupancy Group:

~~R-2, multifamily, with three habitable stories or less; or~~

R-3, single family; or

U-building, located on a residential site.

Proposed Multifamily Chapters

Please see Appendix A for draft multifamily chapter language.

Reference Appendices

The Statewide CASE Team does not propose changes to the Reference Appendices associated with the creation of multifamily chapters. Should the proposed extension of individual submeasures from low-rise or high-rise residential buildings to all multifamily buildings warrant an adjustment to the Reference Appendices, proposed changes will be included in the Multifamily Restructuring CASE Report. None are noted at the time of this publication.

Appendix A

SUBCHAPTER 10
MULTIFAMILY BUILDINGS—MANDATORY REQUIREMENTS

SECTION 160.0 – GENERAL

Multifamily buildings shall comply with the applicable requirements of Sections 160.1 through 160.8. Sections 160.1 through 160.8 apply to attached dwelling units and common use areas in multifamily buildings. Nonresidential occupancies in mixed occupancy buildings shall comply with nonresidential requirements in Sections 120, 130 , 140 and 141.

NOTE: The requirements of Sections 160.1 through 160.8 apply to newly constructed buildings. Sections 180.1 through 180.4 specify which requirements of Sections 160.1 through 160.8 apply to additions or alterations.

SECTION 160.1 – MANDATORY REQUIREMENTS FOR BUILDING ENVELOPES

(a) **Ceiling and ~~Rafter~~ Roof Insulation.** The opaque portions of ceilings and roofs separating conditioned spaces from unconditioned spaces or ambient air shall have insulation installed in direct contact with the continuous roof or ceiling which is sealed to limit infiltration and exfiltration as specified in Section 110.7, including but not limited to placing insulation either above or below the roof deck or on top of the finished ceiling. Insulation shall meet the requirements of Item~~s~~ 1 ~~through 3~~ or 2 below:

1. **Attic Roof**. Shall meet the requirements of Items A through C below:

   A. Shall be insulated to achieve a weighted average U-factor not exceeding U-0.043 or shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-22 or greater for the insulation alone. For vented attics, the mandatory insulation shall be installed at the ceiling level; for unvented attics, the mandatory insulation shall be placed at either ceiling or roof level; and

   B. Attic access doors shall have permanently attached insulation using adhesive or mechanical fasteners. The attic access shall be gasketed to prevent air leakage; and

   C. When loose-fill insulation is installed, the minimum installed weight per square foot shall conform with the insulation manufacturer's installed design weight per square foot at the manufacturer's labeled R-value.

2. **Non Attic Roof**. All roofs other than attic roofs shall meet the applicable requirements of items A through D below:

   A. **Metal Building**- The weighted average U-factor of the roof assembly shall not exceed 0.098.

   B. **Wood Framed and Others**- The weighted average U-factor of the roof assembly shall not exceed 0.075.

   C. **Insulation Placement**- When insulation is installed at the roof~~in nonresidential buildings,~~ fixed vents or openings to the outdoors or to unconditioned spaces shall not be installed. When the space between the ceiling and the roof is either directly or indirectly conditioned space, it shall not be considered an attic for the purposes of complying with CBC attic ventilation requirements.

   ~~D. Insulation placed on top of a suspended ceiling with removable ceiling panels shall not be used to meet the Roof/Ceiling requirement of Sections 140.3 and 141.0.~~

   NOTE: Vents that do not penetrate the roof deck and are instead designed for wind resistance for roof membranes are not within the scope of Section ~~120.7(a)3B~~ 160.0(a)1C.

(b) **Wall Insulation.** Opaque portions of above grade walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the following applicable requirements:

1. **Metal Building-** The weighted average U-factor of the wall assembly shall not exceed 0.113.

2. **Metal Framed**- The weighted average U-factor of the wall assembly shall not exceed 0.151.

3. **Wood Framed and Others-**

   A. Nominal 2x4 inch framing shall have a weighted average U-factor of the wall assembly not exceeding 0.102.

   B. Nominal 2x6 inch framing shall have a weighted average U-factor of the wall assembly not exceeding 0.071.

   C. Other wall assemblies shall have a weighted average U-factor of the wall assembly not exceeding 0.102.

4. **Light Mass Walls-** A 6 inch or greater Hollow Core Concrete Masonry Unit shall have a U-factor not to exceed 0.440.

5. **Heavy Mass Walls-** An 8 inch or greater Hollow Core Concrete Masonry Unit shall have a U-factor not to exceed 0.690.

6. **Spandrel Panels and Curtain Wall**- The weighted average U-factor of the spandrel panels and curtain wall assembly shall not exceed 0.280.

7. **Demising Walls-**. The opaque portions of framed demising walls shall meet the requirements of Item A or B below:

   A. Wood framed walls shall be insulated to meet a U-factor not greater than 0.099.

   B. Metal Framed walls shall be insulated to meet a U-factor not greater than 0.151.

8. **Bay or Bow Window roofs and floors**. Shall be insulated to meet the wall insulation requirements of TABLE ~~150.1-A or B~~170.2-A.

(c) **Floor and Soffit Insulation.** The opaque portions of floors and soffits that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 3 below:

1. **Raised Mass Floors** - Shall have a minimum of 3 inches of lightweight concrete over a metal deck or the weighted average U-factor of the floor assembly shall not exceed 0.269.
2. **Raised Wood Floor** - shall have an overall assembly U-factor not exceeding U-0.037. In a wood framed assembly, compliance with the U-factor may be demonstrated by installing insulation with an R-value of 19 or greater.
3. **Other Floors** -The weighted average U-factor of the floor assembly shall not exceed 0.071.
4. **Heated Slab On Grade Floor**-A heated slab on grade floor shall be insulated to meet the requirements of Section 110.8(g)

EXCEPTION to Section ~~150.0(d)~~ 160.0(c): A building with a controlled ventilation or unvented crawlspace may omit raised floor insulation if all of the following are met:

A. The foundation walls are insulated to meet the wall insulation minimums as shown in TABLE ~~150.1-A or B~~ 170.2-A; and

B. A Class I or Class II vapor retarder is placed over the entire floor of the crawlspace; and

C. Vents between the crawlspace and outside air are fitted with automatically operated louvers that are temperature actuated; and

D. The requirements in Reference Residential Appendix RA4.5.1.

(d) **Vapor Retarder.**

1. In Climate Zones 1-16, the earth floor of unvented crawl space shall be covered with a Class I or Class II vapor retarder. This requirement shall also apply to controlled ventilation crawl space for buildings complying with the Exception to **Section ~~150.0(d)~~ 160.0(c).**
2. In Climate Zones 14 and 16, a Class I or Class II vapor retarder shall be installed on the conditioned space side of all insulation in all exterior walls, vented attics and unvented attics with air-permeable insulation.

(e) **Fenestration Products.** Fenestration separating conditioned space from unconditioned space or outdoors shall meet the requirements of either Item 1 or 2 below:

1. Fenestration, including skylight products, must have a maximum U-factor of 0.58.
2. The weighted average U-factor of all fenestration, including skylight products, shall not exceed 0.58.

EXCEPTION 1 to Section ~~150.0(q)1~~ 160.1(e)1: Up to 10 square feet of fenestration area or 0.5 percent of the Conditioned Floor Area, whichever is greater, is exempt from the maximum U-factor requirement.

EXCEPTION 2 to Section ~~150.0(q)1~~ 160.1(e)1: For dual-glazed greenhouse or garden windows, up to 30 square feet of fenestration area is exempt from the maximum U-factor requirement.

(f) **Installation of Fireplaces, Decorative Gas Appliances and Gas Logs.** If a masonry or factory-built fireplace is installed, it shall comply with Section 110.5, Section 4.503 of Part 11, and shall have the following:

1. Closeable metal or glass doors covering the entire opening of the firebox; and
2. A combustion air intake to draw air from the outside of the building, which is at least 6 square inches in area and is equipped with a readily accessible, operable, and tight-fitting damper or combustion-air control device; and

EXCEPTION to Section ~~150.0(e)1B~~ 160.0(f)2: An outside combustion-air intake is not required if the fireplace will be installed over concrete slab flooring and the fireplace will not be located on an exterior wall.

3. A flue damper with a readily accessible control.

EXCEPTION to Section ~~150.0(e)1C~~ 160.0(f)3: When a gas log, log lighter, or decorative gas appliance is installed in a fireplace, the flue damper shall be blocked open if required by the CMC or the manufacturer's installation instructions.

SECTION 160.2 – MANDATORY REQUIREMENTS FOR VENTILATION AND INDOOR AIR QUALITY

(a) **General Requirements.**

1. Attached dwellings units shall comply with the requirements of subsection 160.2(b) below. Occupiable spaces other than attached dwelling units shall comply with the requirements of section 160.2(c).

2. The required outdoor air-ventilation rate and the air-distribution system design shall be clearly identified on the plans in accordance with Section 10-103 of Title 24, Part 1.

(b) **Dwelling Units.** Attached dwellings units shall comply with the requirements of subsections 1 and 2 below.

1. **Air Filtration.**

A. System types specified in subsections i, ii, and iii shall be provided with air filters in accordance with Sections ~~150.0(m)12B, 150.0(m)12C, and 150.0(m)12D~~160.2(b)1B, 160.2(b)1C, and 160.2(b)1D. System types specified in subsection i shall also comply with Section ~~150.0(m)12E~~160.2(b)1E.

i. Mechanical space conditioning systems that supply air to an occupiable space through ductwork exceeding 10 ft (3 m) in length.

ii. Mechanical supply-only ventilation systems that provide outside air to an occupiable space.

iii. The supply side of mechanical balanced ventilation systems, including heat recovery ventilation systems, and energy recovery ventilation systems that provide outside air to an occupiable space.

EXCEPTION 1 to ~~Section 150.0(m)12~~160.2(b)1A: Evaporative coolers are exempt from the air filtration requirements in Section ~~150.0(m)12~~160.2(b)1.

B. **System Design and Installation.**

i. The system shall be designed to ensure that all recirculated air or outdoor air supplied to the occupiable space is filtered before passing through any system thermal conditioning components.

EXCEPTION ~~1~~ to ~~Section 150.0(m)12~~160.2(b)1Bi: For heat recovery ventilators and energy recovery ventilators the location of the filters required by Section ~~150.0(m)12~~160.2(a)1 may be downstream of a system thermal conditioning component, provided the system is equipped with ancillary filtration upstream of the system's thermal conditioning component.

ii. All systems shall be designed to accommodate the clean-filter pressure drop imposed by the system air filter(s). The design airflow rate, and maximum allowable clean-filter pressure drop at the design airflow rate applicable to each air filter shall be determined and reported on labels according to subsection iv below.

Systems specified in Section ~~150.0(m)12~~160.2(b)1Ai shall be equipped with air filters that meet either subsection a or b below

a. Nominal two-inch minimum depth filter(s) shall be sized by the system designer, or

b. Nominal one-inch minimum depth filter(s) shall be allowed if the filter(s) are sized according to Equation ~~150.0~~160.2-A, based on a maximum face velocity of 150 ft per minute, and according to the maximum allowable clean-filter pressure drop specified in Section ~~150.0(m)12~~160.2(b)1Dii.

$A_{face} = Q_{filter} / V_{face}$ (Equation ~~150.0~~160.2-A)

where

A_{face} = air filter face area, the product of air filter nominal length x nominal width, ft^2

Q_{filter} = design airflow rate for the air filter, ft^3/min

V_{face} = air filter face velocity ≤ 150, ft/min

iii. All system air filters shall be located and installed in such a manner as to be accessible for regular service by the system owner.

iv. All system air filter installation locations shall be labeled to disclose the applicable design airflow rate and the maximum allowable clean-filter pressure drop. The labels shall be permanently affixed to the air filter installation location, readily legible, and visible to a person replacing the air filter.

C. **Air Filter Efficiency**. The system shall be provided with air filter(s) having a designated efficiency equal to or greater than MERV 13 when tested in accordance with ASHRAE Standard 52.2, or a particle size efficiency rating equal to or greater than 50 percent in the 0.30-1.0 µm range, and equal to or greater than 85 percent in the 1.0-3.0 µm range when tested in accordance with AHRI Standard 680.

D. **Air Filter Pressure Drop**. All systems shall be provided with air filter(s) that conform to the applicable maximum allowable clean-filter pressure drop specified in subsections i, ii, iii, or iv below, when tested using ASHRAE Standard 52.2, or as rated using AHRI Standard 680, for the applicable design airflow rate(s) for the system air filter(s).

i. The maximum allowable clean-filter pressure drop determined by the system design for the nominal two-inch minimum depth air filter required by Section ~~150.0(m)12~~160.2(b)1Biia, or

ii. A maximum of 25 PA (0.1 inches water) clean-filter pressure drop shall be allowed for a nominal one-inch depth air filter sized according to Section ~~150.0(m)12~~160.2(b)1Biib, or

iii. For systems specified in ~~150.0(m)12~~160.2(b)1Aii, and ~~150.0(m)12~~160.2(b)1Aiii, the maximum allowable clean filter pressure drop determined by the system design.

iv. If EXCEPTION 1 to **Section** ~~150.0(m)13B~~160.3(b)5Lii or ~~D~~ii is utilized for compliance with cooling system airflow rate and fan efficacy requirements, the clean-filter pressure drop for the system air filter shall conform to the requirements given in TABLE ~~150.0 B~~160.3-A or ~~150.0 C~~160.3-B.

E. **Air Filter Product Labeling**. Systems described in ~~150.0(m)12~~160.2(b)1Ai shall be equipped with air filters that have been labeled by the manufacturer to disclose the efficiency and pressure drop ratings that demonstrate conformance with Sections ~~150.0(m)12~~160.2(b)1C and ~~150.0(m)12~~160.2(b)1D.

2. **Ventilation and Indoor Air Quality.** All dwelling units shall meet the requirements of ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Residential Buildings subject to the amendments specified in Section ~~150.0(o)1~~160.2(b)2A below. All dwelling units shall comply with Section ~~150.0(o)~~ 160.2(b)2B below.

A. Amendments to ASHRAE 62.2 Requirements.

i. Window operation is not a permissible method of providing the dwelling unit ventilation airflow specified in subsections ~~C, E, or F~~ iii, v, or vi below.

ii. Continuous operation of central forced air system air handlers used in central fan integrated ventilation systems is not a permissible method of providing the dwelling unit ventilation airflow required in Section 4 of ASHRAE Standard 62.2.

iii. ~~Single family detached dwelling units, and~~ Attached dwelling units not sharing ceilings or floors with other dwelling units or occupiable spaces, public garages, or commercial spaces shall have mechanical ventilation airflow provided at rates determined in accordance with ASHRAE 62.2 Sections 4.1.1 and 4.1.2 as specified in subsections ~~i, ii, and iii~~ a, b, and c below.

a. Total Required Ventilation Rate [ASHRAE 62.2:4.1.1]. The total required ventilation rate shall be calculated using Equation ~~150.0~~160.2-B

$$Q_{tot} = 0.03A_{floor} + 7.5(N_{br} + 1)$$ (Equation ~~150.0~~160.2-B)

where

Q_{tot} = *total required ventilation rate, cfm*

A_{floor} = *dwelling-unit floor area,* ft^2

N_{br} = *number of bedrooms (not to be less than 1)*

b. Effective Annual Average Infiltration Rate. The effective annual average infiltration rate shall be determined in accordance with subsections a and b:

I. An enclosure leakage rate in cubic feet per minute at 50 Pa (0.2 inch water) (Q_{50}) shall be determined by either subsection 1, or subsection 2 below.

A. Q_{50} shall be calculated based on the conditioned volume of the dwelling unit and a default value for dwelling unit envelope leakage of 2 air changes per hour at 50 PA (0.2 inch water) (2 ACH50) as specified by Equation ~~150.0~~160.2-C below.

$Q_{50} = V_{du}$ x 2 ACH_{50} / 60 min (Equation ~~150.0~~160.2-C)

where

Q_{50} = leakage rate at 50 Pa

V_{du} = dwelling unit conditioned volume, ft^3

ACH_{50} = air changes per hour at 50 Pa (0.2 inch water)

B. If dwelling unit envelope leakage less than 2 ACH_{50} is confirmed by field verification and diagnostic testing, Q_{50} shall be calculated according to Equation ~~150.0~~160.2-D below, using the value for dwelling unit envelope leakage less than 2 ACH_{50} verified by the procedures specified in Reference Residential Appendix RA3.8.

$Q_{50} = V_{du}$ x *Verified* ACH_{50} / 60 min (Equation ~~150.0~~160.2-D)

where

Q_{50} = leakage rate at 50 Pa

V_{du} = dwelling unit conditioned volume, ft^3

ACH_{50} = air changes per hour at 50 Pa (0.2 inch water)

II. The Effective Annual Average Infiltration Rate (Q_{inf}) shall be calculated using Equation ~~150.0~~160.2-E [ASHRAE 62.2:4.1.2.1].

$Qinf = 0.052 \times Q_{50} \times wsf \times [H/Hr]z$ (Equation ~~150.0~~160.2-E)

where

Qinf = effective annual infiltration rate, cfm (L/s)

Q_{50} = leakage rate at 50 Pa from equation ~~150.0~~160.2-C, or equation ~~150.0~~160.2-D

wsf = weather and shielding factor from Table ~~150.0-D~~ 160.2-A

H = vertical distance between the lowest and highest above-grade points within the pressure boundary, ft (m)

Hr = reference height, 8.2 ft (2.5 m)

z = 0.4 for the purpose of calculating the Effective Annual Average Infiltration Rate

c. Required Mechanical Ventilation Rate [ASHRAE 62.2:4.1.2]

The Required Mechanical Ventilation Rate (Qfan) shall be calculated using Equation ~~150.0~~160.2-F

$Q_{fan} = Q_{tot} - \Phi (Q_{inf} \times A_{ext})$ (Equation ~~150.0~~160.2-F)

where

Q_{fan} = required mechanical ventilation rate, cfm (L/s)

Q_{tot} = total required ventilation rate, cfm (L/s) from Equation ~~150.0~~160.2-B.

Q_{inf} = effective annual average infiltration rate, cfm (L/s) from Equation ~~150.0~~160.2-E

A_{ext} = ~~1 for single-family detached homes, or~~ the ratio of exterior envelope surface area that is not attached to garages or other dwelling units to total envelope surface area for attached dwelling

units not sharing ceilings or floors with other dwelling units, occupiable spaces, public garages, or commercial spaces.

Φ=1 for balanced ventilation systems and Q_{inf}/Q_{tot} otherwise

iv. Air filtration shall conform to the specifications in Section ~~150.0(m)12~~160.2(b)1. Compliance with ASHRAE 62.2 Sections 6.7 (Minimum Filtration) and 6.7.1 (Filter Pressure Drop) shall not be required.

v. Multifamily attached dwelling units shall have mechanical ventilation airflow provided at rates in accordance with Equation ~~150.0~~160.2-B [ASHRAE 62.2:4.1.1] and comply with one of the following subsections ~~i or ii~~ a or b below. When subsection ~~ii~~ b below is utilized for compliance, all dwelling units in the multifamily building shall use the same ventilation system type.

a. A balanced ventilation system shall provide the required dwelling-unit ventilation airflow, or

b. Continuously operating supply ventilation systems, or continuously operating exhaust ventilation systems shall be allowed to be used to provide the required dwelling unit ventilation airflow if the dwelling-unit envelope leakage is less than or equal to 0.3 cubic feet per minute at 50 Pa (0.2 inch water) per ft^2 of dwelling unit envelope surface area as confirmed by field verification and diagnostic testing in accordance with the procedures specified in Reference Residential Appendix RA3.8.

vi. Multifamily building central ventilation systems that serve multiple dwelling units shall be balanced to provide ventilation airflow for each dwelling unit served at a rate equal to or greater than the rate specified by Equation ~~150.0~~160.2-B [ASHRAE 62.2:4.1.1], but no more than twenty percent greater than the specified rate. These systems shall utilize balancing means to ensure the dwelling-unit airflows can be adjusted to meet this balancing requirement. These system balancing means may include but not be limited to constant air regulation devices, orifice plates, and variable speed central fans.

vii. Kitchen range hoods shall be rated for sound in accordance with Section 7.2 of ASHRAE 62.2.

EXCEPTION to Section ~~150.0(o)1C~~160.2(b)2Avii: Kitchen range hoods may be rated for sound at a static pressure determined at working speed as specified in HVI 916 section 7.2.

viii. Compliance with ASHRAE 62.2 Section 6.5.2 (Space Conditioning System Ducts) shall not be required.

ix. **Compliance with ASHRAE 62.2 4.4 (Control and Operation).** Compliance with ASHRAE 62.2 Section 4.4 (Control and Operation) shall require manual switches associated with dwelling unit ventilation systems to have a label clearly displaying the following text, or equivalent text: "This switch controls the indoor air quality ventilation for the home. Leave it on unless the outdoor air quality is very poor."

B. **Field Verification and Diagnostic Testing**.

i. **Airflow Performance**. The dwelling unit ventilation airflow required by Sections ~~150.0(o)1C~~160.2(b)2Aiii, ~~150.0(o)1E~~160.2(b)2Av, and ~~150.0(o)1F~~160.2(b)2Avi shall be confirmed through field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.7 or Reference Nonresidential Appendix NA7.18.1.

ii. **Kitchen Range Hoods**. The installed kitchen range hood shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.7.4.3 to confirm the model is rated by HVI to comply with the following requirements:

a. The minimum ventilation airflow rate as specified in Section 5 of ASHRAE 62.2.

b. The maximum sound rating as specified in ~~150.0(o)1C~~160.2(b)2Avii.

(c) **Common Use Areas.** All occupiable spaces shall meet the requirements of subsection 1 and either 2 or 3:

1. **Air Filtration**

A. Mechanical system types described in ~~Section 120.1(b)1A~~ subsections i, ii, and iii shall be provided with air filters to clean the outside and return air prior to its introduction into occupied spaces.

i. Mechanical space conditioning systems that supply air to an occupiable space through ductwork exceeding 10 ft (3 m) in length.

ii. Mechanical supply-only ventilation systems that provide outside air to an occupiable space.

iii. The supply side of mechanical balanced ventilation systems, including heat recovery ventilation systems, and energy recovery ventilation systems that provide outside air to an occupiable space.

B. Air Filter Efficiency. The filters shall have a designated efficiency equal to or greater than MERV 13 when tested in accordance with ASHRAE Standard 52.2, or a particle size efficiency rating equal to or greater than 50 percent in the 0.30-1.0 µm range, and equal to or greater than 85 percent in the 1.0-3.0 µm range when tested in accordance with AHRI Standard 680; and

C. Systems shall be equipped with air filters that meet either subsection i or ii below.

i. Nominal two inch minimum depth filter(s); or

ii. Nominal one inch minimum depth filter(s) shall be allowed if the filter(s) are sized according to Equation ~~120.1~~160.2-A, based on a maximum face velocity of 150 ft per minute.

2. **Natural Ventilation.** Naturally ventilated spaces shall be designed in accordance with ~~120.1(c)~~160.2(c)2A through ~~120.1(c)~~160.2(c)2C and include a mechanical ventilation system designed in accordance with ~~120.1(c)~~160.2(c)3:

EXCEPTION 1 to ~~120.1(c)~~ 160.2(c)2: The mechanical ventilation system shall not be required where natural ventilation openings complying with ~~120.1(c)~~160.2(c)2 are either permanently open or have controls that prevent the openings from being closed during periods of expected occupancy.

EXCEPTION 2 to Section ~~120.1(c)~~ 160.2(c)2: The mechanical ventilation system shall not be required where the zone is not served by a space conditioning system.

A. Floor area to be ventilated. Spaces or portions of spaces to be naturally ventilated shall be located within a distance based on the ceiling height, as specified in i, ii and iii. The ceiling height (H) to be used in i, ii or iii shall be the minimum ceiling height in the space, or for ceilings that are increasing in height as distance from the operable openings is increased, the ceiling height shall be determined as the average height of the ceiling within 20 ft from the operable opening. [ASHRAE 62.1:6.4.1]

i. Single Side Opening. For spaces with operable opening on one side of the space, the maximum distance from the operable opening shall be not more than 2H. [ASHRAE 62.1:6.4.1.1]

ii. Double Side Opening. For spaces with operable openings on two opposite sides of the space, the maximum distance from the operable opening shall be not more than 5H. [ASHRAE 62.1:6.4.1.2]

iii. Corner Opening. For spaces with operable openings on two adjacent sides of a space, the maximum distance from the operable openings shall be not more than 5H along a line drawn between the two openings that are the farthest apart. Floor area outside that line shall comply with i or ii. [ASHRAE 62.1:6.4.1.3]

iv. Ceiling Height. The ceiling height (h) to be used in Section ~~120.1~~160.2(c)2Ai through ~~120.1~~160.2 (c)2Aiii shall be the minimum ceiling height in the space.

EXCEPTION to Section ~~120.1~~160.2(c)2Aiv: For ceilings that are increasing in height as distance from the opening is increased, the ceiling height shall be determined as the average height of the ceiling within 20 feet from the operable openings. [ASHRAE 62.1:6.4.1.4]

B. Location and Size of Openings. Spaces or portions of spaces to be naturally ventilated shall be permanently open to operable wall openings directly to the outdoors. The openable area shall be not less than 4 percent of the net occupiable floor area. Where openings are covered with louvers or otherwise obstructed, the openable area shall be based on the net free unobstructed area through the opening. Where interior rooms, or portions of rooms, without direct openings to the outdoors are ventilated through adjoining rooms, the opening between rooms shall be permanently unobstructed and have a free area of not less than 8 percent of the area of the interior room or less than 25 square feet. [ASHRAE 62.1:6.4.2]

C. Control and Accessibility. The means to open the required operable opening shall be readily accessible to building occupants whenever the space is occupied. Controls shall be designed to coordinate operation of the natural and mechanical ventilation systems. [ASHRAE 62.1:6.4.3]

3. **Mechanical Ventilation.** Occupiable spaces shall be ventilated with a mechanical ventilation system capable of providing an outdoor airflow rate (V_z) to the zone no less than the larger of A or B as described below:

A. The outdoor airflow rate to the zone (V_z) shall be determined in accordance with Equation ~~120.1-F~~160.2-G; or

$V_z = R_a \times A_z$ (Equation ~~120.1-F~~160.2-G)

Where:

R_a = Outdoor airflow rate required per unit area as determined from Table ~~120.1~~160.2-B.

A_z = Zone floor area is the net occupiable floor area of the ventilation zone in square feet.

B. For spaces designed for an expected number of occupants ~~or spaces with fixed seating~~, the outdoor airflow rate to the zone (V_z) shall be determined in accordance with Equation ~~120.1-G~~160.2-H;

$V_z = R_p \times P_z$ (Equation ~~120.1-G~~160.2-H)

Where:

R_p = 15 cubic feet per minute of outdoor airflow per person

P_z = The expected number of occupants. The expected number of occupants shall be the expected number specified by the building designer. For spaces with fixed seating, the expected number of occupants shall be determined in accordance with the California Building Code.

EXCEPTION to Section ~~120.1(c)3~~160.2(c)3: Transfer air. The rate of outdoor air required by Section ~~120.1(c)3~~160.2(c)3 may be provided with air transferred from other ventilated space if:

i. Use of transfer air is in accordance with Section ~~120.1(g)~~160.2(c)8; and

ii. The outdoor air that is supplied to all spaces combined, is sufficient to meet the requirements of Section ~~120.1~~160.2(c)3 for each space individually.

4. **Exhaust Ventilation.** The design exhaust airflow shall be determined in accordance with the requirements in Table ~~120.1-B~~160.2-C. Exhaust makeup air shall be permitted to be any combination of outdoor air, recirculated air, or transfer air. [ASHRAE 62.1:6.5.1]

5. **Operation and Control Requirements for Minimum Quantities of Outdoor Air**.

A. **Times of occupancy.** The minimum rate of outdoor air required by Section ~~120.1~~160.2(c) shall be supplied to each space at all times when the space is usually occupied.

EXCEPTION 1 to Section ~~120.1(d)1~~160.2(c)5A: Demand control ventilation. In intermittently occupied spaces that do not have processes or operations that generate dusts, fumes, mists, vapors or gasses and are not provided with local exhaust ventilation (such as indoor operation of internal combustion engines or areas designated for unvented food service preparation), the rate of outdoor air may be reduced if the ventilation system serving the space is controlled by a demand control ventilation device complying with Section ~~120.1(d)4~~160.2(c)5D or by an occupant sensor ventilation control device complying with Section ~~120.1(d)5~~160.2(c)5E.

EXCEPTION 2 to Section ~~120.1(d)1~~160.2(c)5A: Temporary reduction. The rate of outdoor air provided to a space may be reduced below the level required by Section ~~120.1~~160.2(c) for up to 30 minutes at a time if the average rate for each hour is equal to or greater than the required ventilation rate.

B. **Pre-occupancy.** The lesser of the minimum rate of outdoor air required by Section ~~120.1~~160.2(c) or three complete air changes shall be supplied to the entire building during the 1-hour period immediately before the building is normally occupied.

C. **Required Demand Control Ventilation.** Demand ventilation controls complying with ~~120.1(d)4~~160.2(c)5D are required for a space with a design occupant density, or a maximum occupant load factor for egress purposes in the CBC, greater than or equal to 25 people per 1000 square feet (40 square feet or less per person) if the system serving the space has one or more of the following:

i. an air economizer; or

ii. modulating outside air control; or

iii. design outdoor airflow rate > 3,000 cfm.

EXCEPTION 1 to Section ~~120.1(d)3~~160.2(c)5C: Where space exhaust is greater than the design ventilation rate specified in Section ~~120.1(c)3~~160.2(c)3 minus 0.2 cfm per ft² of conditioned area.

EXCEPTION 2 to Section ~~120.1(d)3~~160.2(c)5C: Spaces that have processes or operations that generate dusts, fumes, mists, vapors, or gases and are not provided with local exhaust ventilation, such as indoor operation of internal combustion engines or areas designated for unvented food service preparation, daycare sickrooms, science labs, barber shops or beauty and nail salons shall not install demand control ventilation.

EXCEPTION 3 to Section ~~120.1(d)3~~160.2(c)5C: Spaces with an area of less than 150 square feet, or a design occupancy of less than 10 people as specified by Section ~~120.1(e)3~~160.2(c)3.

D. Demand Control Ventilation Devices.

i. For each system with demand control ventilation (DCV), CO2 sensors shall be installed in each room that meets the criteria of Section ~~120.1(d)3~~160.2(c)5C with no less than one sensor per 10,000 ft² of floor space. When a zone or a space is served by more than one sensor, a signal from any sensor indicating that CO2 is near or at the setpoint within the zone or space shall trigger an increase in ventilation.

ii. CO2 sensors shall be located in the room between 3 ft and 6 ft above the floor or at the anticipated height of the occupants' heads.

iii. Demand ventilation controls shall maintain CO2 concentrations less than or equal to 600 ppm plus the outdoor air CO2 concentration in all rooms with CO2 sensors.

EXCEPTION to Section ~~120.1(d)4C~~ 160.2(c)5Diii: The outdoor air ventilation rate is not required to be larger than the design outdoor air ventilation rate required by Section ~~120.1(e)3~~160.2(c)3 regardless of CO_2 concentration.

iv. Outdoor air CO2 concentration shall be determined by one of the following:

a. CO_2 concentration shall be assumed to be 400 ppm without any direct measurement; or

b. CO_2 concentration shall be dynamically measured using a CO_2 sensor located within 4 ft of the outdoor air intake.

v. When the system is operating during hours of expected occupancy, the controls shall maintain system outdoor air ventilation rates no less than the rate listed in Table ~~120.1-A~~160.2-B for DCV, times the conditioned floor area for spaces with CO2 sensors, plus the rate required by Section ~~120.1(e)3~~160.2(c)3 for other spaces served by the system, or the exhaust air rate whichever is greater.

vi. CO2 sensors shall be certified by the manufacturer to be accurate within plus or minus 75 ppm at a 600 and 1000 ppm concentration when measured at sea level and 25°C, factory calibrated, and certified by the manufacturer to require calibration no more frequently than once every 5 years. Upon detection of sensor failure, the system shall provide a signal which resets to supply the minimum quantity of outside air to levels required by Section ~~120.1(e)3~~160.2(c)3 to the zone serviced by the sensor at all times that the zone is occupied.

vii. The CO2 sensor(s) reading for each zone shall be displayed continuously, and shall be recorded on systems with DDC to the zone level.

E. **Occupant Sensor Ventilation Control Devices.** When occupancy sensor ventilation devices are required by Section ~~120.2(e)3~~160.3(a)2Diii, occupant sensors shall be used to reduce the rate of outdoor air flow when occupants are not present in accordance with the following:

i. Occupant sensors shall meet the requirements in Section 110.9(b)4 and shall have suitable coverage and placement to detect occupants in the entire space ventilated. If occupant sensors controlling lighting are used for ventilation, the ventilation signal shall be independent of daylighting, manual lighting overrides or manual control of lighting. When a single zone damper or a single zone system serves multiple rooms, there shall be an occupancy sensor in each room and the zone is not considered vacant until all rooms in the zone are vacant.

ii. One hour prior to normal scheduled occupancy, the occupancy sensor ventilation control shall allow pre-occupancy purge as described in Section ~~120.1(d)2~~160.2(c)5B.

6. **Ducting for Zonal Heating and Cooling Units.** Where a return plenum is used to distribute outdoor air to a zonal heating or cooling unit which then supplies the air to a space in order to meet the requirements of Section ~~120.1(e)3~~160.2(c)3, the outdoor air shall be ducted to discharge either:

A. Within 5 feet of the unit; or

B. Within 15 feet of the unit, substantially toward the unit, and at a velocity not less than 500 feet per minute.

7. **Design and Control Requirements for Quantities of Outdoor Air**.

A. All mechanical ventilation and space-conditioning systems shall be designed with and have installed ductwork, dampers, and controls to allow outside air rates to be operated at ~~the larger of (1)~~ the minimum levels specified in Section ~~120.1(e)3~~160.2(c)3 ~~or~~ (2) the rate required for make-up of exhaust systems that are required for an exempt or covered process, for control of odors, or for the removal of contaminants within the space.

B. All variable air volume mechanical ventilation and space-conditioning systems shall include dynamic controls that maintain measured outside air ventilation rates within 10 percent of the required outside air ventilation rate at both full and reduced supply airflow conditions. Fixed minimum damper position is not considered to be dynamic and is not an allowed control strategy.

C. Measured outdoor air rates of constant volume mechanical ventilation and space-conditioning systems shall be within 10 percent of the required outside air rate.

8. **Air Classification and Recirculation Limitations.** Air classification and recirculation limitations of air shall be based on the air classification as listed in Table ~~120.1 A~~160.2-B or Table ~~120.1 C~~160.2-D, and in accordance with the requirements of ~~120.1(g)1~~160.2(c)8A through ~~4~~D.

A. Class 1 Air. Recirculation or transfer of Class 1 air to any space shall be permitted; [ASHRAE 62.1:5.16.3.1]

B. Class 2 Air. Recirculation or transfer of Class 2 air shall be permitted in accordance with ~~120.1(g)A~~ 160.2(c)8Bi through ~~120.1(g)E~~160.2(c)8Bv:

i. Recirculation of Class 2 air within the space of origin shall be permitted [ASHRAE 62.1:5.16.3.2.1]:

ii. Recirculation or transfer of Class 2 to other Class 2 or Class 3 spaces shall be permitted, provided that the other spaces are used for the same or similar purpose or task and involve the same or similar pollutant sources as the Class 2 space [ASHRAE 62.1:5.16.3.2.2]; or

iii. Transfer of Class 2 air to toilet rooms [ASHRAE 62.1:5.16.3.2.3]; or

iv. Recirculation or transfer of Class 2 air to Class 4 spaces [ASHRAE 62.1:5.16.3.2.4]; or

v. Class 2 air shall not be recirculated or transferred to Class 1 spaces. [ASHRAE 62.1:5.16.3.2.5]

EXCEPTION to Section ~~120.1(g)2E~~160.2(c)8Bv: When using any energy recovery device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device is permitted. Recirculated Class 2 air shall not exceed 10% of the outdoor air intake flow.

C. Class 3 Air. Recirculation or transfer of Class 3 air shall be permitted in accordance with ~~120.1(g)A~~160.2(c)8Ci and ~~120.1(g)B~~160.2(c)8Cii:

i. Recirculation of Class 3 air within the space of origin shall be permitted. [ASHRAE 62.1:5.16.3.3.1]

ii. Class 3 air shall not be recirculated or transferred to any other space. [ASHRAE 62.1:5.16.3.3.2].

EXCEPTION to Section ~~120.1(g)3B~~160.2(c)8Cii: When using any energy recovery device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device is permitted. Recirculated Class 3 air shall not exceed 5% of the outdoor air intake flow.

D. Class 4 Air. Class 4 air shall not be recirculated or transferred to any space or recirculated within the space of origin. [ASHRAE 62.1:5.16.3.4]

E. Ancillary spaces. Redesignation of Class 1 air to Class 2 air shall be permitted for Class 1 spaces that are ancillary to Class2 spaces. [ASHRAE 62.1:5.16.2.3]

F. Transfer. A mixture of air that has been transferred through or returned form spaces or locations with different air classes shall be redesignated with the highest classification among the air classes mixed. [ASHRAE 62.1:5.16.2.2]

G. Classification. Air leaving each space or location shall be designated at an expected air-quality classification not less than that shown in Tables ~~120.1 A~~160.2-B, ~~120.1 B~~160.2 C or ~~120.1 C~~160.2-D. Air leaving spaces or locations that are not listed in Tables ~~120.1 A~~160.2-B, ~~120.1 B~~160.2 C or ~~120.1 C~~160.2-D shall be designated

with the same classification as air from the most similar space or location listed in terms of occupant activities and building construction.

(d) **Parking Garages.** Mechanical ventilation systems for enclosed parking garages in multifamily buildings shall comply with Section 120.6(c).

TABLE ~~150.0-D~~ 160.2-A: Infiltration Effectiveness Weather and Shielding Factors [ASHRAE 62.2:Table B1]

TMY3	wsf	Weather Station	Latitude	Longitude	State
690150	0.50	Twentynine Palms	34.30	–116.17	California
722860	0.43	March AFB	33.90	–117.25	California
722868	0.45	Palm Springs Intl	33.83	–116.50	California
722869	0.42	Riverside Muni	33.95	–117.45	California
722880	0.39	Burbank–Glendale–Pasadena AP	34.20	–118.35	California
722885	0.39	Santa Monica Muni	34.02	–118.45	California
722886	0.39	Van Nuys Airport	34.22	–118.48	California
722895	0.55	Lompoc (AWOS)	34.67	–120.47	California
722897	0.51	San Luis Co Rgnl	35.23	–120.63	California
722899	0.45	Chino Airport	33.97	–117.63	California
722900	0.38	San Diego Lindbergh Field	32.73	–117.17	California
722903	0.39	San Diego/Montgomery	32.82	–117.13	California
722904	0.40	Chula Vista Brown Field NAAS	32.58	–116.98	California
722906	0.39	San Diego North Island NAS	32.70	–117.20	California
722926	0.40	Camp Pendleton MCAS	33.30	–117.35	California
722927	0.38	Carlsbad/Palomar	33.13	–117.28	California
722930	0.39	San Diego Miramar NAS	32.87	–117.13	California
722950	0.42	Los Angeles Intl Arpt	33.93	–118.40	California
722956	0.38	Jack Northrop Fld H	33.92	–118.33	California
722970	0.38	Long Beach Daugherty Fld	33.83	–118.17	California
722976	0.34	Fullerton Municipal	33.87	–117.98	California
722977	0.36	Santa Ana John Wayne AP	33.68	–117.87	California
723805	0.51	Needles Airport	34.77	–114.62	California
723810	0.59	Edwards AFB	34.90	–117.87	California
723815	0.58	Daggett Barstow–Daggett AP	34.85	–116.80	California
723816	0.62	Lancaster Gen Wm Fox Field	34.73	–118.22	California
723820	0.57	Palmdale Airport	34.63	–118.08	California
723830	0.68	Sandberg	34.75	–118.72	California
723840	0.43	Bakersfield Meadows Field	35.43	–119.05	California
723890	0.45	Fresno Yosemite Intl AP	36.78	–119.72	California
723895	0.42	Porterville (AWOS)	36.03	–119.07	California
723896	0.43	Visalia Muni (AWOS)	36.32	–119.40	California
723910	0.45	Point Mugu Nf	34.12	–119.12	California
723925	0.44	Santa Barbara Municipal AP	34.43	–119.85	California
723926	0.43	Camarillo (AWOS)	34.22	–119.08	California
723927	0.45	Oxnard Airport	34.20	–119.20	California
723940	0.52	Santa Maria Public Arpt	34.92	–120.47	California

TABLE ~~150.0-D~~ 160.2-A: Infiltration Effectiveness Weather and Shielding Factors [ASHRAE 62.2:Table B1] (continued)

TMY3	wsf	Weather Station	Latitude	Longitude	State
723965	0.53	Paso Robles Municipal Arpt	35.67	–120.63	California
724800	0.55	Bishop Airport	37.37	–118.35	California
724815	0.46	Merced/Macready Fld	37.28	–120.52	California
724830	0.51	Sacramento Executive Arpt	38.50	–121.50	California
724837	0.45	Beale AFB	39.13	–121.43	California
724838	0.50	Yuba Co	39.10	–121.57	California
724839	0.51	Sacramento Metropolitan AP	38.70	–121.58	California
724915	0.49	Monterey Naf	36.60	–121.87	California
724917	0.54	Salinas Municipal AP	36.67	–121.60	California
724920	0.50	Stockton Metropolitan Arpt	37.90	–121.23	California
724926	0.47	Modesto City–County AP	37.63	–120.95	California
724927	0.53	Livermore Municipal	37.70	–121.82	California
724930	0.54	Oakland Metropolitan Arpt	37.72	–122.22	California
724935	0.47	Hayward Air Term	37.67	–122.12	California
724936	0.53	Concord–Buchanan Field	38.00	–122.05	California
724940	0.60	San Francisco Intl AP	37.62	–122.40	California
724945	0.48	San Jose Intl AP	37.37	–121.93	California
724955	0.55	Napa Co. Airport	38.22	–122.28	California
724957	0.49	Santa Rosa (AWOS)	38.52	–122.82	California
725845	0.44	Blue Canyon AP	39.30	–120.72	California
725846	0.66	Truckee–Tahoe	39.32	–120.13	California
725847	0.64	South Lake Tahoe	38.90	–120.00	California
725905	0.47	Ukiah Municipal AP	39.13	–123.20	California
725910	0.50	Red Bluff Municipal Arpt	40.15	–122.25	California
725920	0.47	Redding Municipal Arpt	40.52	–122.32	California
725945	0.56	Arcata Airport	40.98	–124.10	California
725946	0.60	Crescent City Faa Ai	41.78	–124.23	California
725955	0.55	Montague Siskiyou County AP	41.78	–122.47	California
725958	0.59	Alturas	41.50	–120.53	California
745090	0.45	Mountain View Moffett Fld NAS	37.40	–122.05	California
745160	0.67	Travis Field AFB	38.27	–121.93	California
746120	0.52	China Lake Naf	35.68	–117.68	California
747020	0.50	Lemoore Reeves NAS	36.33	–119.95	California
747185	0.46	Imperial	32.83	–115.58	California
747187	0.46	Palm Springs Thermal AP	33.63	–116.17	California
747188	0.48	Blythe Riverside Co Arpt	33.62	–114.72	California

TABLE ~~120.1-A~~ 160.2-B – Minimum Ventilation Rates for Multifamily Common Use Areas

Occupancy Category	Area Outdoor Air Rate[1] R_a cfm/ft^2	Min Air Rate for DC cfm/ft^2**V**^{2}	Air Class	Notes
~~Educational Facilities~~				
Daycare (through age 4)	0.21	0.15	2	
~~Daycare sickroom~~	~~0.15~~		~~3~~	
~~Classrooms (ages 5-8)~~	~~0.38~~	~~0.15~~	~~1~~	
~~Classrooms (age 9 -18)~~	~~0.38~~	~~0.15~~	~~1~~	
~~Lecture/postsecondary classroom~~	~~0.38~~	~~0.15~~	~~1~~	~~F~~
~~Lecture hall (fixed seats)~~	~~-~~	~~0.15~~	~~1~~	~~F~~
~~Art classroom~~	~~0.15~~		~~2~~	
~~Science laboratories~~	~~0.15~~		~~2~~	
~~University/college laboratories~~	~~0.15~~		~~2~~	
~~Wood/metal shop~~	~~0.15~~		~~2~~	
~~Computer lab~~	~~0.15~~		~~1~~	
~~Media center~~	~~0.15~~		~~1~~	~~A~~
~~Music/theater/dance~~	~~1.07~~	~~0.15~~	~~1~~	~~F~~
Multiuse assembly	0.50	0.15	1	F
~~Food and Beverage Service~~				
~~Restaurant d~~Dining rooms	0.50	0.15	2	
~~Cafeteria/fast-food dining~~	~~0.50~~	~~0.15~~	~~2~~	
Bars, cocktail lounges	0.50	0.20	2	
Kitchen (cooking)	0.15		2	
~~General~~				
Break rooms	0.50	0.15	1	F
Coffee stations	0.50	0.15	1	F
Conference/meeting	0.50	0.15	1	F
Corridors	0.15		1	F
Occupiable storage rooms for liquids or gels	0.15		2	B
~~Hotels, Motels, Resorts, Dormitories~~				
~~Bedroom/living room~~	~~0.15~~		~~1~~	~~F~~
~~Barracks sleeping areas~~	~~0.15~~		~~1~~	~~F~~
Laundry rooms, central	0.15		2	
~~Laundry rooms within dwelling units~~	~~0.15~~		~~1~~	
Lobbies/pre-function	0.50	0.15	1	F

~~Multipurpose assembly~~	~~0.50~~		~~1~~	~~F~~
~~Office Buildings~~				
Breakrooms	0.50	0.15	1	
~~Main entry lobbies~~	~~0.50~~	~~0.15~~	~~1~~	~~F~~
Occupiable storage rooms for dry materials	0.15		1	
Office space	0.15		1	F
Reception areas	0.15		1	F
Telephone/data entry	0.15		1	F
~~Miscellaneous Spaces~~				
~~Bank vaults/safe deposit~~	~~0.15~~		~~2~~	~~F~~
~~Banks or bank lobbies~~	~~0.15~~		~~1~~	~~F~~
Computer (not printing)	0.15		1	F
Freezer and refrigerated spaces (<50ºF)	-		2	E
~~General manufacturing (excludes heavy industrial and process using chemicals)~~	~~0.15~~		~~3~~	
~~Pharmacy (prep. Area)~~	~~0.15~~		~~2~~	
~~Photo studios~~	~~0.15~~		~~1~~	
Shipping/receiving	0.15		2	B
~~Sorting, packing, light assembly~~	~~0.15~~		~~2~~	
~~Telephone closets~~	~~0.15~~		~~1~~	
~~Transportation waiting~~	~~0.50~~	~~0.15~~	~~1~~	~~F~~
~~Warehouses~~	~~0.15~~		~~2~~	~~B~~
All others	0.15		2	
~~Public Assembly Spaces~~				
~~Auditorium seating area~~	~~1.07~~	~~0.15~~	~~1~~	~~F~~
~~Places of religious worship~~	~~1.07~~	~~0.15~~	~~1~~	~~F~~
~~Courtrooms~~	~~0.19~~	~~0.15~~	~~1~~	~~F~~
~~Legislative chambers~~	~~0.19~~	~~0.15~~	~~1~~	~~F~~
~~Libraries (reading rooms and stack areas)~~	~~0.15~~		~~1~~	
~~Lobbies~~	~~0.50~~	~~0.15~~	~~1~~	~~F~~
~~Museums (children's)~~	~~0.25~~	~~0.15~~	~~1~~	
~~Museums/galleries~~	~~0.25~~	~~0.15~~	~~1~~	~~F~~

~~**Residential**~~				
~~Common corridors~~	~~0.15~~		~~1~~	~~F~~
~~**Retail**~~				
~~Sales (except as below)~~	~~0.25~~	~~0.20~~	~~2~~	
~~Mall common areas~~	~~0.25~~	~~0.15~~	~~1~~	~~F~~
~~Barbershop~~	~~0.40~~		~~2~~	
~~Beauty and nail salons~~	~~0.40~~		~~2~~	
~~Pet shops (animal areas)~~	~~0.25~~	~~0.15~~	~~2~~	
~~Supermarket~~	~~0.25~~	~~0.20~~	~~1~~	~~F~~
~~Coin-operated laundries~~	~~0.30~~		~~2~~	
~~**Sports and Entertainment**~~				
Gym, sports arena (play area)	0.50	0.15	2	E
~~Spectator areas~~	~~0.50~~	~~0.15~~	~~1~~	~~F~~
Swimming (pool)	0.15		2	C
Swimming (deck)	0.50	0.15	2	C
Disco/dance floors	1.50	0.15	2	F
Health club/aerobics room/weight rooms	0.15		2	
~~Health club/weight rooms~~	~~0.15~~		~~2~~	
~~Bowling alley (seating)~~	~~1.07~~	~~0.15~~	~~1~~	
~~Gambling casinos~~	~~0.68~~	~~0.15~~	~~1~~	
Game arcades	0.68	0.15	1	
~~Stages, studios~~	~~0.50~~	~~0.15~~	~~1~~	~~D, F~~

General:

[1] Ra was determined as being the larger of the area method and the default per person method. The occupant density used in the per person method was assumed to be one half of the maximum occupant load assumed for egress purposes in the CBC.

[2]If this column specifies a minimum cfm/ft^2 then it shall be used to comply with Section ~~120.1(d)4E~~ 160.2(c)5E.

Specific Notes:

A – ~~For high-school and college libraries, the values shown for "Public Assembly Spaces – Libraries" shall be used..~~ Not used.

B – Rate may not be sufficient where stored materials include those having potentially harmful emissions.

C – Rate does not allow for humidity control. "Deck area" refers to the area surrounding the pool that is capable of being wetted during pool use or when the pool is occupied. Deck area that is not expected to be wetted shall be designated as an occupancy category.

D – ~~Rate does not include special exhaust for stage effects such as dry ice vapors and smoke~~ Not used.

E – Where combustion equipment is intended to be used on the playing surface or in the space, additional dilution ventilation, source control, or both shall be provided.

F – Ventilation air for this occupancy category shall be permitted to be reduced to zero when the space is in occupied-standby mode

TABLE ~~120.1 B~~ 160.2-C – Minimum Exhaust Rates

[ASHRAE 62.1: TABLE 6.5]

Occupancy Category	Exhaust Rete, cfm/unit	Exhaust Rate, cfm/ft^2	Air Class	Notes
~~Arenas~~	~~-~~	~~0.50~~	~~1~~	~~B~~
~~Art classrooms~~	~~-~~	~~0.70~~	~~2~~	
~~Auto repair rooms~~	~~-~~	~~1.5~~	~~2~~	~~A~~
~~Barber shops~~	~~-~~	~~0.50~~	~~2~~	
~~Beauty and nail salons~~	~~-~~	~~0.60~~	~~2~~	
~~Cells with toilet~~	~~-~~	~~1.00~~	~~2~~	
Copy, printing rooms	-	0.50	2	
~~Darkrooms~~	~~-~~	~~1.00~~	~~2~~	
~~Educational science laboratories~~	~~-~~	~~1.00~~	~~2~~	
Janitor closets, trash rooms, recycling	-	1.00	3	
Kitchenettes	-	0.30	2	
Kitchens – commercial	-	0.70	2	
Locker rooms for athletic or industrial facilities	-	0.50	2	
All other locker rooms	-	0.25	2	
Shower rooms	20/50	-	2	G, H
~~Paint spray booths~~	~~-~~	~~-~~	~~4~~	~~F~~
Parking garages	-	0.75	2	C
Pet shops (animal areas)	-	0.90	2	
~~Refrigerating machinery rooms~~	~~-~~	~~-~~	~~3~~	~~F~~
Soiled laundry storage rooms	-	1.00	3	F
Storage rooms, chemical	-	1.50	4	F
Toilets – private	25/50	-	2	E
Toilets – public	50/70	-	2	D
~~Woodwork shop/classrooms~~	~~-~~	~~0.50~~	~~2~~	

TABLE ~~120.1 B~~ 160.2-C – Minimum Exhaust Rates

[ASHRAE 62.1: TABLE 6.5]

Occupancy Category	Exhaust Rete, cfm/unit	Exhaust Rate, cfm/ft^2	Air Class	Notes
Notes: A – ~~Stands where engines are run shall have exhaust systems that directly connect to the engine exhaust and prevent escape of fumes.~~ Not used. B – ~~Where combustion equipment is intended to be used on the playing surface, additional dilution ventilation, source control, or both shall be provided.~~ Not used. C – Exhaust shall not be required where two or more sides comprise walls that are at least 50% open to the outside. D – Rate is per water closet, urinal, or both. Provide the higher rate where periods of heavy use are expected to occur. The lower rate shall be permitted to be used otherwise. E – Rate is for a toilet room intended to be occupied by one person at a time. For continuous systems operation during hours of use, the lower rate shall be permitted to be used. Otherwise the higher rate shall be used. F – See other applicable standards for exhaust rate. G – For continuous system operation, the lower rate shall be permitted to be used. Otherwise the higher rate shall be used. H – Rate is per showerhead				

TABLE ~~120.1 C~~ 160.2-D – Airstreams or Sources

[ASHRAE 62.1:Table 5.16.1]

Description	Air Class
~~Diazo printing equipment discharge~~	~~4~~
Commercial kitchen grease hoods	4
Commercial kitchen hoods other than grease	3
~~Laboratory hoods~~	~~4[a]~~
Hydraulic elevator machine room	2
~~a. Air Class 4 unless determined otherwise by the Environmental Health and Safety professional responsible to the owner or to the owner's designee.~~	

SECTION 160.3 – MANDATORY REQUIREMENTS FOR SPACE CONDITIONING SYSTEMS IN MULTIFAMILY BUILDINGS

Space conditioning systems serving multifamily dwelling units and common use areas shall comply with the applicable requirements of Sections 160.3(a) through 160.3(c).

(a) **Controls –** Space conditioning systems serving dwelling units and common use areas in multifamily buildings shall comply with applicable requirements of Sections 160.3(a)1 or 160.3(a)2.

1. **Dwelling Unit Thermostats.** All heating or cooling systems, including heat pumps, not controlled by a central energy management control system (EMCS) shall have a setback thermostat, as specified in Section 110.2(c).

2. **Common Use Area Controls**. All heating or cooling systems serving common use areas of multifamily buildings shall comply with application requirements of Sections 160.3(a)2A through 160.3(a)2J.

A. **Thermostatic Controls for Each Zone.** The supply of heating and cooling energy to each space-conditioning zone ~~or dwelling unit~~ shall be controlled by an individual thermostatic control that responds to temperature within the zone and that meets the applicable requirements of Section ~~120.2(b)~~160.3(a)2B. An Energy Management Control System (EMCS) may be installed to comply with the requirements of one or more thermostatic controls if it complies with all applicable requirements for each thermostatic control.

EXCEPTION to Section ~~120.2(a)~~160.3(a)2A: An independent perimeter heating or cooling system may serve more than one zone without individual thermostatic controls if:

i. All zones are also served by an interior cooling system; and

ii. The perimeter system is designed solely to offset envelope heat losses or gains; and

iii. The perimeter system has at least one thermostatic control for each building orientation of 50 feet or more; and

iv. The perimeter system is controlled by at least one thermostat located in one of the zones served by the system.

B. **Criteria for Zonal Thermostatic Controls.** The individual thermostatic controls required by Section ~~120.2(a)~~160.3(a)2A shall meet the following requirements as applicable:

i. Where used to control comfort heating, the thermostatic controls shall be capable of being set, locally or remotely, down to 55°F or lower.

ii. Where used to control comfort cooling, the thermostatic controls shall be capable of being set, locally or remotely, up to 85°F or higher.

iii. Where used to control both comfort heating and comfort cooling, the thermostatic controls shall meet Items ~~1~~i and ~~2~~ii and shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

EXCEPTION 1 to Section ~~120.2(b)3~~160.3(a)2Biii: Systems with thermostats that require manual changeover between heating and cooling modes.

~~**EXCEPTION 2 to Section 120.2(b)3:** Systems serving healthcare facilities.~~

iv. Thermostatic controls for all single zone air conditioners and heat pumps, shall comply with the requirements of Section 110.2(c) and 110.12(a) and, if equipped with DDC to the Zone level, with the Automatic Demand Shed Controls of Section 110.12(b).

~~**EXCEPTION 1 to Section 120.2(b)4:** Systems serving exempt process loads that must have constant temperatures to prevent degradation of materials, a process, plants or animals.~~

EXCEPTION ~~2~~ 1 to Section ~~120.2(b)4~~160.3(a)2Biv: Package terminal air conditioners, package terminal heat pumps, room air conditioners, and room air-conditioner heat pumps.

~~**EXCEPTION 3 to Section 120.2(b)4:** Systems serving healthcare facilities.~~

C. **Heat Pump Controls.** All heat pumps with supplementary electric resistance heaters shall be installed with controls that comply with Section 110.2(b).

D. **Shut-off and Reset Controls for Space-conditioning Systems.** Each space-conditioning system shall be installed with controls that comply with the following:

i. The control shall be capable of automatically shutting off the system during periods of nonuse and shall have:

a. An automatic time switch control device complying with Section 110.9, with an accessible manual override that allows operation of the system for up to 4 hours; or

b. An occupancy sensor; or

c. A 4-hour timer that can be manually operated.

~~**EXCEPTION to Section 120.2(e)1:** Mechanical systems serving retail stores and associated malls, restaurants, grocery stores, churches, and theaters equipped with 7-day programmable timers.~~

ii. The control shall automatically restart and temporarily operate the system as required to maintain:

a. A setback heating thermostat setpoint if the system provides mechanical heating; and

EXCEPTION to Section ~~120.2(e)2A~~160.3(a)2Diia: Thermostat setback controls are not required in ~~nonresidential~~ multifamily buildings in areas where the Winter Median of Extremes outdoor air temperature determined in accordance with Section ~~140.4(b)3~~170.2(c)1C is greater than 32°F.

b. A setup cooling thermostat setpoint if the system provides mechanical cooling.

EXCEPTION to Section ~~120.2(e)2B~~160.3(a)2Diib: Thermostat setup controls are not required in ~~nonresidential~~ multifamily buildings in areas where the Summer Design Dry Bulb 0.5 percent temperature determined in accordance with Section ~~140.4(b)3~~170.2(c)1C is less than 100°F.

iii. **Occupancy Sensing Zone Controls**. Space conditioning systems serving room(s) that are required to have occupant sensing controls in accordance with Section ~~130.1(c)~~160.5(b)4C, and where the Table ~~120.1-A~~160.2-B occupancy category permits ventilation air to be reduced to zero when the space is in occupied-standby mode, shall meet the following:

a. The zone shall be placed in occupied standby mode when all room(s) served by the zone are unoccupied for more than 5 minutes; and

b. During occupied standby mode.

I. Automatically setup the operating cooling temperature set point by 2°F or more and setback the operating heating temperature set point by 2°F or more; or

II. For multiple zone systems with Direct Digital Controls (DDC) to the zone level, setup the operating cooling temperature setpoint by 0.5°F or more and setback the operating heating temperature setpoint by 0.5°F or more.

c. During occupied-standby mode, all airflow to the zone shall be shut off whenever the space temperature is between the active heating and cooling setpoints.

EXCEPTION 1 to Sections ~~120.2(e)1, 2, and 3~~160.3(a)2Di,ii, and iii: Where it can be demonstrated to the satisfaction of the enforcing agency that the system serves an area that must operate continuously.

EXCEPTION 2 to Sections ~~120.2(e)1, 2, and 3~~160.3(a)2Di,ii, and iii: Systems with full load demands of 2 kW or less, if they have a readily accessible manual shut-off switch.

~~**EXCEPTION 3 to Sections 120.2(e)1 and 2:** Systems serving hotel/motel guest rooms, if they have a readily accessible manual shut-off switch.~~

~~**EXCEPTION to Section 120.2(e):** Systems serving healthcare facilities.~~

E. **Dampers for Air Supply and Exhaust Equipment.** Outdoor air supply and exhaust equipment shall be installed with dampers that automatically close upon fan shutdown.

EXCEPTION 1 to Section ~~120.2(f)~~160.3(a)2E: Equipment that serves an area that must operate continuously.

EXCEPTION 2 to Section ~~120.2(f)~~160.3(a)2E: Gravity and other nonelectrical equipment that has readily accessible manual damper controls.

EXCEPTION 3 to Section ~~120.2(f)~~160.3(a)2E: At combustion air intakes and shaft vents.

EXCEPTION 4 to Section ~~120.2(f)~~160.3(a)2E: Where prohibited by other provisions of law.

F. **Isolation Area Devices**. Each space-conditioning system serving multiple zones with a combined conditioned floor area of more than 25,000 square feet shall be designed, installed, and controlled to serve isolation areas.

i. Each zone, or any combination of zones not exceeding 25,000 square feet, shall be a separate isolation area.

ii. Each isolation area shall be provided with isolation devices, such as valves or dampers that allow the supply of heating or cooling to be reduced or shut-off independently of other isolation areas.

iii. Each isolation area shall be controlled by a device meeting the requirements of Section ~~120.2(e)1~~160.3(a)2Di.

EXCEPTION to Section ~~120.2(g)~~160.3(a)2F: Zones designed to be conditioned continuously.

G. **Automatic Demand Shed Controls.** See Section 110.12 for requirements for Automatic Demand Shed Controls.

H. **Economizer Fault Detection and Diagnostics (FDD).** All newly installed air handlers with a mechanical cooling capacity greater than 54,000 Btu/hr and an installed air economizer shall include a stand-alone or integrated Fault Detection and Diagnostics (FDD) system in accordance with Subsections ~~120.2(i)1~~160.3(a)2Hi through ~~120.2(i)8~~160.3(a)2Hviii

i. The following temperature sensors shall be permanently installed to monitor system operation: outside air, supply air, and when required for differential economizer operation, a return air sensor; and

ii. Temperature sensors shall have an accuracy of ±2°F over the range of 40°F to 80°F; and

iii. The controller shall have the capability of displaying the value of each sensor; and

iv. The controller shall provide system status by indicating the following conditions:

a. Free cooling available;

b. Economizer enabled;

c. Compressor enabled;

d. Heating enabled, if the system is capable of heating; and

e. Mixed air low limit cycle active.

v. The unit controller shall allow manual initiation of each operating mode so that the operation of cooling systems, economizers, fans, and heating systems can be independently tested and verified; and

vi. Faults shall be reported in one of the following ways:

a. Reported to an Energy Management Control System regularly monitored by facility personnel.

b. Annunciated locally on one or more zone thermostats, or a device within five (5) feet of zone thermostat(s), clearly visible, at eye level, and meeting the following requirements:

I. On the thermostat, device, or an adjacent written sign, display instructions to contact appropriate building personnel or an HVAC technician; and

II. In buildings with multiple tenants, the annunciation shall either be within property management offices or in a common space accessible by the property or building manager.

c. Reported to a fault management application which automatically provides notification of the fault to remote HVAC service provider.

vii. The FDD system shall detect the following faults:

a. Air temperature sensor failure/fault;

b. Not economizing when it should;

c. Economizing when it should not;

d. Damper not modulating; and

e. Excess outdoor air.

viii. The FDD System shall be certified by the Energy Commission as meeting requirements of Sections ~~120.2(i)1~~160.3(a)2Hi through ~~120.2(i)7~~160.3(a)2Hvii in accordance with Section 110.0 and JA6.3.

EXCEPTION to ~~120.2(i)8~~160.3(a)2Hviii: FDD algorithms based in Direct Digital Control systems are not required to be certified to the Energy Commission.

I. **Direct Digital Controls (DDC).** Direct Digital Controls to the zone shall be provided as specified by Table ~~120.2-A~~160.3-C.

The provided DDC system shall meet the control logic requirements of Sections ~~120.1(d)~~ 160.3(a)2E and ~~120.2(h)~~160.3(a)2G, and be capable of the following:

i. Monitoring zone and system demand for fan pressure, pump pressure, heating and cooling;

ii. Transferring zone and system demand information from zones to air distribution system controllers and from air distribution systems to heating and cooling plant controllers;

iii. Automatically detecting the zones and systems that may be excessively driving the reset logic and generate an alarm or other indication to the system operator;

iv. Readily allow operator removal of zones(s) from the reset algorithm;

v. For new buildings, trending and graphically displaying input and output points; and

vi. Resetting heating and cooling setpoints in all non-critical zones upon receipt of a signal from a centralized contact or software point as described in Section ~~120.2(h)~~160.3(a)2G.

J. **Optimum Start/Stop Controls.** Space conditioning systems with DDC to the zone level shall have optimum start/stop controls. The control algorithm shall, as a minimum, be a function of the difference between space temperature and occupied setpoint, the outdoor air temperature, and the amount of time prior to scheduled occupancy. Mass radiant floor slab systems shall incorporate floor temperature onto the optimum start algorithm.

EXCEPTION to Section ~~120.2(k)~~160.3(a)2J: Systems that must operate continuously.

(b) **Space Conditioning and Distribution Systems Serving Individual Dwelling Units.**

1. **Building Cooling and Heating Loads.** Building heating and cooling loads shall be determined using a method based on any one of the following:

A. The ASHRAE Handbook, Equipment Volume, Applications Volume, and Fundamentals Volume; or

B. The SMACNA Residential Comfort System Installation Standards Manual; or

C. The ACCA Manual J.

The cooling and heating loads are two of the criteria that shall be used for equipment sizing and selection.

NOTE: Heating systems are required to have a minimum heating capacity adequate to meet the minimum requirements of the CBC. The furnace output capacity and other specifications are published in the Commission's directory of certified equipment or other directories approved by the Commission.

2. **Design conditions**. For the purpose of sizing the space-conditioning (HVAC) system, the indoor design temperatures shall be 68°F for heating and 75°F for cooling. Outdoor design conditions shall be selected from Reference Joint Appendix JA2, which is based on data from the ASHRAE Climatic Data for Region X. The outdoor design temperatures for heating shall be no lower than the Heating Winter Median of Extremes values. The outdoor design temperatures for cooling shall be no greater than the 1.0 percent Cooling Dry Bulb and Mean Coincident Wet Bulb values.

3. **Outdoor Condensing Units**.

A. **Clearances.** Installed air conditioner and heat pump outdoor condensing units shall have a clearance of at least five (5) feet (1.5 meters) from the outlet of any dryer vent.

B. **Liquid Line Drier.** Installed air conditioner and heat pump systems shall be equipped with liquid line filter driers if required, as specified by manufacturer's instructions.

4. **Central Forced-Air Heating Furnaces**.

A. **Temperature Rise**. Central forced-air heating furnace installations shall be configured to operate in conformance with the furnace manufacturer's maximum inlet-to-outlet temperature rise specifications.

5. **Air-Distribution and Ventilation System Ducts, Plenums, and Fans.**

A. **CMC Compliance.**

i. All air-distribution system ducts and plenums, including, but not limited to, mechanical closets and air-handler boxes, shall meet the requirements of the CMC Sections 601.0, 602.0, 603.0, 604.0, 605.0 and ANSI/SMACNA-006-2006 HVAC Duct Construction Standards Metal and Flexible 3rd Edition, incorporated herein by reference.

ii. Portions of supply-air and return-air ducts and plenums of a space heating or cooling system shall either be insulated to:

a. a minimum installed level of R-6.0 when the duct is located inside conditioned space as confirmed by visual inspection, or

b. a minimum installed level of R-4.2 when the duct system is located entirely in conditioned space as confirmed through field verification and diagnostic testing in accordance with the requirements of Reference Residential Appendix RA3.1.4.3.8, or~~.~~

c. a minimum installed level of R-8.0.

EXCEPTION 1 to Section ~~150.0(m)1B~~ 160.3(b)Aii: Portions of the duct system located in wall cavities are not required to be insulated if the following conditions are met:

a. The cavity, duct or plenum is located entirely inside the building's thermal envelope as confirmed by visual inspection.

b. At all locations where portions of non-insulated cavities, ducts, or plenums make a transition into unconditioned space, the transition shall be air-sealed to prevent air infiltration into the cavity and be insulated to a minimum of R-~~6~~8 as confirmed by visual inspection.

EXCEPTION 2 to Section ~~150.0(m)1B~~160.3(b)Aii: Portions of the duct system completely exposed and surrounded by directly conditioned space are not required to be insulated.

iii. Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened.

iv. Openings shall be sealed with mastic, tape, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A or UL 181B or aerosol sealant that meets the requirements of UL 723. If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape shall be used.

v. Building cavities, support platforms for air handlers, and plenums designed or constructed with materials other than sealed sheet metal, duct board or flexible duct shall not be used for conveying conditioned air. Building cavities and support platforms may contain ducts. Ducts installed in cavities and support platforms shall not be compressed to cause reductions in the cross-sectional area of the ducts.

EXCEPTION to Section ~~150.0(m)1~~160.3(b)A: Ducts and fans integral to a wood heater or fireplace.

B. Factory-Fabricated Duct Systems.

i. All factory-fabricated duct systems shall comply with UL 181 for ducts and closure systems, including collars, connections, and splices, and be labeled as complying with UL 181. UL 181 testing may be performed by UL laboratories or a laboratory approved by the Executive Director.

ii. All pressure-sensitive tapes, heat-activated tapes, and mastics used in the manufacture of rigid fiberglass ducts shall comply with UL 181 and UL 181A.

iii. All pressure-sensitive tapes and mastics used with flexible ducts shall comply with UL 181 and UL 181B.

iv. Joints and seams of duct systems and their components shall not be sealed with cloth back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands.

C. **Field-Fabricated Duct Systems.**

i. Factory-made rigid fiberglass and flexible ducts for field-fabricated duct systems shall comply with UL 181. All pressure-sensitive tapes, mastics, aerosol sealants, or other closure systems used for installing field-fabricated duct systems shall meet the applicable requirements of UL 181, UL 181A, and UL 181B.

ii. Mastic sealants and mesh.

a. Sealants shall comply with the applicable requirements of UL 181, UL 181A, and UL 181B, and be nontoxic and water resistant.

b. Sealants for interior applications shall be tested in accordance with ASTM C731 and D2202, incorporated herein by reference.

c. Sealants for exterior applications shall be tested in accordance with ASTM C731, C732, and D2202, incorporated herein by reference.

d. Sealants and meshes shall be rated for exterior use.

iii. Pressure-sensitive tape. Pressure-sensitive tapes shall comply with the applicable requirements of UL 181, UL 181A, and UL 181B.

iv. Joints and seams of duct systems and their components shall not be sealed with cloth back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands.

v. Drawbands used with flexible duct.

a. Drawbands shall be either stainless-steel worm-drive hose clamps or UV-resistant nylon duct ties.

b. Drawbands shall have a minimum tensile strength rating of 150 pounds.

c. Drawbands shall be tightened as recommended by the manufacturer with an adjustable tensioning tool.

vi. Aerosol-sealant closures.

a. Aerosol sealants shall meet the requirements of UL 723 and be applied according to manufacturer specifications.

b. Tapes or mastics used in combination with aerosol sealing shall meet the requirements of this section.

D. Duct Insulation R-value Ratings. All duct insulation product R-values shall be based on insulation only (excluding air films, vapor retarder, or other duct components) and tested C-values at 75°F mean temperature at the installed thickness, in accordance with ASTM C518 or ASTM C177, incorporated herein by reference, and certified pursuant to Section 110.8.

E. Duct Insulation Thickness. The installed thickness of duct insulation used to determine its R-value shall be determined as follows:

i. For duct board, duct liner, and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.

ii. For duct wrap, installed thickness shall be assumed to be 75 percent (25 percent compression) of nominal thickness.

iii. For factory-made flexible air ducts, the installed thickness shall be determined by dividing the difference between the actual outside diameter and nominal inside diameter by two.

F. Duct Labeling. Insulated flexible duct products installed to meet this requirement shall include labels, in maximum intervals of 3 feet, showing the thermal performance R-value for the duct insulation itself (excluding air films, vapor retarder, or other duct components), based on the tests in Section ~~150.0(m)4~~160.3(b)5D and the installed thickness determined by Section ~~150.0(m)5C~~160.3(b)5Eiii**.**

G. Backdraft Dampers. All fan systems, regardless of volumetric capacity, that exchange air between the building conditioned space and the outside of the building shall be provided with backdraft or automatic dampers to prevent unintended air leakage through the fan system when the fan system is not operating.

H. **Gravity Ventilation Dampers.** All gravity ventilating systems that serve conditioned space shall be provided with either automatic or readily accessible, manually operated dampers in all openings to the outside except combustion inlet and outlet air openings and elevator shaft vents.

I. **Protection of Insulation.** Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind but not limited to the following: Insulation exposed to weather shall be suitable for outdoor service (e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover). Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.

J. **Porous Inner Core Flex Duct.** Flexible ducts having porous inner cores shall have a non-porous layer or air barrier between the inner core and the outer vapor barrier.

K. **Duct System Sealing and Leakage Testing.** When space conditioning systems utilize forced air duct systems to supply conditioned air to an occupiable space, the ducts shall be sealed, as confirmed through field verification and diagnostic testing, in accordance with all applicable procedures specified in Reference Residential Appendix RA3.1, and the leakage compliance criteria specified in Reference Residential Appendix TABLE RA3.1-2~~, and conforming to one of the following Subsections A, B, or C as applicable:~~

For multifamily dwellings with the air-handling unit installed and the ducts connected directly to the air handler, regardless of duct system location:

i. The total leakage of the duct system shall not exceed 12 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

ii. The duct system leakage to outside shall not exceed 6 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4.

L. ~~**Space Conditioning**~~ **System Airflow Rate and Fan Efficacy.** Space conditioning systems that utilize forced air ducts to supply cooling to an occupiable space shall:

i. **Static Pressure Probe.** Have a hole for the placement of a static pressure probe (HSPP), or a permanently installed static pressure probe (PSPP) in the supply plenum downstream of the air conditioning evaporator coil. The size, location, and labeling of the HSPP or PSPP shall conform to the requirements specified in Reference Residential Appendix RA3.3.1.1 as confirmed by field verification and diagnostic testing; and

EXCEPTION to ~~150.0(m)13A~~160.3(b)5Li: Systems that cannot conform to the specifications for hole location in Reference Residential Appendix Figure RA3.3-1 shall not be required to provide holes as described in Figure RA3.3-1.

ii. **Single Zone Central Forced Air Systems**. Demonstrate, in every control mode, airflow greater than or equal to 350 CFM per ton of nominal cooling capacity through the return grilles, and an air-handling unit fan efficacy less than or equal to the maximum W/CFM specified in subsections ~~ia~~ or ~~ii~~b below. The airflow rate and fan efficacy requirements in this section shall be confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.

a. 0.45 W/CFM for gas furnace air-handling units.

b. 0.58 W/CFM for air-handling units that are not gas furnaces.

iii. **Zonally Controlled Central Forced Air Systems.** Zonally controlled central forced air cooling systems shall be capable of simultaneously delivering, in every zonal control mode, an airflow from the dwelling, through the air handler fan and delivered to the dwelling, of greater than or equal to 350 CFM per ton of nominal cooling capacity, and operating at an air-handling unit fan efficacy of less than or equal to the maximum W/CFM specified in subsections ~~ia~~ or ~~ii~~b below. The airflow rate and fan efficacy requirements in this section shall be confirmed by field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.3.

a. 0.45 W/CFM for gas furnace air-handling units.

b. 0.58 W/CFM for air-handling units that are not gas furnaces.

EXCEPTION 1 to Section ~~150.0(m)13C~~160.3(b)5Liii: Multispeed or variable speed compressor systems, or single speed compressor systems that utilize the performance compliance approach, shall demonstrate compliance with the airflow (cfm/ton) and fan efficacy (Watt/cfm) requirements of Section

~~150.0(m)13C~~160.3(b)5Liii by operating the system at maximum compressor capacity and system fan speed with all zones calling for conditioning, rather than in every zonal control mode.

~~**EXCEPTION 2 to Section 150.0(m)13C:** Gas furnace air handling units manufactured prior to July 3, 2019 shall comply with a fan efficacy value less than or equal to 0.58 w/cfm as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.~~

iv. **Small Duct High Velocity Forced Air Systems.** Demonstrate, in every control mode, airflow greater than or equal to 250 CFM per ton of nominal cooling capacity through the return grilles, and an air-handling unit fan efficacy less than or equal to 0.62 W/CFM as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3

EXCEPTION 1 to Section ~~150.0(m)13B and D~~160.3(b)5Lii and iv: Standard ducted systems without zoning dampers may comply by meeting the applicable requirements in TABLE ~~150.0-B~~160.3-A or ~~150.0-C~~160.3-B as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Sections RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements specified by Section ~~150.0(m)12Div~~160.2(b)1Div for the system air filter(s) shall conform to the requirements given in TABLE ~~150.0-B~~160.3-A or ~~150.0-C~~160.3-B.

EXCEPTION 2 to ~~150.0(m)13B and D~~160.3(b)5Lii and iv: Multispeed compressor systems or variable speed compressor systems shall verify airflow (cfm/ton) and fan efficacy (Watt/cfm) for system operation at the maximum compressor speed and the maximum air handler fan speed.

~~**EXCEPTION 3 to 150.0(m)13B:** Gas furnace air handling units manufactured prior to July 3, 2019 shall comply with a fan efficacy value less than or equal to 0.58 w/cfm as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.~~

6. Piping for space conditioning systems, solar water-heating system collector loop, and distribution piping for steam and hydronic heating system, shall meet the requirements of Section ~~120.3(c)~~160.3(c)1.

(c) **Central Systems Serving Multiple Dwelling Units and Common Use Area Space-Conditioning Systems.** ~~Nonresidential, high-rise residential, and hotel/motel buildings~~ Multifamily common areas shall comply with the applicable requirements of Sections ~~120.2(a)~~160.3(a)2A through ~~120.2(k)~~160.3(a)2I.

1. **Pipe Insulation**. ~~Nonresidential, high-rise residential, and hotel/motel buildings~~ Multifamily common areas shall comply with the applicable requirements of Sections ~~120.3(a)~~160.3(c)1A through ~~120.3(c)~~160.3(c)1C.

A. **General Requirements.** The piping conditions listed below for space-conditioning ~~and service water heating~~ systems with fluid normal operating temperatures listed in 160.3-D, shall have at least the amount of insulation specified in ~~Subsection (c)~~ Section 160.3(c)1C:

i. **Space Cooling Systems.** All refrigerant suction, chilled water, and brine fluid distribution systems.

ii. **Space Heating Systems.** All refrigerant, steam, steam condensate and hot water fluid distribution systems.

~~iii. **Service water-heating systems.**~~

~~a. Recirculating system piping, including the supply and return piping to the water heater.~~

~~b. The first 8 feet of hot and cold outlet piping, including piping between a storage tank and a heat trap, for a nonrecirculating storage system.~~

~~c. Pipes that are externally heated.~~

Insulation conductivity shall be determined in accordance with ASTM C335 at the mean temperature listed in 160.3-D, and shall be rounded to the nearest 1/100 Btu-inch per hour per square foot per °F. Fluid distribution systems include all elements that are in series with the fluid flow, such as pipes, pumps, valves, strainers, coil u-bends, and air separators, but not including elements that are not in series with the fluid flow, such as expansion tanks, fill lines, chemical feeders, and drains.

B. **Insulation Protection.** Pipe Insulation shall be protected from damage due to sunlight, moisture, equipment maintenance, and wind. Protection shall, at minimum, include the following:

i. Pipe insulation exposed to weather shall be protected by a cover suitable for outdoor service. The cover shall be water retardant and provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be used to provide this protection.

ii. Pipe insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall include, or be protected by, a Class I or Class II vapor retarder. All penetrations and joints shall be sealed.

iii. Pipe insulation buried below grade must be installed in a water proof and non-crushable casing or sleeve.

C. Insulation Thickness

i. For insulation with a conductivity in the range shown in 160.3-D for the applicable fluid temperature range, the insulation shall have the applicable minimum thickness or R-value shown in 160.3-D.

ii. For insulation with a conductivity outside the range shown in 160.3-D for the applicable fluid temperature range, the insulation shall have a minimum R-value shown in 160.3-D or thickness as calculated with:

MINIMUM INSULATION THICKNESS EQUATION

$$T = PR\left[\left(1+\frac{t}{PR}\right)^{\frac{K}{k}}-1\right]$$

WHERE:

T = *Minimum insulation thickness for material with conductivity K, inches.*

PR = *Pipe actual outside radius, inches.*

t = *Insulation thickness from 160.3-D, inches.*

K = *Conductivity of alternate material at the mean rating temperature indicated in 160.3-D for the applicable fluid temperature range, in Btu-inch per hour per square foot per °F.*

k = *The lower value of the conductivity range listed in 160.3-D for the applicable fluid temperature range, Btu-inch per hour per square foot per °F.*

EXCEPTION 1 to Section ~~120.3~~160.3(c)1: Factory-installed piping within space-conditioning equipment certified under Section 110.1 or 110.2.

EXCEPTION 2 to Section ~~120.3~~160.3(c)1: Piping that conveys fluids with a design operating temperature range between 60°F and 105°F.

EXCEPTION 3 to Section ~~120.3~~160.3(c)1: Where the heat gain or heat loss to or from piping without insulation will not increase building source energy use.

EXCEPTION 4 to Section ~~120.3~~160.3(c)1: Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. Metal piping that penetrates metal framing shall use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the metal framing.

2. **Requirements for Air Distribution System, Ducts, and Plenum.** ~~Nonresidential, high-rise residential, and hotel/motel buildings~~ Multifamily common area shall comply with the applicable requirements of Sections ~~120.4(a)~~160.3(c)2A through ~~120.4(f)~~160.3(c)2F.

~~EXCEPTION to Section 120.5:~~ ~~Systems serving healthcare facilities.~~

A. **CMC Compliance.** All air distribution system ducts and plenums, including, but not limited to, building cavities, mechanical closets, air-handler boxes and support platforms used as ducts or plenums, shall meet the requirements of the CMC Sections 601.0, 602.0, 603.0, 604.0, 605.0, and ANSI/SMACNA-006-2006 HVAC Duct Construction Standards Metal and Flexible 3rd Edition, incorporated herein by reference. Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened. Openings shall be sealed with

mastic, tape, aerosol sealant, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A, or UL 181B. If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape shall be used.

B. Portions of supply-air and return-air ducts conveying heated or cooled air located in one or more of the following spaces shall be insulated to a minimum installed level of R-8:

iii. Outdoors; or

iv. In a space between the roof and an insulated ceiling; or

v. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces; or

vi. In an unconditioned crawlspace; or

vii. In other unconditioned spaces.

Portions of supply-air ducts that are not in one of these spaces, including ducts buried in concrete slab, shall be insulated to a minimum installed level of R-4.2 or be enclosed in directly conditioned space.

C. **Duct and Plenum Materials.**

i. Factory-fabricated duct systems.

a. All factory-fabricated duct systems shall comply with UL 181 for ducts and closure systems, including collars, connections, and splices, and be labeled as complying with UL 181. UL 181 testing may be performed by UL laboratories or a laboratory approved by the Executive Director.

b. All pressure-sensitive tapes, heat-activated tapes, and mastics used in the manufacture of rigid fiberglass ducts shall comply with UL 181 and UL 181A.

c. All pressure-sensitive tapes and mastics used with flexible ducts shall comply with UL 181 and UL 181B.

d. Joints and seams of duct systems and their components shall not be sealed with cloth back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands.

ii. **Field-fabricated duct systems.**

a. Factory-made rigid fiberglass and flexible ducts for field-fabricated duct systems shall comply with UL 181. All pressure-sensitive tapes, mastics, aerosol sealants, or other closure systems used for installing field-fabricated duct systems shall meet the applicable requirements of UL 181, UL 181A, and UL 181B.

b. Mastic sealants and mesh.

I. Sealants shall comply with the applicable requirements of UL 181, UL 181A, and UL 181B, and be nontoxic and water resistant.

II. Sealants for interior applications shall pass ASTM C731 (extrudability after aging) and D2202 (slump test on vertical surfaces), incorporated herein by reference.

III. Sealants for exterior applications shall pass ASTM C731, C732 (artificial weathering test), and D2202, incorporated herein by reference.

IV. Sealants and meshes shall be rated for exterior use.

c. Pressure-sensitive tape. Pressure-sensitive tapes shall comply with the applicable requirements of UL 181, UL 181A, and UL 181B.

d. Joints and seams of duct systems and their components shall not be sealed with cloth back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands.

e. Drawbands used with flexible duct.

I. Drawbands shall be either stainless-steel worm-drive hose clamps or UV-resistant nylon duct ties.

II. Drawbands shall have a minimum tensile strength rating of 150 pounds.

III. Drawbands shall be tightened as recommended by the manufacturer with an adjustable tensioning tool.

f. Aerosol-sealant closures.

I. Aerosol sealants shall meet the requirements of UL 723 and be applied according to manufacturer specifications.

II. Tapes or mastics used in combination with aerosol sealing shall meet the requirements of this section.

D. All duct insulation product R-values shall be based on insulation only (excluding air films, vapor retarders, or other duct components) and tested C-values at 75°F mean temperature at the installed thickness, in accordance with ASTM C518 or ASTM C177, incorporated herein by reference, and certified pursuant to Section 110.8.

E. The installed thickness of duct insulation used to determine its R-value shall be determined as follows:

i. For duct board, duct liner, and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.

ii. For duct wrap, installed thickness shall be assumed to be 75 percent (25 percent compression) of nominal thickness.

iii. For factory-made flexible air ducts, the installed thickness shall be determined by dividing the difference between the actual outside diameter and nominal inside diameter by two.

F. Insulated flexible duct products installed to meet this requirement must include labels, in maximum intervals of 3 feet, showing the thermal performance R-value for the duct insulation itself (excluding air films, vapor retarder, or other duct components), based on the tests in Section ~~120.4(c)~~160.3(c)2D and the installed thickness determined by Section ~~120.4(d)3~~ 160.3(c)2Eiii.

G. Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind but not limited to the following: Insulation exposed to weather shall be suitable for outdoor service e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.

3. **~~Required~~ Mechanical Acceptance Testing.** ~~Nonresidential, high-rise residential, and hotel/motel buildings~~ Multifamily common area shall comply with the applicable requirements of Sections ~~120.5(a)~~160.3(c)3A and ~~120.5(b)~~160.3(c)3B.

~~EXCEPTION to Section 120.5:~~ ~~Systems serving healthcare facilities.~~

A. Before an occupancy permit is granted the following equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements:

i. Outdoor air ventilation systems shall be tested in accordance with NA7.5.1

ii. Constant volume, single zone air conditioning and heat pump unit controls shall be tested in accordance with NA7.5.2.

iii. Duct systems shall be tested in accordance with NA7.5.3 where either:

a. They are new duct systems that meet the criteria of Sections ~~140.4(l)1~~170.2(c)4Ji, ~~140.4(l)2~~170.2(c)4Jii, and ~~140.4(l)3~~170.2(c)4Jiii; or

b. They are part of a system that meets the criteria of Section ~~141.0(b)2D~~180.2(b)2Bii.

iv. Air economizers shall be tested in accordance with NA7.5.4.

EXCEPTION to Section ~~120.5(a)4~~160.3(c)3Aiv: Air economizers installed by the HVAC system manufacturer and certified to the Commission as being factory calibrated and tested are exempt from the Functional Testing section of the Air Economizer Controls acceptance test as described in NA7.5.4.2.

v. Demand control ventilation systems required by Section ~~120.1(c)3~~160.2(c)3 shall be tested in accordance with NA7.5.5

vi. Supply fan variable flow controls shall be tested in accordance with NA7.5.6

vii. Hydronic system variable flow controls shall be tested in accordance with NA7.5.7 and NA7.5.9

viii. Boiler or chillers that require isolation controls as specified by Section ~~140.4(k)2~~170.2(c)4Iii or ~~140.4(k)3~~170.2(c)4Iiii shall be tested in accordance with NA7.5.7

ix. Hydronic systems with supply water temperature reset controls shall be tested in accordance with NA7.5.8

x. Automatic demand shed controls shall be tested in accordance with NA7.5.10.

xi. Fault Detection and Diagnostics (FDD) for Packaged Direct-Expansion Units shall be tested in accordance with NA7.5.11.

xii. Automatic Fault Detection and Diagnostics (FDD) for air handling units and zone terminal units shall be tested in accordance with NA7.5.12.

xiii. Distributed Energy Storage DX AC Systems shall be tested in accordance with NA7.5.13.

xiv. Thermal Energy Storage (TES) Systems shall be tested in accordance with NA7.5.14.

xv. Supply air temperature reset controls shall be tested in accordance with NA7.5.15.

xvi. Water-cooled chillers served by cooling towers with condenser water reset controls shall be tested in accordance with NA7.5.16.

xvii. When an Energy Management Control System is installed, it shall functionally meet all of the applicable requirements of Part 6.

xviii. Occupant Sensing Zone Controls shall be tested in accordance with NA7.5.17.

B. When certification is required by Title 24, Part 1, Section 10-103.2, the acceptance testing specified by Section ~~120.5(a)~~ 160.3(c)3A shall be performed by a Certified Mechanical Acceptance Test Technician (CMATT). If the CMATT is operating as an employee, the CMATT shall be employed by a Certified Mechanical Acceptance Test Employer. The CMATT shall disclose on the Certificate of Acceptance a valid CMATT certification identification number issued by an approved Acceptance Test Technician Certification Provider. The CMATT shall complete all Certificate of Acceptance documentation in accordance with the applicable requirements in Section 10-103(a)4.

TABLE ~~150.0 B~~160.3-A: Return Duct Sizing for Single Return Duct Systems

Return duct length shall not exceed 30 feet and shall contain no more than 180 degrees of bend. If the total bending exceeds 90 degrees, one bend shall be a metal elbow.

Return grille devices shall be labeled in accordance with the requirements in Section ~~150.0(m)12Biv~~160.2(b)1Biv to disclose the grille's design airflow rate and a maximum allowable clean-filter pressure drop of 25 Pa (0.1 inches water) for the air filter when tested using ASHRAE Standard 52.2, or as rated in accordance with AHRI Standard 680 for the design airflow rate for the return grille.

System Nominal Cooling Capacity (Ton)*	Return Duct Minimum Nominal Diameter (inch)	Minimum Total Return Filter Grille Nominal Area (inch^2)
1.5	16	500
2.0	18	600
2.5	20	800

*****Not applicable to systems with nominal cooling capacity greater than 2.5 tons or less than 1.5 ton

TABLE ~~150.0 C~~160.3-B: Return Duct Sizing for Multiple Return Duct Systems

Each return duct length shall not exceed 30 feet and shall contain no more than 180 degrees of bend. If the total bending exceeds 90 degrees, one bend shall be a metal elbow.

Return grille devices shall be labeled in accordance with the requirements in Section ~~150.0(m)12Biv~~160.2(b)1Biv to disclose the grille's design airflow rate and a maximum allowable clean-filter pressure drop of 25 Pa (0.1 inches water) for the air filter when tested using ASHRAE Standard 52.2, or as rated in accordance with AHRI Standard 680 for the design airflow rate for the return grille.

System Nominal Cooling Capacity (Ton)*	Return Duct 1 Minimum Nominal Diameter (inch)	Return Duct 2 Minimum Nominal Diameter (inch)	Minimum Total Return Filter Grille Nominal Area (inch^2)
1.5	12	10	500
2.0	14	12	600
2.5	14	14	800
3.0	16	14	900
3.5	16	16	1000
4.0	18	18	1200
5.0	20	20	1500

*****Not applicable to systems with nominal cooling capacity greater than 5.0 tons or less than 1.5 tons.

TABLE ~~120.2 A~~160.3-C DDC Applications and Qualifications

Building Status	Applications	Qualifications
Newly Constructed Buildings	Air handling system and all zones served by the system	Individual systems supplying more than three zones and with design heating or cooling capacity of 300 kBtu/h and larger
Newly Constructed Buildings	Chilled water plant and all coils and terminal units served by the system	Individual plants supplying more than three zones and with design cooling capacity of 300 kBtu/h (87.9 kW) and larger
Newly Constructed Buildings	Hot water plant and all coils and terminal units served by the system	Individual plants supplying more than three zones and with design heating capacity of 300 kBtu/h (87.9 kW) and larger
Additions or Alterations	Zone terminal unit such as VAV box	Where existing zones served by the same air handling, chilled water, or hot water systems that have DDC
Additions or Alterations	Air handling system or fan coil	Where existing air handling system(s) and fan coil(s) served by the same chilled or hot water plant have DDC
Additions or Alterations	New air handling system and all new zones served by the system	Individual systems with design heating or cooling capacity of 300 kBtu/h and larger and supplying more than three zones and more than 75 percent of zones are new
Additions or Alterations	New or upgraded chilled water plant	Where all chillers are new and plant design cooling capacity is 300 kBtu/h (87.9 kW) and larger
Additions or Alterations	New or upgraded hot water plant	Where all boilers are new and plant design heating capacity is 300 kBtu/h (87.9 kW) and larger

TABLE ~~120.3-A~~160.3-D PIPE INSULATION THICKNESS

Fluid Operating Temperature Range (°F)	Insulation Conductivity			Nominal Pipe Diameter (in inches)				
	Conductivity (in Btu·in/h·ft²·°F)	Mean Rating Temperature (°F)		< 1	1 to <1.5	1.5 to < 4	4 to < 8	8 and larger
Space heating and Service Water Heating Systems (Steam, Steam Condensate, Refrigerant, Space Heating, Service Hot Water)				**Minimum Pipe Insulation Required (Thickness in inches or R-value)**				
Above 350	0.32-0.34	250	Inches	4.5	5.0	5.0	5.0	5.0
			R-value	R 37	R 41	R 37	R 27	R 23
251-350	0.29-0.32	200	Inches	3.0	4.0	4.5	4.5	4.5
			R-value	R 24	R 34	R 35	R 26	R 22
201-250	0.27-0.30	150	Inches	2.5	2.5	2.5	3.0	3.0
			R-value	R 21	R 20	R 17.5	R 17	R 14.5
141-200	0.25-0.29	125	Inches	1.5	1.5	2.0	2.0	2.0
			R-value	R 11.5	R 11	R 14	R 11	R 10
105-140	0.22-0.28	100	Inches	1.0	1.5	1.5	1.5	1.5
			R-value	R 7.7	R 12.5	R 11	R 9	R 8
				Nominal Pipe Diameter (in inches)				
				< 1	**1 to <1.5**	**1.5 to < 4**	**4 to < 8**	**8 and larger**
Space cooling systems (chilled water, refrigerant and brine)				**Minimum Pipe Insulation Required (Thickness in inches or R-value)[1]**				
40-60	0.21-0.27	75	Inches	Nonres 0.5 / Res 0.75		Nonres 0.5 / Res 0.75		1.0	1.0	1.0
			R-value	Nonres R 3	Res R 6	Nonres R 3	Res R 5	R 7	R 6	R 5
Below 40	0.20-0.26	50	Inches	1.0		1.5		1.5	1.5	1.5
			R-value	R 8.5		R 14		R 12	R 10	R 9

Footnote to TABLE ~~120.3-A~~160.3-D:

1. These thickness are based on energy efficiency considerations only. Issues such as water vapor permeability or surface condensation sometimes require vapor retarders or additional insulation.

SECTION 160.4 – MANDATORY REQUIREMENTS FOR WATER HEATING SYSTEMS

(a) Systems using gas or propane water heaters to serve individual dwelling units shall include the following components:

1. A dedicated 125 volt, 20 amp electrical receptacle that is connected to the electric panel with a 120/240 volt 3 conductor, 10 AWG copper branch circuit, within 3 feet from the water heater and accessible to the water heater with no obstructions. In addition, all of the following:

   A. Both ends of the unused conductor shall be labeled with the word "spare" and be electrically isolated; and

   B. A reserved single pole circuit breaker space in the electrical panel adjacent to the circuit breaker for the branch circuit in A above and labeled with the words "Future 240V Use"; and

2. A Category III or IV vent, or a Type B vent with straight pipe between the outside termination and the space where the water heater is installed; and

3. A condensate drain that is no more than 2 inches higher than the base of the installed water heater, and allows natural draining without pump assistance, and

4. A gas supply line with a capacity of at least 200,000 Btu/hr.

(b) Water heating recirculation loops serving multiple dwelling units shall meet the requirements of Section 110.3(c)5.

(c) Solar water-heating systems and collectors shall be certified and rated by the Solar Rating and Certification Corporation (SRCC), the International Association of Plumbing and Mechanical Officials, Research and Testing (IAPMO R&T), or by a listing agency that is approved by the Executive Director.

(d) Instantaneous water heaters with an input rating greater than 6.8 kBTU/hr (2kW) shall meet the requirements of Section 110.3(c)7

(e) ~~Mandatory Requirements for~~ **Commercial Boilers**

1. Combustion air positive shut-off shall be provided on all newly installed boilers as follows:

   A. All boilers with an input capacity of 2.5 MMBtu/h (2,500,000 Btu/h) and above, in which the boiler is designed to operate with a nonpositive vent static pressure.

   B. All boilers where one stack serves two or more boilers with a total combined input capacity per stack of 2.5 MMBtu/h (2,500,000 Btu/h).

2. Boiler combustion air fans with motors 10 horsepower or larger shall meet one of the following for newly installed boilers:

   A. The fan motor shall be driven by a variable speed drive, or

   B. The fan motor shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume.

3. Newly installed boilers with an input capacity 5 MMBtu/h (5,000,000 Btu/h) and greater shall maintain excess (stack-gas) oxygen concentrations at less than or equal to 5.0 percent by volume on a dry basis over firing rates of 20 percent to 100 percent. Combustion air volume shall be controlled with respect to firing rate or flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

   EXCEPTION to Section ~~120.9(c)~~ 160.4(e)3: Boilers with steady state full-load thermal efficiency 85 percent or higher.

(f) **Insulation for Piping and Tanks**

1. **Storage tank insulation.** Unfired hot water tanks, such as storage tanks and backup storage tanks for solar water-heating systems, shall be externally wrapped with insulation having an installed thermal resistance of R-12 or greater or have internal insulation of at least R-16 and a label on the exterior of the tank showing the insulation R-value.

2. ~~Piping shall be insulated as follows:~~All domestic hot water piping shall be insulated as specified in Section 609.11 of the California Plumbing Code. In addition, the following piping conditions shall have a minimum insulation wall thickness of 1 inch or a minimum insulation R-value of 7.7:

A. The first 5 feet (1.5 meters) of cold water pipes from the storage tank.

B. All hot water piping with a nominal diameter equal to or greater than 3/4 inch (19 millimeter) and less than 1 inch.

C. All hot water piping with a nominal diameter less than 3/4 inch that is:

i. Associated with a domestic hot water recirculation system;

ii. From the heating source to the kitchen fixtures;

iii. From the heating source to a storage tank or between storage tanks; or

iv. Buried below grade.

EXCEPTION 1 to Section ~~150.0(j)2~~160.4(f)2: Factory-installed piping within space-conditioning equipment certified under Section 110.1 or 110.2.

EXCEPTION 2 to Section ~~150.0(j)2~~160.4(f)2: Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. Piping that penetrates metal framing shall use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the metal framing. Insulation shall abut securely against all framing members.

EXCEPTION 3 to Section ~~150.0(j)2~~160.4(f)2: Piping installed in interior or exterior walls shall not be required to have pipe insulation if all of the requirements are met for compliance with Quality Insulation Installation (QII) as specified in the Reference Residential Appendix RA3.5.

EXCEPTION 4 to Section ~~150.0(j)2~~160.4(f)2: Piping surrounded with a minimum of 1 inch of wall insulation, 2 inches of crawlspace insulation, or 4 inches of attic insulation, shall not be required to have pipe insulation.

3. **Insulation Protection.** Pipe Insulation shall be protected from damage due to sunlight, moisture, equipment maintenance, and wind. Protection shall, at minimum, include the following:

A. Pipe insulation exposed to weather shall be protected by a cover suitable for outdoor service. The cover shall be water retardant and provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be used to provide this protection.

B. Pipe insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall include, or be protected by, a Class I or Class II vapor retarder. All penetrations and joints shall be sealed.

C. Pipe insulation buried below grade must be installed in a water proof and non-crushable casing or sleeve.

SECTION 160.5 – MANDATORY LIGHTING REQUIREMENTS FOR INDOOR AND OUTDOOR SPACES.

The design and installation of all lighting systems, lighting controls, and equipment in the following functional areas shall comply with the applicable ~~residential~~ lighting requirements of Section ~~150.0(k)~~160.5(a)..

1. ~~High-rise residential~~ Multifamily dwelling units.
2. Outdoor lighting attached to ~~a high-rise residential or hotel/motel~~ multifamily building and separately controlled from the inside of a dwelling unit ~~or guest room~~.
3. ~~Fire station dwelling accommodations.~~
4. ~~Hotel and motel guest rooms. Additionally, hotel and motel guest rooms shall meet the requirements of Section 130.1(c)8 and Section 130.5(d)4.~~
5. ~~Dormitory and Senior housing dwelling accommodations.~~

In buildings containing these functional areas, all other functional areas, such as common use areas, shall comply with the applicable ~~nonresidential~~ lighting and controlled receptacle requirements of Sections 160.5(b) through 160.5(e).

(a) **Dwelling Unit Lighting.**

1. Luminaire Requirements.

A. **Luminaire Efficacy.** All installed luminaires shall meet the requirements in TABLE ~~150.0~~160.5-A.

B. **Blank Electrical Boxes.** The number of electrical boxes that are more than 5 feet above the finished floor and do not contain a luminaire or other device shall be no greater than the number of bedrooms. These electrical boxes must be served by a dimmer, vacancy sensor control, or fan speed control.

C. **Recessed Downlight Luminaires in Ceilings.** In addition to complying with ~~150.0(k)1A~~160.56(a)1A, luminaires recessed into ceilings shall meet all of the following requirements:

i. Be listed, as defined in Section 100.1, for zero clearance insulation contact (IC) by Underwriters Laboratories or other nationally recognized testing/rating laboratory; and

ii. Have a label that certifies the luminaire is airtight with air leakage less than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283. An exhaust fan housing shall not be required to be certified airtight; and

iii. Be sealed with a gasket or caulk between the luminaire housing and ceiling, and have all air leak paths between conditioned and unconditioned spaces sealed with a gasket or caulk; and

iv. For luminaires with hardwired ballasts or drivers, allow ballast or driver maintenance and replacement to be readily accessible to building occupants from below the ceiling without requiring the cutting of holes in the ceiling; and

v. Shall not contain screw base sockets.

D. **Electronic Ballasts for Fluorescent Lamps.** Ballasts for fluorescent lamps rated 13 watts or greater shall be electronic and shall have an output frequency no less than 20 kHz.

E. **Night Lights, Step Lights and Path Lights.** Night lights, step lights and path lights shall not be required to comply with TABLE ~~150.0~~160.5-A or be controlled by vacancy sensors provided they are rated to consume no more than 5 watts of power and emit no more than 150 lumens.

F. **Lighting Integral to Exhaust Fans.** Lighting integral to exhaust fans shall meet the applicable requirements of Section ~~150.0(k)~~160.5(a).

EXCEPTION to Section ~~150.0(k)1F~~160.5(a)1F: Lighting installed by the manufacturer in kitchen exhaust hoods.

G. **Screw based luminaires.** Screw based luminaires shall contain lamps that comply with Reference Joint Appendix JA8.

EXCEPTION to Section ~~150.0(k)1G~~160.5(a)1G: Luminaires with hard-wired ballasts for high intensity discharge lamps.

H. **Light Sources in Enclosed or Recessed Luminaires.** Lamps and other separable light sources that are not compliant with the JA8 elevated temperature requirements, including marking requirements, shall not be installed in enclosed or recessed luminaires.

I. **Light Sources in Drawers, Cabinets, and Linen Closets.** Light sources internal to drawers, cabinetry or linen closets shall not be required to comply with TABLE ~~150.0~~160.5-A or be controlled by vacancy sensors provided that they are rated to consume no more than 5 watts of power and emit no more than 150

2. Interior Lighting **Switching Devices and Controls.**

A. All forward phase cut dimmers used with LED light sources shall comply with NEMA SSL 7A.

B. Exhaust fans shall be controlled separately from lighting systems.

EXCEPTION to Section ~~150.0(k)2B~~160.5(a)2B: Lighting integral to an exhaust fan may be on the same control as the fan provided the lighting can be turned OFF in accordance with the applicable provisions in Section ~~150.0(k)2~~160.5(a)2 while allowing the fan to continue to operate.

C. Lighting shall have readily accessible wall-mounted controls that allow the lighting to be manually turned ON and OFF.

EXCEPTION to Section ~~150.0(k)2C~~160.5(a)2C: Ceiling fans may provide control of integrated lighting via a remote control.

D. Lighting controls and equipment shall be installed in accordance with the manufacturer's instructions.

E. No controls shall bypass a dimmer, occupant sensor or vacancy sensor function where that dimmer or sensor has been installed to comply with Section ~~150.0(k)~~160.5(a).

F. Lighting controls shall comply with the applicable requirements of Section 110.9.

G. An Energy Management Control System (EMCS) may be used to comply with control requirements in Section ~~150.0(k)~~160.5(a) if at a minimum it provides the functionality of the specified controls in accordance with Section 110.9, meets the installation certificate requirements in Section ~~130.4~~ 160.5(e), meets the EMCS requirements in Section ~~130.0(c)~~160.5(b)4, and complies with all other applicable requirements in Section ~~150.0(k)2~~160.5(a)2.

H. A multiscene programmable controller may be used to comply with dimmer requirements in Section ~~150.0(k)~~ 160.5(a) if at a minimum it provides the functionality of a dimmer in accordance with Section 110.9, and complies with all other applicable requirements in Section ~~150.0(k)2~~160.5(a)2.

I. In bathrooms, ~~garages,~~ dwelling unit laundry rooms, and utility rooms, at least one luminaire in each of these spaces shall be controlled by an occupant or vacancy sensor providing automatic-off functionality. If an occupant sensor is installed, it shall be initially configured to manual-on operation using the manual control required under Section ~~150.0(k)2C~~160.5(a)2C.

J. Luminaires that are or contain light sources that meet Reference Joint Appendix JA8 requirements for dimming, and that are not controlled by occupancy or vacancy sensors, shall have dimming controls.

EXCEPTION 1 to Section ~~150.0(k)2K~~160.5(a)2J: Luminaires in closets less than 70 square feet.

EXCEPTION 2 to Section ~~150.0(k)2K~~160.5(a)2J: Luminaires in hallways.

K. Undercabinet lighting shall be controlled separately from ceiling-installed lighting such that one can be turned on without turning on the other.

(b) **Common Use Area Lighting.** The design and installation of all lighting systems and equipment in multifamily common use areas ~~nonresidential, high-rise residential, hotel/motel buildings~~, outdoor lighting, and electrical power distribution systems within the scope of Section 100.0(a) shall comply with the applicable provisions of Sections ~~130.0~~160.5(b)1 through ~~130.5~~160.5(e).

NOTE: The requirements of Section~~s~~ ~~130.0~~160.5(b) ~~through~~ ~~130.5~~ appl~~y~~ies to newly constructed buildings. Section ~~141.0~~180.1 and 180.2 specifi~~es~~y which requirements of Sections ~~130.0~~160.5(b)1 through ~~130.5~~160.5(e)also apply to additions and alterations to existing buildings.

1. **Luminaire classification and power**. Luminaires shall be classified and their wattage determined as follows:

A. Luminaire wattage shall be labeled as follows:

i. High intensity discharge luminaires, having an integral electronic ballast, with a maximum relamping rated wattage of 150 watts.

ii. Low-voltage luminaires (except 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.

a. The maximum rated wattage or relamping rated wattage of a luminaire shall be listed on a permanent, preprinted, factory-installed label, as specified by UL 1574, 1598, 2108, or 8750, as applicable; and

b. The factory-installed maximum rated wattage or relamping rated wattage label shall not consist of peel-off or peel-down layers or other methods that allow the rated wattage to be changed after the luminaire has been shipped from the manufacturer.

EXCEPTION to Section ~~130.0(c)1B~~ 160.5(b)1Aiiib: Peel-down labels may be used only for the following luminaires when they can accommodate a range of lamp wattages without changing the luminaire housing, ballast, transformer or wiring. Qualifying luminaires shall have a single lamp, and shall have integrated ballasts or transformers. Peel-down labels must be layered such that the rated wattage reduces as successive layers are removed.

B. For luminaires with line voltage lamp holders not containing permanently installed ballasts or transformers, the wattage of such luminaires shall be determined as follows:

i. The maximum rated wattage of the luminaire; and

ii. For recessed luminaires with line-voltage medium screw base sockets, wattage shall not be less than 50 watts per socket, or the rated wattage of the installed JA8 compliant lamps.

C. For luminaires with permanently installed or remotely installed ballasts, the wattage of such luminaires shall be the operating input wattage of the rated lamp/ballast combination published in the ballast manufacturer's catalogs based on independent testing lab reports as specified by UL 1598.

D. For inseparable SSL luminaires and SSL luminaires with remotely mounted drivers, the maximum rated wattage shall be the maximum rated input wattage of the SSL luminaire as specified in Section ~~130.0(c)1~~ 160.5(c)1A when tested in accordance with UL 1598, 2108, 8750, or IES LM-79.

E. For LED tape lighting and LED linear lighting with LED tape lighting components, the maximum rated wattage shall be the sum of the installed length of the tape lighting times its rated linear power density in watts per linear feet, or the maximum rated input wattage of the driver or power supply providing power to the lighting system, with tape lighting tested in accordance with UL 2108, 8750, or IES LM-79,

F. For modular lighting systems that allow the addition or relocation of luminaires without altering the wiring of the system, shall be determined as follows:

i. The wattage shall be the greater of:

c. 30 watts per linear foot of track or plug-in busway; or

d. the rated wattage of all of the luminaires included in the system, where the luminaire wattage is determined as specified in Section ~~130.0(c)1~~ 160.5(c)1A; or

ii. For line-voltage lighting track and plug-in busway served by a track lighting integral current limiter or a dedicated track lighting supplementary overcurrent protection panel, the wattage shall be determined as follows:

a. The volt-ampere rating of current limiter as specified by UL 1077;

b. The sum of the ampere (A) rating of all of the current protection devices times the branch circuit voltages for track lighting supplementary overcurrent protection panel ; or

iii. For other modular lighting systems with power supplied by a driver, power supply or transformer, including but not limited to low-voltage lighting systems, the wattage of the system shall be the maximum rated input wattage of the driver, power supply or transformer published in the manufacturer's catalogs, as specified by UL 2108 or 8750.

EXCEPTION to Section ~~130.0(c)6~~160.5(b)1F: For power-over-Ethernet lighting systems, power provided to installed non-lighting devices may be subtracted from the total power rating of the power-over-Ethernet system.

G. For all other lighting equipment not addressed by Sections ~~130.0(c)2~~160.5(b)1B through ~~6~~F, the wattage of the lighting equipment shall be the maximum rated wattage of the lighting equipment, or operating input wattage of the system, labeled in accordance with Section ~~130.0(c)1~~160.5(b)1A, or published in manufacturer's catalogs, based on independent testing lab reports as specified by UL 1574, 1598, 2108, 8750, or IES LM-79.

2. **Lighting Controls**. All lighting controls and equipment shall comply with the applicable requirements in Sections 110.9, ~~130.1~~160.5(b)5 and ~~130.2~~160.5(c), and shall be installed in accordance with any applicable manufacturer instructions.

3. **Energy Management Control System (EMCS)**. An EMCS may be installed to comply with the requirements of one or more lighting controls if it meets the following minimum requirements:

A. Provides all applicable functionality for each specific lighting control or system for which it is installed in accordance with Sections 110.9, ~~130.1~~160.5(b)5 and ~~130.2~~160.5(c); and

B. Complies with all applicable Lighting Control Installation Requirements in accordance with Section ~~130.4~~160.5(e) for each specific lighting control or system for which it is installed; and

C. Complies with all applicable application requirements for each specific lighting control or system for which it is installed, in accordance with Part 6.

4. **Mandatory Indoor Lighting Controls**. ~~Nonresidential, high-rise residential,~~ Multifamily common use areas ~~and hotel/motel buildings~~ shall comply with the applicable requirements of Sections ~~130.1(a)~~160.5.(b)4A through ~~130.1(f)~~ 160.5(b)4F, in addition to the applicable requirements of Sections 110.9.

A. **Manual Area Controls.** Each area enclosed by ceiling-height partitions shall provide lighting controls that allow the lighting in that area to be manually turned on and off. The manual control shall:

i. Be readily accessible; and

EXCEPTION to Section ~~130.1(a)1~~160.5(b)4Ai: Public restrooms having two or more stalls, parking areas, stairwells, and corridors may use a manual control not accessible to unauthorized personnel.

ii. Be located in the same enclosed area with the lighting it controls; and

EXCEPTION 1 to Section ~~130.1(a)2~~160.5(b)4Aii: For ~~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, arenas, psychiatric and secure areas in healthcare facilities, and other~~ areas where placement of a manual area control poses a health and safety hazard, the manual area control may instead be located so that a person using the control can see the lights or area controlled by that control, or visually signal or display the current state of the controlled lighting.

~~**EXCEPTION 2 to Section 130.1(a)2160.5(b)4Aii:** In healthcare facilities, for restrooms and bathing rooms intended for a single occupant, the lighting control may be located outside the enclosed area but directly adjacent to the door.~~

iii. Provide separate control of general~~, floor display,~~ wall display, window display, case display, ornamental, and special effects lighting, such that each type of lighting can be turned on or off without turning on or off other types of lighting, and without turning on or off any other equipment.

EXCEPTION to Section ~~130.1(a)~~160.5(b)4A: Up to 0.2 watts per square foot of indoor lighting may be continuously illuminated to allow for means of egress illumination consistent with California Building Code Section 1008. Egress lighting complying with this wattage limitation is not required to comply with manual area control requirements if:

i. The area is designated for means of egress on the plans and specifications submitted to the enforcement agency under Section 10-103(a)2 of Part 1; and

ii. The controls for the egress lighting are not accessible to unauthorized personnel.

B. **Multi-Level Lighting Controls.** The general lighting of any enclosed area 100 square feet or larger with a connected lighting load that exceeds 0.5 watts per square foot shall provide multi-level lighting controls that allow the level of lighting to be adjusted up and down. The multi-level controls shall provide the number of control steps and meet the uniformity requirements specified in TABLE ~~130.1-A~~160.5-B.

EXCEPTION 1 to Section ~~130.1(b)~~ 160.5(b)4B: An area enclosed by ceiling height partitions that has only one luminaire with no more than two lamps.

EXCEPTION 2 to Section ~~130.1(b)~~ 160.5(b)4B: Restrooms.

~~**EXCEPTION 3 to Section 130.1(b):** Healthcare facilities.~~

C. **Shut-OFF Controls.** All installed indoor lighting shall be equipped with controls able to automatically reduce lighting power when the space is typically unoccupied.

~~**EXCEPTION to Section 130.1(c):** Healthcare facilities.~~

i. In addition to lighting controls installed to comply with Sections ~~130.1(a)~~ 160.5(b)4A and ~~(b)~~B, all installed indoor lighting shall be equipped with controls that meet the following requirements:

a. Shall be controlled with an occupant sensing control, automatic time-switch control, or other control capable of automatically shutting OFF all of the lighting when the space is typically unoccupied; and

b. Separate controls for the lighting on each floor, other than lighting in stairwells; and

c. Separate controls for a space enclosed by ceiling height partitions not exceeding 5,000 square feet; and

~~**EXCEPTION to Section 130.1(c)1C:** In the following function areas the area controlled may not exceed 20,000 square feet: Malls, auditoriums, single tenant retail, industrial, convention centers, and arenas;~~

d. Separate controls for general, display, and ornamental, ~~and display case~~ lighting; and

e. For automatic time-switch controls, may include a manual-on mode.

EXCEPTION 1 to Section ~~130.1(c)1~~160.5(b)4Ci: Where the lighting is serving an area that is in continuous use, 24 hours per day/365 days per year.

EXCEPTION 2 to Section ~~130.1(c)1~~160.5(b)4Ci: Lighting complying with Section ~~130.1(c)5~~160.5(b)4Cv or ~~7~~vii.

EXCEPTION 3 to Section ~~130.1(c)1~~160.5(b)4Ci: Up to 0.1 watts per square foot of lighting in any area within a building 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 Section 10-103(a)2 of Part 1.

EXCEPTION 4 to Section ~~130.1(c)1~~160.5(b)4Ci: Electrical equipment rooms subject to Article 110.26(D) of the California Electrical Code.

EXCEPTION 5 to Section ~~130.1(c)1~~160.5(b)4Ci: Illumination provided by lighting equipment that is designated for 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.

ii. Countdown timer switches may be used to comply with the automatic shut-OFF control requirements in **Section ~~130.1(c)1~~160.5(b)4Ci** only in closets less than 70 square feet~~, and server aisles in server rooms~~. The maximum timer setting shall be 10 minutes for closets~~, and 30 minutes for server aisles~~.

iii. If an automatic time-switch control, other than an occupant sensing control, is installed to comply with **Section ~~130.1(c)1~~160.5(b)4Ci**, it shall incorporate a manual override lighting control that:

a. Complies with ~~130.1(a)~~160.5(b)4A; and

b. Allows the lighting to remain ON for no more than 2 hours when an override is initiated.

~~**EXCEPTION to Section 130.1(c)3B:** In the following function areas, the override time may exceed 2 hours: Malls, auditoriums, single tenant retail, industrial, and arenas where captive key override is utilized.~~

iv. If an automatic time-switch control, other than an occupant sensing control, is installed to comply with Section ~~130.1(c)1~~160.5(b)4Ci, 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.

~~EXCEPTION to Section 130.1(c)4:~~ ~~In retail stores and associated malls, restaurants, grocery stores, churches, and theaters, the automatic time-switch control is not required to incorporate an automatic holiday shut-OFF feature.~~

v. **Areas where Occupant Sensing Controls are required to shut OFF All Lighting**. In offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, ~~classrooms of any size,~~ conference rooms of any size, and restrooms of any size, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting when the room is unoccupied.

In areas required by Section ~~130.1(b)~~160.5(b)4B 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, or

b. Vacancy Sensor, where all lighting responds to a manual ON input only.

In areas not required by Section ~~130.1(b)~~160.5(b)4B to have multi-level lighting controls, the occupant sensing controls shall function either as a:

a. Occupant Sensor; or

b. Partial-ON Occupant Sensor, or

c. Vacancy Sensor, where all lighting responds to a manual ON input only.

In addition, controls shall be provided that allow the lights to be manually shut-OFF in accordance with Section ~~130.1(a)~~160.5(b)4A regardless of the sensor status.

vi. Areas where full or partial OFF occupant sensing controls are required. Lighting installed in the following areas shall meet the following requirements in addition to complying with Section 130.1(c)1.

~~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 shall independently control lighting in each aisle way, and shall not control lighting beyond the aisle way being controlled by the sensor.~~

~~EXCEPTION 1 to Section 130.1(c)6A:~~ ~~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.~~

~~EXCEPTION 2 to Section 130.1(c)6A:~~ ~~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.~~

a. 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.

vii. Areas where partial OFF occupant sensing controls are required. Lighting installed in the following areas shall meet the following requirements instead of complying with Section ~~130.1(c)1~~160.5(b)4Ci.

a. Lighting in stairwells and common area corridors that 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.

EXCEPTION to Section ~~130.1(c)7A~~160.5(b)4Cviia: In 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.

b. In parking garages, parking areas and loading and unloading areas, general lighting shall be controlled by occupant sensing controls having at least one control step between 20 percent and 50 percent of design lighting power. No more than 500 watts of rated lighting power shall be controlled together as a single zone. A reasonably uniform level of illuminance shall be achieved in accordance with the applicable requirements in TABLE ~~130.1-A~~160.5-B. 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.

Interior areas of parking garages are classified as indoor lighting for compliance with Section ~~130.1(c)7B~~160.5(b)4Cviiib. Parking areas on the roof of a parking structure are classified as outdoor hardscape and shall comply with the applicable provisions in Section ~~130.2~~ 60.5(c).

EXCEPTION to Section ~~130.1(c)7B~~160.5(b)4Cviiib: Metal halide luminaires with a lamp plus ballast mean system efficacy of greater than 75 lumens per watt, used for general lighting in parking garages, parking areas and loading and unloading areas, shall be controlled by occupant sensing controls having at least one control step between 20 percent and 60 percent of design lighting power.

EXCEPTION 2 to Section ~~130.1(c)~~160.5(b)4C: Lighting providing means of egress illumination, as the term is used in the California Building Code, shall be configured to provide no less than the amount of light required by California Building Code Section 1008 while in the partial-off mode.

D. **Automatic Daylighting Controls.** The general lighting in skylit daylit zones and primary sidelit daylit zones, as well as the general lighting in the combined primary and secondary sidelit daylit zones in parking garages, shall provide controls that automatically adjust the power of the installed lighting up and down to keep the total light level stable as the amount of incoming daylight changes. For skylight located in an atrium, the skylit daylit zone definition shall apply to the floor area directly under the atrium and the top floor area directly adjacent to the atrium.

i. All skylit daylit zones, primary sidelit daylit zones, and the combined primary and secondary sidelit daylit zones in parking garages shall be shown on the plans.

NOTE: Parking areas on the roof of a parking structure are outdoor hardscape, not skylit daylit areas.

ii. The automatic daylighting controls shall provide separate control for luminaires in each type of daylit zone. Luminaires that fall in both a skylit and sidelit daylit zone shall be controlled as part of the skylit zone.

iii. The automatic daylighting controls shall:

a. For spaces required to install multilevel controls under Section ~~130.1(b)~~160.5(b)4B, adjust lighting via continuous dimming or the number of control steps provided by the multilevel controls;

b. For each space, ensure the combined illuminance from the controlled lighting and daylight is not less than the illuminance from controlled lighting when no daylight is available;

c. For areas other than parking garages, ensure that 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; and

d. For parking garages, ensure that when illuminance levels measured at the farthest edge of the secondary sidelit zone away from the glazing or opening are greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power consumption is zero.

iv. When photosensors are located within the daylit zone, at least one photosensor shall be located so that they are not readily accessible to unauthorized personnel.

v. 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.

EXCEPTION 1 to Section ~~130.1(d)~~160.5(b)4D: Areas under skylights where it is documented that existing adjacent structures or natural objects block direct sunlight for more than 1,500 daytime hours per year between 8a.m. and 4p.m.

EXCEPTION 2 to Section ~~130.1(d)~~160.5(b)4D Areas adjacent to vertical glazing below an overhang, where the overhang covers the entire width of the vertical glazing, no vertical glazing is above the overhang, and the ratio of the overhang projection to the overhang rise is greater than 1.5 for South, East and West orientations or greater than 1 for North orientations.

EXCEPTION 3 to Section ~~130.1(d)~~160.5(b)4D: 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, or parking garage areas where the total combined general lighting power in the sidelit daylight zones is less than 60 watts.

EXCEPTION 4 to Section ~~130.1(d)~~160.5(b)4D: Rooms that have a total glazing area of less than 24 square feet, or parking garage areas with a combined total of less than 36 square feet of glazing or opening.

EXCEPTION 5 to Section ~~130.1(d)~~160.5(b)4D: For parking garages, luminaires located in the daylight adaptation zone and luminaires for only dedicated ramps. Daylight adaptation zone and dedicated ramps are defined in Section 100.1.

~~**EXCEPTION 6 to Section 130.1(d):** Luminaires in sidelit daylit zones in retail merchandise sales and wholesale showroom areas.~~

E. **Demand Responsive Controls.** See Section 110.12 for requirements for demand responsive lighting controls.

F. **Control Interactions.** Each lighting control installed to comply with Section ~~130.1~~160.5(b)4 shall permit or incorporate the functions of the other lighting controls required by this Section.

i. For general lighting, the manual area control shall permit the level or amount of light provided while the lighting is on to be set or adjusted by the controls specified in Sections ~~130.1(b), (c), (d), and (e)~~ 160.5(b)4B, C, D, and E..

ii. The manual area control shall permit the shutoff control to turn the lighting down or off.

iii. The multi-level lighting control shall permit the automatic daylighting control to adjust the electric lighting level in response to changes in the amount of daylight in the daylit zone.

iv. The multi-level lighting control shall permit the demand responsive control to adjust the lighting during a demand response event and to return it to the level set by the multilevel control after the event.

v. The shutoff control shall permit the manual area control to turn the lighting on. If the on request occurs while an automatic time switch control would turn the lighting off, then the on request shall be treated as an override request consistent with Section ~~130.1(c)3~~160.5(c)4Ciii.

vi. The automatic daylighting control shall permit the multi-level lighting control to adjust the level of lighting.

vii. For lighting controlled by multi-level lighting controls and by occupant sensing controls that provide an automatic-on function, the controls shall provide a partial-on function that is capable of automatically activating between 50-70 percent of controlled lighting power.

(c) **Outdoor Lighting and Controls Equipment.** ~~Nonresidential, high-rise residential and hotel/motel~~ Multifamily common use areas ~~buildings~~ shall comply with the applicable requirements of Sections ~~130.2(a)~~ 160.5(c)1 through ~~130.2(c)~~ 160.5(c)2.

1. **Luminaire Cutoff Requirements.** All outdoor luminaires of 6,200 initial luminaire lumens or greater, shall comply with Backlight, Uplight, and Glare (collectively referred to as "BUG" in accordance with IES TM-15-11, Addendum A) requirements as follows:

A. Maximum zonal lumens for Backlight, Uplight, and Glare shall be in accordance with Title 24, Part 11, Section 5.106.8.

EXCEPTION 1 to Section ~~130.2(b)~~ 160.5(c)1: Signs.

EXCEPTION 2 to Section ~~130.2(b)~~ 160.5(c)1: Lighting for building facades, public monuments, statues, and vertical surfaces of bridges.

EXCEPTION 3 to Section ~~130.2(b)~~ 160.5(c)1: Lighting not permitted by a health or life safety statute, ordinance, or regulation to be a cutoff luminaire.

EXCEPTION 4 to Section ~~130.2(b)~~ 160.5(c)1: Temporary outdoor lighting**.**

EXCEPTION 5 to Section ~~130.2(b)~~ 160.5(c)1: Replacement of existing pole mounted luminaires in hardscape areas meeting all of the following conditions:

A. Where the existing luminaire does not meet the luminaire BUG requirements in Section ~~130.2(b)~~ 160.5(c)1; and

B. Spacing between existing poles is greater than six times the mounting height of the existing luminaires; and

C. Where no additional poles are being added to the site; and

D. Where new wiring to the luminaires is not being installed; and

E. Provided that the connected lighting power wattage is not increased.

EXCEPTION 6 to Section ~~130.2(b)~~ 160.5(c)1: Luminaires that illuminate the public right of way on publicly maintained roadways, sidewalks, and bikeways that are owned or maintained by the local municipality or utility.

EXCEPTION 7 to Section ~~130.2(b)~~ 160.5(c)1: Outdoor lighting attached to a ~~high-rise residential or hotel/motel~~ multifamily building and separately controlled from the inside of a dwelling unit ~~or guest room~~.

2. **Controls for Outdoor Lighting.** Outdoor lighting shall be independently controlled from other electrical loads, and the controls for outdoor lighting shall meet the following functional requirements:

EXCEPTION 1 to Section ~~130.2(c)~~ 160.5(c)2: Outdoor lighting not permitted by a health or life safety statute, ordinance, or regulation to be turned OFF or reduced.

EXCEPTION 2 to Section ~~130.2(c)~~ 160.5(c)2: Lighting in tunnels required to be illuminated 24 hours per day and 365 days per year.

A. **Daylight Availability.** All installed outdoor lighting shall be controlled by a photo control, astronomical time-switch control, or other control capable of automatically shutting OFF the outdoor lighting when daylight is available.

B. **Automatic Scheduling Controls.**

i. Automatic scheduling controls shall be capable of reducing the outdoor lighting power by at least 50 percent and no more than 90 percent, and separately capable of turning the lighting OFF, during scheduled unoccupied periods.

ii. Automatic scheduling controls shall allow scheduling of a minimum of two nighttime periods with independent lighting levels, and may include an override function that turns lighting ON during its scheduled dim or OFF state for no more than two hours when an override is initiated.

iii. Acceptance tests of outdoor lighting controls shall verify the scheduled occupied and unoccupied periods, as specified in Section ~~130.4(a)6~~ 160.5(e)6.

iv. Automatic scheduling controls shall be installed for all outdoor lighting, and may be installed in combination with motion sensing controls or other outdoor lighting controls.

C. Motion Sensing Controls.

i. Motion sensing controls shall be capable of reducing the outdoor lighting power of each controlled luminaire by at least 50 percent and no more than 90 percent, and separately capable of turning the luminaire OFF, during unoccupied periods.

ii. Motion sensing controls shall be capable of reducing the lighting to its dim or OFF state no longer than 15 minutes after the area has been vacated, and of returning the lighting to its ON state when the area becomes occupied.

iii. No more than 1,500 watts of lighting power shall be controlled by a single sensor.

iv. Motion sensing controls shall be installed for the following luminaires, and may be installed for other outdoor lighting and in combination with other outdoor lighting controls:

a. Outdoor luminaires other than Building Façade, Ornamental Hardscape, or Outdoor Dining, ~~or Outdoor Sales Frontage lighting~~, where the bottom of luminaire is mounted 24 feet or less above grade; and,

b. Outdoor wall mounted luminaires installed for Building Façade, Ornamental Hardscape or Outdoor Dining lighting that have a bilaterally symmetric distribution as described in the IES Handbook (typically referred to as "wall packs") mounted 24 feet above grade or lower.

EXCEPTION 1 to Section ~~130.2(c)3~~160.5(c)2iii: Luminaires with a maximum rated wattage of 40 watts each are not required to have motion sensing controls.

EXCEPTION 2 to Section ~~130.2(c)3~~160.5(c)2iii: Applications listed as Exceptions to Section ~~140.7(a)~~170.2(e)2A are not required to have motion sensing controls.

EXCEPTION 3 to Section ~~130.2(c)3~~160.5(c)2iii: Lighting subject to a health or life safety statute, ordinance, or regulation may have a minimum time-out period longer than 15 minutes or a minimum dimming level above 50 percent when necessary to comply with the applicable law.

(d) **Sign Lighting Controls.** All sign lighting shall meet the requirements below as applicable:

1. **Indoor Signs.** All indoor sign lighting other than exit sign lighting shall be controlled with an automatic time-switch control or astronomical time-switch control.

2. **Outdoor Signs.** Outdoor sign lighting shall meet the following requirements as applicable:

A. All outdoor sign lighting shall be controlled with a photocontrol in addition to an automatic time-switch control, or an astronomical time-switch control.

EXCEPTION to Section ~~130.3(a)2A~~160.5(d)2A: Outdoor signs in tunnels, and signs in large permanently covered outdoor areas that are intended to be continuously lit, 24 hours per day and 365 days per year.

B. All outdoor sign lighting that is ON both day and night shall be controlled with a dimmer that provides the ability to automatically reduce sign lighting power by a minimum of 65 percent during nighttime hours. Signs that are illuminated at night and for more than 1 hour during daylight hours shall be considered ON both day and night.

EXCEPTION to Section ~~130.3(a)2B~~160.5(d)2B: Outdoor signs in tunnels and large covered areas that are intended to be illuminated both day and night.

3. **Demand Responsive Electronic Message Center (EMC) Control.** See Section 110.12 for requirements for demand responsive EMC controls.

(e) Lighting Control Acceptance and Installation Certificate Requirement. ~~Nonresidential buildings other than healthcare facilities, high-rise residential~~ Multifamily common area ~~buildings, and hotel/motel buildings~~ shall comply with the applicable requirements of Sections ~~130.4(a)~~160.5(e)1 through ~~130.4(c)~~ 160.5(e)3. ~~Healthcare facilities shall comply with the applicable acceptance and installation documentation requirements of OSHPD.~~

1. **Lighting Control Acceptance Requirements.** Before an occupancy permit is granted, indoor and outdoor lighting controls serving the building, area, or site shall be certified as meeting the Acceptance Requirements for Code Compliance in accordance with Section ~~130.4(a)~~160.5(e) A Certificate of Acceptance shall be submitted to the enforcement agency under Section 10-103(a) of Part 1, that:

A. Certifies that all of the lighting acceptance testing necessary to meet the requirements of Part 6 is completed;

B. Certifies that the applicable procedures in Reference Nonresidential Appendix NA7.6 and NA7.8 have been followed;

C. Certifies that automatic daylight controls comply with Section ~~130.1(d)~~160.5(b)4D and Reference Nonresidential Appendix NA7.6.1;

D. Certifies that lighting shut-OFF controls comply with Section ~~130.1(c)~~ 160.5(b)4C and Reference Nonresidential Appendix NA7.6.2;

E. Certifies that demand responsive controls comply with Section ~~130.1(e)~~ 160.5(b)4E and Reference Nonresidential Appendix NA7.6.3; and

F. Certifies that outdoor lighting controls comply with the applicable requirements of Section ~~130.2(c)~~160.5(c)2 and Reference Nonresidential Appendix NA7.8; and

G. Certifies that lighting systems receiving the Institutional Tuning Power Adjustment Factor comply with Section ~~140.6(a)2J~~170.2(e)1Aiij and Reference Nonresidential Appendix NA7.7.6.2.

2. **Lighting Control Installation Certificate Requirements.** To be recognized for compliance with Part 6 an Installation Certificate shall be submitted in accordance with Section 10-103(a) for any lighting control system, Energy Management Control System, track lighting integral current limiter, track lighting supplementary overcurrent protection panel, interlocked lighting system, lighting Power Adjustment Factor, or additional wattage available for a videoconference studio, in accordance with the following requirements, as applicable:

A. Certification that when a lighting control system is installed to comply with lighting control requirements in Part 6 it complies with the applicable requirements of Section 110.9; and complies with Reference Nonresidential Appendix NA7.7.1.

B. Certification that when an Energy Management Control System is installed to function as a lighting control required by Part 6 it functionally meets all applicable requirements for each application for which it is installed, in accordance with Sections 110.9, ~~130.0 through 130.5, 140.6 through 150.0, and 150.2~~160, 170, and 180; and complies with Reference Nonresidential Appendix NA7.7.2.

C. Certification that interlocked lighting systems used to serve an approved area comply with Section ~~140.6(a)1~~170.2(e)1A; and comply with Reference Nonresidential Appendix NA7.7.5.

D. Certification that lighting controls installed to earn a lighting Power Adjustment Factor (PAF) comply with Section ~~140.6(a)2~~170.2(e)1B; and comply with Reference Nonresidential Appendix NA7.7.6.

E. Certification that additional lighting wattage installed for a videoconference studio complies with Section ~~140.6(c)2Gvii~~170.2(e)1CigVI; and complies with Reference Nonresidential Appendix NA7.7.7.

3. When certification is required by Title 24, Part 1, Section 10-103.1, the acceptance testing specified by Section ~~130.4~~ 160.5(e) shall be performed by a Certified Lighting Controls Acceptance Test Technician (CLCATT). If the CLCATT is operating as an employee, the CLCATT shall be employed by a Certified Lighting Controls Acceptance Test Employer. The CLCATT shall disclose on the Certificate of Acceptance a valid CLCATT certification identification number issued by an approved Acceptance Test Technician Certification Provider. The CLCATT shall complete all Certificate of Acceptance documentation in accordance with the applicable requirements in Section 10-103(a)4.

TABLE ~~150.0~~160.5-A CLASSIFICATION OF DWELLING UNIT HIGH EFFICACY LIGHT SOURCES

High Efficacy Light Sources Light sources shall comply with one of the columns below:	
Light sources in this column other than those installed in ceiling recessed downlight luminaires are classified as high efficacy and are **not** required to comply with Reference Joint Appendix JA8	Light sources in this column are only considered to be high efficacy if they are certified to the Commission as High Efficacy Light Sources in accordance with Reference Joint Appendix JA8 and marked as required by JA8.
1. Pin-based linear fluorescent or compact fluorescent light sources using electronic ballasts. 2. Pulse-start metal halide light sources. 3. High pressure sodium light sources. 4. Luminaires with hardwired high frequency generator and induction lamp. 5. LED light sources installed outdoors. 6. Inseparable SSL luminaires containing colored light sources that are installed to provide decorative lighting.	8. All light sources installed in ceiling recessed downlight luminaires. Note that ceiling recessed downlight luminaires shall not have screw bases regardless of lamp type as described in Section ~~150.0(k)1C~~160.5(a)1C. 9. Any light source not otherwise listed in this table.

TABLE ~~130.1-A~~160.5-B MULTI-LEVEL LIGHTING CONTROLS AND UNIFORMITY REQUIREMENTS

<table>
<tr><th>Luminaire Type</th><th colspan="4">Minimum Required Control Steps
(percent of full rated power[1])</th><th>Uniform level of illuminance shall be achieved by:</th></tr>
<tr><td>Line-voltage sockets except GU-24</td><td colspan="4" rowspan="4">Continuous dimming 10-100 percent</td><td rowspan="4"></td></tr>
<tr><td>Low-voltage incandescent systems</td></tr>
<tr><td>LED luminaires and LED source systems</td></tr>
<tr><td>GU-24 rated for LED</td></tr>
<tr><td>GU-24 sockets rated for fluorescent > 20 watts</td><td colspan="4" rowspan="2">Continuous dimming 20-100 percent</td><td rowspan="2"></td></tr>
<tr><td>Pin-based compact fluorescent > 20 watts[2]</td></tr>
<tr><td>GU-24 sockets rated for fluorescent ≤ 20 watts</td><td colspan="4" rowspan="3">Minimum one step between
30-70 percent</td><td>Stepped dimming; or
Continuous dimming; or
Switching alternate lamps in a luminaire</td></tr>
<tr><td>Pin-based compact fluorescent ≤ 20 watts[2]</td></tr>
<tr><td>Linear fluorescent and U-bent fluorescent ≤ 13 watts</td></tr>
<tr><td rowspan="2">Linear fluorescent and U-bent fluorescent > 13 watts</td><td colspan="4">Minimum one step in each range:</td><td rowspan="2">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</td></tr>
<tr><td>20-40 %</td><td>50-70 %</td><td>75-85 %</td><td>100 %</td></tr>
<tr><td>Track Lighting</td><td colspan="4">Minimum one step between
30 – 70 percent</td><td>Step dimming; or
Continuous dimming; or
Separately switching circuits in multi-circuit track with a minimum of two circuits.</td></tr>
<tr><td>HID > 20 watts</td><td colspan="4" rowspan="3">Minimum one step between
50 - 70 percent</td><td rowspan="3">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.</td></tr>
<tr><td>Induction > 25 watts</td></tr>
<tr><td>Other light sources</td></tr>
<tr><td colspan="6">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</td></tr>
<tr><td colspan="6">~~EXCEPTION 1 to Table 130.1-A Minimum Required Control Steps:~~ ~~Classrooms with a connected general lighting load of 0.7 watts per square feet or less shall have a minimum of one control step between 30-70 percent of full rated power, regardless of luminaire type~~.

EXCEPTION 2 to TABLE ~~130.1-A~~160.5-B -A Minimum Required Control Steps: ~~Library stack aisles, aisle ways and open areas in warehouses,~~ Parking garages, parking areas, loading and unloading areas, stairwells, and corridors shall have a minimum of one control step between 20-60 percent of full rated power, regardless of luminaire type.</td></tr>
</table>

SECTION 160.6 – MANDATORY REQUIREMENTS FOR ELECTRIC POWER DISTRIBUTION SYSTEM

~~Nonresidential, high-rise residential and hotel/motel buildings~~ Multifamily buildings shall comply with the applicable requirements of ~~Sections 130.5(a) through 130.5(e)~~ Sections 160.6(a) through 160.6(e).

(a) **Service Electrical Metering.** Each electrical service or feeder that provides power to the common use areas (interior and exterior) shall have a permanently installed metering system which measures electrical energy use in accordance with ~~TABLE 130.5-A~~TABLE 160.6-A.

EXCEPTION 1 to ~~Section 130.5(a)~~ Section 160.6(a): Service or feeder for which the utility company provides a metering system that indicates instantaneous kW demand and kWh for a utility-defined period.

~~**EXCEPTION 2 to Section 130.5(a): Electrical power distribution systems subject to California Electrical Code Article 517.**~~

(b) **Separation of Electrical Circuits for Electrical Energy Monitoring**. Electrical power distribution systems shall be designed so that measurement devices can monitor the electrical energy usage of load types according to ~~TABLE 130.5-B~~ TABLE 160.6-B.

EXCEPTION 1 to ~~Section 130.5(b)~~ Section 160.6(b): For each separate load type, up to 10 percent of the connected load may be of any type.

~~**EXCEPTION 2 to Section 130.5(b)**: Electrical power distribution systems subject to California Electrical Code Article 517.~~

EXCEPTION 2 to Section 160.6(b): Submetered electrical power distribution systems that provide power to occupancy spaces of group R.

(c) **Voltage Drop.** The maximum combined voltage drop on both installed feeder conductors and branch circuit conductors to the farthest connected load or outlet shall not exceed 5 percent.

EXCEPTION to ~~Section 130.5(c)~~ Section 160.6(c): Voltage drop permitted by California Electrical Code Sections 647.4, 695.6 and 695.7.

(d) **Circuit Controls for 120-Volt Receptacles and Controlled Receptacles**. In all ~~buildings~~ common use areas, both controlled and uncontrolled 120 volt receptacles shall be provided in office areas, lobbies, conference rooms, kitchen areas in office spaces, and copy rooms. ~~Additionally, hotel/motel guest rooms shall comply with Section 130.5(d)4.~~ Controlled receptacles shall meet the following requirements, as applicable:

1. Install a control capable of automatically shutting OFF the controlled receptacles when the space is typically unoccupied, either at the receptacle or circuit level. When an automatic time switch control is installed it shall incorporate an override control that allows the controlled receptacle to remain ON for no more than 2 hours when an override is initiated and an automatic holiday "shut-OFF" feature that turns OFF all loads for at least 24 hours and then resumes the normally scheduled operation. Countdown timer switches shall not be used to comply with the automatic time switch control requirements; and
2. Install at least one controlled receptacle within 6 feet from each uncontrolled receptacle, or install a splitwired receptacle with at least one controlled and one uncontrolled receptacle. Where receptacles are installed in modular furniture in open office areas, at least one controlled receptacle shall be installed at each workstation; and
3. Provide a permanent and durable marking for controlled receptacles or circuits to differentiate them from uncontrolled receptacles or circuits; and

~~4. For hotel and motel guest rooms, install controlled receptacles for at least one-half of the 120-volt receptacles in each guestroom. Electric circuits serving controlled receptacles in guestrooms shall have captive-card key controls, occupancy sensing controls, or automatic controls so the power is switched off no longer than 30 minutes after the guestroom has been vacated.~~

NOTE: A hardwired power strip controlled by an occupant sensing control may be used to comply with ~~Section 130.5(d)~~ Section 160.6(d). Plug-in strips and other plug-in devices shall not be used to comply with the requirements of this Section.

EXCEPTION 1 to ~~Section 130.5(d)~~ Section 160.6(d): Receptacles that are only for the following purposes:

A. Receptacles specifically for refrigerators and water dispensers in kitchen areas.

B. Receptacles located a minimum of six feet above the floor that are specifically for clocks.

C. Receptacles for network copiers, fax machines, A/V and data equipment other than personal computers in copy rooms.

D. Receptacles on circuits rated more than 20 amperes.

E. Receptacles connected to an uninterruptible power supply (UPS) that are intended to be in continuous use, 24 hours per day/365 days per year, and are marked to differentiate them from other uncontrolled receptacles or circuits.

~~**EXCEPTION 2 to Section 130.5(d):** Receptacles in healthcare facilities.~~

EXCEPTION 2 to Section 160.6(d): Receptacles in dwelling units.

(e) **Demand responsive controls and equipment.** See Section 110.12 for requirements for demand responsive controls and equipment.

NOTE: Definitions of terms and phrases in ~~Section 130.5~~ Section 160.6 are determined as specified in Section 100.1(b). Terms and phrases not found in Section 100.1(b) shall be defined as specified in Title 24, Part 3, Article 100 of the California Electrical Code.

TABLE ~~130.5-A~~ 160.6-A MINIMUM REQUIREMENTS FOR METERING OR SUBMETERING OF ELECTRICAL LOAD

Metering Functionality	**Electrical Services[1] rated 50 kVA or less**	**Electrical Services[1] rated more than 50kVA and less than or equal to 250 kVA**	**Electrical Services[1] rated more than 250 kVA and less than or equal to 1000kVA**	**Electrical Services[1] rated more than 1000kVA**
Instantaneous (at the time) kW demand	Required	Required	Required	Required
Historical peak demand (kW)	Not required	Not required	Required	Required
Tracking kWh for a user-definable period.	Required	Required	Required	Required
kWh per rate period	Not required	Not required	Not required	Required

[1] "Electrical Services" applies to the main building entrance rating or to the submeter service. For a building with master and submetering, this applies to the submetering service size.

~~TABLE 130.5-B~~ TABLE 160.6-B MINIMUM REQUIREMENTS FOR SEPARATION OF ELECTRICAL LOAD

Electrical Load Type	**Electrical Services[1] rated 50 kVA or less**	**Electrical Services[1] rated more than 50kVA and less than or equal to 250 kVA**	**Electrical Services[1] rated more than 250 kVA and less than or equal to 1000kVA**	**Electrical Services[1] rated more than 1000kVA**
Lighting including exit and egress lighting and exterior lighting	Not required	All lighting in aggregate	All lighting disaggregated by floor, type or area	All lighting disaggregated by floor, type or area
HVAC systems and components including chillers, fans, heaters, furnaces, package units, cooling towers, and circulation pumps associated with HVAC	Not required	All HVAC in aggregate	All HVAC in aggregate and each HVAC load rated at least 50 kVA	All HVAC in aggregate and each HVAC load rated at least 50kVA
Domestic and service water system pumps and related systems and components	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Plug load including appliances rated less than 25 kVA	Not required	All plug load in aggregate Groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf	All plug load separated by floor, type or area Groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf	All plug load separated by floor, type or area All groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf
Elevators, escalators, moving walks, and transit systems	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
~~Other individual non-HVAC loads or appliances rated 25kVA or greater~~	~~Not required~~	~~All loads in aggregate~~	~~All loads in aggregate~~	~~All loads in aggregate~~
~~Industrial and commercial load centers 25 kVA or greater including theatrical lighting installations and commercial kitchens~~	~~Not required~~	~~All loads in aggregate~~	~~All loads in aggregate~~	~~All loads in aggregate~~
Renewable power source (net or total)	Each group	Each group	Each group	Each group
Loads associated with renewable power source	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Charging stations for electric vehicles	All loads in aggregate	All loads in aggregate	All loads in aggregate	All loads in aggregate

[1] "Electrical Services" applies to the main building entrance rating or to the submeter service. For a building with master and submetering, this applies to the submetering service size.

SECTION 160.7 – MANDATORY REQUIREMENTS FOR COVERED PROCESSES

(a) **Elevators.** Shall meet the requirements of section 120.6(f).

(b) **Residential Pools.** ~~Any residential pool system or equipment installed s~~Shall comply with the applicable requirements of Section 110.4~~, as well as the requirements listed in this section~~**.**

SECTION 160.8 – MANDATORY REQUIREMENTS FOR SOLAR READY BUILDINGS

(a) Solar Ready Buildings. Shall meet the requirements of Section 110.10 applicable to the building project.

SUBCHAPTER 11
MULTIFAMILY BUILDINGS - PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

SECTION 170.0 – GENERAL

Multifamily buildings shall comply with the applicable requirements of Sections 170.0 through 170.2. Sections 170.0 through 170.2 apply to attached dwelling units and common use areas in multifamily buildings. Nonresidential occupancies in mixed occupancy buildings shall comply with nonresidential requirements in Sections 120, 130 , 140 and 141.

(a) ~~Low-rise residential~~ Multifamily buildings shall meet all of the following:

1. The applicable requirements of Sections 110.0 through 110.10.

2. The applicable requirements of Section ~~150.0~~160.0 (mandatory features).

3. Either the performance standards (170.1) or the prescriptive standards (170.2) set forth in this section for the Climate Zone in which the building is located. Climate zones are shown in Reference Joint Appendix JA2 – Weather/Climate Data.

EXCEPTION to Section ~~150.1(a)3~~ 170.0 (a)3: If a single ~~contiguous subdivision or tract~~ development falls in more than one Climate Zone, all buildings in the subdivision or tract may be designed to meet the performance or prescriptive standards for the Climate Zone that contains 50 percent or more of the dwelling units.

NOTE: The Commission periodically updates, publishes, and makes available to interested persons and local enforcement agencies precise descriptions of the Climate Zones, as specified in Reference Joint Appendix JA2 – Weather/Climate Data.

NOTE: The requirements of Sections ~~150.0(a)~~ 170.1(a) through ~~150.0(r)~~ 170.2(e) apply to newly constructed buildings and Sections ~~150.2(a)~~180.1 and ~~150.2(b)~~180.2 specif~~ies~~y changes to the requirements of Sections ~~150.0(a)~~ 170.1(a) through ~~150.1(c)~~ 170.2(e) that apply to additions or alterations.

SECTION 170.1 – PERFORMANCE APPROACH

A building complies with the performance approach if the energy budget calculated for the Proposed Design Building under Subsection (b) is no greater than the energy budget calculated for the Standard Design Building under Subsection (a).

(a) **Energy Budget for the Standard Design Building.** The energy budget for the Standard Design Building is determined by applying the mandatory and prescriptive requirements to the Proposed Design Building. The energy budget is the sum of the TDV energy for space-conditioning, indoor lighting, mechanical ventilation, service water heating, and covered process loads.

(b) **Energy Budget for the Proposed Design Building.** The energy budget for a Proposed Design Building is determined by calculating the TDV energy for the Proposed Design Building. The energy budget is the sum of the TDV energy for space-conditioning, indoor lighting, mechanical ventilation and service water heating and covered process loads.

(c) **Calculation of Energy Budget.** The TDV energy for both the Standard Design Building and the Proposed Design Building shall be computed by Compliance Software certified for this use by the Commission. The processes for Compliance Software approval by the Commission are documented in the ACM Approval Manual.

(d) **Compliance Demonstration Requirements for Performance Standards.**

1. Certificate of Compliance and Application for a Building Permit. The application for a building permit shall include documentation pursuant to Sections 10-103(a)1 and 10-103(a)2 which demonstrates, using an approved calculation method, that the building has been designed ~~so that its Energy Efficiency Design Rating and the total~~ EDRs ~~meets or~~ do~~es~~ not exceed~~s~~ the Standard ~~d~~Design ~~EDR~~ EDRs for the applicable Climate Zone.

   ~~**EXCEPTION to Section 150.1(b)3A: Multiple Orientation:** A permit applicant may demonstrate compliance with the energy budget requirements of Section 150.1(a)and (b) for any orientation of the same building model if the documentation demonstrates that the building model with its proposed designs and features would comply in each of the four cardinal orientations.~~

2. **Field Verification**. When performance of installed features, materials, components, manufactured devices or systems above the minimum specified in Section ~~150.1(c)~~170.2 is necessary for the building to comply with Section ~~150.1(b)~~170.1, or is necessary to achieve a more stringent local ordinance, field verification shall be performed in accordance with the applicable requirements in the following subsections, and the results of the verification(s) shall be documented on applicable Certificates of Installation pursuant to Section 10-103(a)3 and applicable Certificates of Verification pursuant to Section 10-103(a)5.

A. **SEER Rating.** When performance compliance requires installation of a space conditioning system with a SEER rating that is greater than the minimum SEER rating required ~~by TABLE 150.1-A or B~~, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.

B. **EER Rating.** When performance compliance requires installation of a space conditioning system with an EER rating greater than the standard design value for EER, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.

C. **Low Leakage Air Handler.** When performance compliance requires installation of a low leakage air-handling unit, the installed air handling unit shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.1.4.3.9.

D. **HSPF Rating.** When performance compliance requires installation of a heat pump system with an HSPF rating that is greater than the minimum HSPF rating required ~~by TABLE 150.1-A or B~~, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.

E. **Heat Pump - Rated Heating Capacity.** When performance compliance requires installation of a heat pump system, the heating capacity values at 47 degrees F and 17 degrees F shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.2.

F. **Whole House Fan**. When performance compliance requires installation of a whole-house fan, the whole house fan ventilation airflow rate and fan efficacy shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.9.

G. **Central Fan Ventilation Cooling System**. When performance compliance requires installation of a central fan ventilation cooling system, the installed system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.3.4.

H. **Building Enclosure Air Leakage**. When performance compliance requires a building enclosure leakage rate that is lower than the standard design, the building enclosure shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.8.

I. **Quality Insulation Installation (QII).** When performance compliance requires field verification of QII, the building insulation system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.5.

SECTION 170.2 – PRESCRIPTIVE APPROACH

Multifamily ~~B~~buildings, including both dwelling units and common use areas, that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE ~~150.1-A or B~~ 170.2-A. In TABLE ~~150.1-A or B~~ 170.2-A, a NA (not allowed) means that feature is not permitted in a particular Climate Zone and a NR (no requirement) means that there is no prescriptive requirement for that feature in a particular Climate Zone. Installed components shall meet the following requirements:

(a) **Envelope Component Requirements**.

1. **Exterior roofs and ceilings**. Exterior roofs and ceilings shall comply with each of the applicable requirements in this subsection:

   A. **Roofing Products.** All roofing products shall meet the requirements of Section 110.8 and the applicable requirements of Subsection i through iii:

      i. ~~Low-rise residential buildings with l~~Low-sloped roofs; in Climate Zones 13 and 15 shall have a minimum aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75 or a minimum SRI of 75.

      ii. Low-sloped roofs in Climate Zones 9, 10, 11, ~~13,~~ and 14 ~~and 15~~ shall have a minimum aged solar reflectance of 0.55 and a minimum thermal emittance of 0.75, or a minimum SRI of 64.

      iii. Steep-sloped roofs in Climate Zones 2 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

      EXCEPTION 1 to Section ~~150.1(c)11~~ 170.2(a)1A: Building integrated photovoltaic panels and building integrated solar thermal panels are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI.

      EXCEPTION 2 to Section ~~150.1(c)11~~ 170.2(a)1A: Roof constructions with a weight of at least 25 lb/ft² are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI.

   B. **Roof Insulation.** Roofs shall have an overall assembly U-factor no greater than the applicable value in TABLE ~~150.1-A or B~~ 170.2-A, meeting option i, ii, or iii below..~~and w~~Where required by Section 110.8 and ~~120.7(a)3~~160.1(a), insulation shall be placed in direct contact with a continuous roof or drywall ceiling.

      i. Option A: ~~RESERVED~~A minimum U-factor for roof assemblies above conditioned space without attic.

      ii. Option B: A minimum R-value of insulation installed between the roof rafters in contact with the roof deck and an additional layer of ceiling insulation located between the attic and the conditioned space when meeting Section ~~150.1(c)9A~~170.2(c)3Bi; or

      iii. Option C: A minimum R-value of ceiling insulation located between the attic and the conditioned space when meeting Section ~~150.1(c)9B~~170.2(c)3Bii.

   C. **Radiant Barrier.** A radiant barrier required in TABLE ~~150.1-A or B~~ 170.2-A shall meet the requirements specified in Section 110.8(j), and shall meet the installation criteria specified in the Reference Residential Appendix RA4**.**

2. **Wall Insulation**

   A. Exterior walls shall have an overall assembly U-factor no greater than the applicable value in TABLE ~~140.3-B, C or D~~ 170.2-A.

   B. Demising walls shall meet the requirements of Section ~~120.7(b)7~~160.1(b)7. ~~Vertical windows in demising walls between conditioned and unconditioned spaces shall have an area-weighted average U-factor no greater than the applicable value in TABLE140.3-B, C or D.~~

3. **Fenestration.**

   A. Vertical windows in exterior walls shall comply with subsections i, ii, and iii:

      i. Percent window area shall be limited in accordance with the applicable requirements of ~~i and ii~~ a and b below:

         a. A total no greater than 20 percent of the conditioned floor area; and.

~~a. a west-facing area no greater than 40 percent of the gross west-facing exterior wall area, or 6 feet times the west-facing display perimeter, whichever is greater; and~~

b. A total area no greater than 40 percent of the gross exterior wall area~~, or 6 feet times the display perimeter, whichever is greater; and~~

NOTE: Demising walls are not exterior walls, and therefore demising wall area is not part of the gross exterior wall area ~~or display perimeter~~, and windows in demising walls are not part of the window area.

ii. Window Properties. Installed fenestration products, including glazed doors, shall have an area weighted average U-factor and Solar Heat Gain Coefficient (SHGC) meeting the applicable fenestration values in TABLE ~~150.1-A or B~~ 170.2-A and shall be determined in accordance with Sections 110.6(a)2 and 110.6(a)3.

Vertical windows in demising walls between conditioned and unconditioned spaces shall have an area-weighted average U-factor no greater than the applicable value in TABLE 170.2-A.

EXCEPTION 1 to Section ~~150.1(c)3A~~170.2(a)3Aii: For each dwelling unit up to 3 square feet of new glazing area installed in doors ~~and up to 3 square feet of new tubular skylights area with dual-pane diffusers~~ shall not be required to meet the U-factor and SHGC requirements of TABLE ~~150.1-A or B~~ 170.2-A.

EXCEPTION ~~3~~2 to Section ~~150.1(c)3A~~170.2(a)3Aii For fenestration containing chromogenic type glazing:

a. The lower-rated labeled U-factor and SHGC shall be used with automatic controls to modulate the amount of solar gain and light transmitted into the space in multiple steps in response to daylight levels or solar intensity;

b. Chromogenic glazing shall be considered separately from other fenestration; and

c. Area-weighted averaging with other fenestration that is not chromatic shall not be permitted and shall be determined in accordance with Section 110.6(a).

EXCEPTION ~~4~~ 3to Section 150.1(c)3A: For dwelling units containing unrated site-built fenestration that meets the maximum area restriction, the U-factor and SHGC can be determined in accordance with the Nonresidential Reference Appendix NA6 or use default values in TABLE 110.6-A and TABLE 110.6-B.

iii. **Shading.** Where TABLE ~~150.1-A or B~~ 170.2-A requires a Maximum SHGC, the requirements shall be met by one of the following:

Complying with the required SHGC pursuant to Section ~~150.1(c)3A~~170.2(a)3Aii; or

a. An exterior operable shading louver or other exterior shading device that meets the required SHGC; or

b. A combination of Items ~~A and B~~ ii and iii to achieve the same performance as achieved in Section ~~150.1(c)3A~~170.2(a)3Aii.

c. For south-facing glazing only, optimal overhangs shall be installed so that the south-facing glazing is fully shaded at solar noon on August 21 and substantially exposed to direct sunlight at solar noon on December 21.

d. Exterior shading devices must be permanently secured with attachments or fasteners that are not intended for removal.

EXCEPTION to Section ~~150.1(c)4E~~170.2(a)3Aiiid: Where the California Building Code (CBC) requires emergency egress or where compliance would conflict with Health and Safety regulations.

B. **Skylights shall**:

i. Have an area no greater than 5 percent of the gross exterior roof area Skylight Roof Ratio (SRR); and

EXCEPTION to Section ~~140.3(a)6A~~170.2(a)3Bi: Buildings with an atria over 55 feet high shall have a skylight area no greater than 10 percent of the gross exterior roof area.

ii. Have an Area-Weighted Performance Rating U-factor no greater than the applicable value in TABLE ~~140.3-B, C or D~~170.2-A.

~~**EXCEPTION to Section 140.3(a)6B:** For skylights containing chromogenic type glazing:~~

~~a. the lower-rate labeled U-factor shall be used with automatic controls to modulate the amount of U-factor heat flow into the space in multiple steps in response to daylight levels or solar intensity; and~~

~~b. chromogenic glazing shall be considered separately from other glazing; and~~

~~c. area-weighted averaging with other glazing that is not chromogenic shall not be permitted.~~

EXCEPTION 2 to Section ~~150.1(c)3A~~170.2(a)3Bii: For each dwelling unit up to 16 square feet of new skylight area with a maximum U-factor of 0.55 and a maximum SHGC of 0.30.

iii. Solar Heat Gain Coefficient. Have an area-weighted performance rating Solar Heat Gain Coefficient no greater than the applicable value in TABLE ~~140.3-B, C or D~~170.2-A.

EXCEPTION to Section ~~140.3(a)6C~~ 170.2(a)3Bii and 170.2(a)3Biii: For skylights containing chromogenic type glazing:

a. the lower-rated labeled SHGC shall be used with automatic controls to modulate the amount of heat flow into the space in multiple steps in response to daylight levels or solar intensity; and

b. chromogenic glazing shall be considered separately from other glazing; and

c. area-weighted averaging with other glazing that is not chromogenic shall not be permitted.

~~iv. Visible Transmittance. Have an Area-Weighted Performance Rating VT no less than the applicable value in TABLE 140.3-B or C; and~~

~~**EXCEPTION to Section 140.3(a)6D:** For skylights containing chromogenic type glazing:~~

~~a. the higher-rated labeled VT shall be used with automatic controls to modulate the amount of light transmitted into the space in multiple steps in response to daylight levels or solar intensity and;~~

~~b. chromogenic glazing shall be considered separately from other glazing; and~~

~~c. area-weighted averaging with other glazing that is not chromogenic shall not be permitted.~~

iv. Haze Value. Have a glazing material or diffuser that has a measured haze value greater than 90 percent, determined according to ASTM D1003, or other test method approved by the Energy Commission.

EXCEPTION to Section 140.3(a)6E: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of the skylight and light well.

4. All exterior doors that separate conditioned space from unconditioned space or from ambient air shall have a U-factor not greater than the applicable value in TABLE ~~140.3-B, C or D~~ 170.2-A. Doors that are more than one-half glass in area are considered Glazed Doors.

EXCEPTION to Section ~~150.1(c)5~~170.2(a)4: Swinging doors ~~between the garage and conditioned space~~ that are required to have fire protection are not required to meet the applicable door value in TABLE 150.1-A or B.

5. Raised-floors shall be insulated such that the floor assembly has an assembly U-factor equal to or less than shown in TABLE ~~150.1-A or B~~ 170.2-A, or shall be insulated between wood framing with insulation having an R-value equal to or greater than shown in TABLE ~~150.1-A or B~~ 170.2-A.

EXCEPTION to Section ~~150.1(c)1C~~170.2(a)5: Raised-floor insulation may be omitted if the foundation walls are insulated to meet the wall insulation minimums shown in TABLE ~~150.1-A or B~~ 170.2-A~~, and a vapor retarder is placed over the entire floor of the crawl space, and the vents are fitted with automatically operated louvers, and the requirements of Reference Residential Appendix RA4.5.1 are met~~.

~~B. Slab floor perimeter insulation shall be installed with a U-factor equal to or less than or R-value equal to or greater than shown in TABLE 150.1-A or B. The minimum depth of concrete slab floor perimeter insulation shall be 16 inches or the depth of the footing of the building, whichever is less.~~

~~**EXCEPTION to Section 150.1(c)1:** The insulation requirements of TABLE 150.1-A and TABLE 150.1-B may also be met by ceiling, roof deck, wall, or floor assemblies that meet the required maximum U-factors using a U-factor calculation method that considers the thermal effects of all elements of the assembly and is approved by the Executive Director.~~

6. All buildings shall comply with the Quality Insulation Installation (QII) requirements shown in TABLE ~~150.1-A or B~~ 170.2-A. When QII is required, insulation installation shall meet the criteria specified in Reference Appendix RA3.5.

TABLE ~~150.1-B~~170.2-A ENVELOPE COMPONENT PACKAGE – Multifamily Standard Building Design

Multifamily				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation	Roofs/Ceilings	Option A	Metal Building U-factor	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
			Wood Framed and Other U-factor	~~0.028~~ 0.024	0.028	~~0.034~~ 0.030	0.028	~~0.034~~ 0.030	~~0.034~~ 0.030	~~0.034~~ 0.030	0.028	0.028	0.028	~~0.028~~ 0.024	~~0.028~~ 0.024	~~0.028~~ 0.024	~~0.028~~ 0.024	~~0.028~~ 0.024	~~0.028~~ 0.024
		Option B	Below Roof Deck Insulation [1,2] (With Air Space)	NR	NR	NR	R19	NR	NR	NR	R19	R19	R13	R19	R19	R19	R19	R19	R13
			Ceiling Insulation	R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38
			Radiant Barrier	NR	REQ	REQ	NR	REQ	REQ	REQ	NR	NR	NR	NR	NR	NR	NR	NR	NR
		Option C	Ceiling Insulation	R38	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38
			Radiant Barrier	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
	Walls	~~Above Grade~~	Metal-Building, any fire rating	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.057	0.057	0.057	0.057	0.057
			Metal-framed, >1hr fire rating	0.069	0.069	0.069	0.069	0.069	0.069	0.105	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.048	0.069
			Wood-Framed, >1hr fire rating	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.042	0.059	0.059	0.042	0.042	0.042
			Framed (wood, metal and others), ≤1hr fire rating[3]	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.065	U 0.065	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051
			~~Mass Wall Interior~~ Mass Light [4,5]	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.059 R 17

Multifamily			Climate Zone															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		~~Mass Wall Exterior[5]~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.125 R 8.0~~	~~U 0.077 R 13~~
		Mass Heavy	0.253	0.650	0.650	0.650	0.650	0.690	0.690	0.690	0.690	0.650	0.184	0.253	0.211	0.184	0.184	0.160
	~~Below Grade~~	Below Grade ~~Interior~~	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.067 R 15
		~~Below Grade Exterior~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.200 R 5.0~~	~~U 0.100 R 10~~	~~U 0.100 R 10~~	~~U 0.053 R 19~~
	Floors/Soffits	~~Slab Perimeter~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~	~~U 0.58 R 7.0~~
		~~Raised~~ Wood Framed	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19
		~~Concrete Raised~~ Raised Mass	U 0.092 R 8.0	U 0.092 R 8.0	U 0.269 R 0	U 0.269 R 0	U-0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0
		Other	0.048	0.039	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.039	0.071	0.071	0.039	0.039	0.039
Quality Insulation Installation (QII)			Yes	Yes	Yes	Yes	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Roofing Products	**Low-sloped**	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	~~NR~~0.55	~~NR~~0.55	~~NR~~0.55	~~NR~~0.55	NR	0.63	~~NR~~0.55	0.63	NR
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	~~NR~~0.75	~~NR~~0.75	~~NR~~0.75	~~NR~~0.75	NR	0.75	~~NR~~0.75	0.75	NR

Multifamily			Climate Zone															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Steep-sloped	Aged Solar Reflectance	NR	~~NR~~0.20	~~NR~~0.20	~~NR~~0.20	~~NR~~0.20	~~NR~~0.20	~~NR~~0.20	~~NR~~0.20	~~NR~~0.20	0.20	0.20	0.20	0.20	0.20	0.20	NR
		Thermal Emittance	NR	~~NR~~0.75	~~NR~~0.75	~~NR~~0.75	~~NR~~0.75	~~NR~~0.75	~~NR~~0.75	~~NR~~0.75	~~NR~~0.75	0. 75	0.75	0.75	0.75	0.75	0.75	NR
Fenestration	Curtain Walls	Maximum U-factor	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
		Maximum SHGC	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
	Glazed Doors	Maximum U-factor	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		Maximum SHGC	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
	All Other Fenestrations	Maximum U-factor	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
		Maximum SHGC	NR	0.23	NR	0.23	NR	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	NR
	Maximum ~~Total Area~~ Window to Floor Ratio		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Maximum Window to Wall Ratio ~~Maximum West Facing Area~~		40% ~~NR~~	40% ~~5%~~	40% ~~NR~~	40% ~~5%~~	40% ~~NR~~	40% ~~5%~~	40% ~~5%~~	40% ~~5%~~	40% ~~5%~~	40% ~~5%~~	40% ~~5%~~	40% ~~5%~~	40% ~~5%~~	40% ~~5%~~	40% ~~5%~~	40% ~~NR~~
~~Door~~ Exterior Doors,	Maximum U-factor	~~Maximum U-factor~~ Dwelling Unit Entry	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
		Common Use Area Entry Non-Swinging	0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50
		Common Use Area Entry Swinging	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

Footnote requirements to TABLE ~~150.1-B~~170.2-A:

1. Install the specified R-value with an air space present between the roofing and the roof deck. Such as standard installation of concrete or clay tile.
2. R-values shown for below roof deck insulation are for wood-frame construction with insulation installed between the framing members. Alternatives including insulation above rafters or above roof deck shall comply with the performance standards.
3. Assembly U-factors for exterior framed walls can be met with cavity insulation alone or with continuous insulation alone, or with both cavity and continuous insulation that results in an assembly U-factor equal to or less than the U-factor shown. Use Reference Joint Appendices JA4 Table 4.3.1, 4.3.1(a), or Table 4.3.4 to determine alternative insulation products to be less than or equal to the required maximum U-factor.
4. Mass wall has a heat capacity greater than or equal to 7.0 Btu/h-ft^2.
5. ~~"Interior" denotes insulation installed on the inside surface of the wall. "Exterior" denotes insulation installed on the exterior surface of the wall.~~

~~6. Below grade "interior" denotes insulation installed on the inside surface of the wall; and~~

~~Below grade "exterior" denotes insulation installed on the outside surface of the wall.~~

(b) **Minimum Daylighting Requirement for Large Enclosed Spaces.** In Climate Zones 2 through 15, conditioned enclosed spaces, and unconditioned enclosed spaces, that are greater than 5,000 ft² and that are directly under a roof with ceiling heights greater than 15 feet, shall meet the following requirements:

1. A combined total of at least 75 percent of the floor area, as determined in building floor plan (drawings) view, shall be within one or more of the following:

   A. Primary Sidelight Daylight Zone in accordance with Section ~~130.1(d)1B~~160.5(b)4Dib, or

   B. The total floor area in the space within a horizontal distance of 0.7 times the average ceiling height from the edge of rough opening of skylights.

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

3. General lighting in daylit zones shall be controlled in accordance with Section ~~130.1(d)~~160.5(b)4D.

4. 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 rough opening of 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 rough opening of skylights.

5. All skylights shall have a glazing material or diffuser that has a measured haze value greater than 90 percent, tested according to ASTM D1003 (notwithstanding its scope) or another test method approved by the Commission.

~~6. Skylights for conditioned and unconditioned spaces shall have an area-weighted average Visible Transmittance (VT) no less than the applicable value required by Section 140.3(a)6D.~~

~~**EXCEPTION 1 to Section 140.3(c):** Auditoriums, churches, movie theaters, museums, and refrigerated warehouses.~~

EXCEPTION ~~2~~1 to Section ~~140.3(c)~~170.2(b): In buildings with unfinished interiors, future enclosed spaces for which there are plans to have:

A. A floor area of less than or equal to 5,000 square feet; or

B. Ceiling heights of less than or equal to 15 feet. This exception shall not be used for S-1 or S-2 (storage), or for F-1 or F-2 (factory) occupancies.

EXCEPTION ~~3~~2 to Section ~~140.3(c)~~170.2(b): Enclosed spaces having a designed general lighting system with a lighting power density less than 0.5 watts per square foot.

EXCEPTION ~~4~~3 to Section ~~140.3(c)~~170.2(b): 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 1500 daytime hours per year between 8 a.m. and 4 p.m.

(c) **Space Conditioning Systems**. All space heating and space cooling equipment shall comply with minimum Appliance Efficiency Regulations as specified in Sections 110.0 through 110.2 ~~A building complies with this section by being designed with and having constructed and installed a space conditioning system(s) that meets~~ and the applicable requirements of Subsections 1 through 4.

1. **Sizing and Equipment Selection**. ~~Mechanical heating and mechanical cooling equipment serving healthcare facilities shall be sized to meet the design heating and cooling loads as calculated according to the subsection (b).~~ Mechanical heating and mechanical cooling equipment serving ~~high rise residential~~ multifamily buildings~~, hotel/motel buildings and nonresidential buildings other than healthcare facilities~~, shall be the smallest size, within the available options of the desired equipment line, necessary to meet the design heating and cooling loads of the building, as calculated according to Subsection ~~(b)~~B

   EXCEPTION 1 to Section ~~140.4(a)~~170.2(c)1: Where it can be demonstrated to the satisfaction of the enforcing agency that oversizing will not increase building TDV energy use.

   EXCEPTION 2 to Section ~~140.4(a)~~170.2(c)1: Standby equipment with controls that allow the standby equipment to operate only when the primary equipment is not operating.

   EXCEPTION 3 to Section ~~140.4(a)~~170.2(c)1: Multiple units of the same equipment type, such as multiple chillers and boilers, having combined capacities exceeding the design load, if they have controls that sequence or otherwise optimally control the operation of each unit based on load.

2. **Calculations**. In making equipment sizing calculations under Subsection (a)1, all of the following rules shall apply:

A. **Heating and cooling loads.** Heating and cooling system design loads shall be determined in accordance with ~~the procedures described in subsection A or B below:~~

i. ~~For systems serving high-rise residential buildings, hotel/motel buildings, and nonresidential multifamily buildings other than healthcare facilities,~~ the method in the 2017 ASHRAE Handbook, Fundamentals shall be used, or as specified in a method approved by the Commission.

~~ii. For system serving healthcare facilities the method in the California Mechanical Code shall be used.~~

B. **Indoor design conditions.** Indoor design temperature and humidity conditions for comfort applications shall be determined ~~in accordance with subsection A or B below:~~

a. ~~For systems serving high-rise residential buildings, hotel/motel buildings, and nonresidential buildings other than healthcare facilities,~~ using ASHRAE Standard 55 or the 2017 ASHRAE Handbook, Fundamentals Volume, except that winter humidification and summer dehumidification shall not be required.

b. ~~For system serving healthcare facilities the method in Section 320.0 of the California Mechanical Code shall be used~~.

C. **Outdoor design conditions.** Outdoor design conditions shall be in accordance with ~~subsection A or B below:~~

a. ~~For systems serving high-rise residential~~ multifamily ~~buildings, hotel/motel buildings, and nonresidential buildings other than healthcare facilities~~ the design conditions from Reference Joint Appendix JA2 shall be used, which is based on data from the ASHRAE Climatic Data for Region X. Heating design temperatures shall be no lower than the Heating Winter Median of Extremes values. Cooling design temperatures shall be no greater than the 0.5 percent Cooling Dry Bulb and Mean Coincident Wet Bulb values.

~~b. For system serving healthcare facilities the method in Section 320.0 of the California Mechanical Code shall be used.~~

EXCEPTION to Section ~~140.4(b)3~~170.2(c)1C: Cooling design temperatures for cooling towers shall be no greater than the 0.5 percent Cooling Design Wet bulb values.

D. **Ventilation.** Outdoor air ventilation loads shall be calculated using the ventilation rates required in Section ~~120.1(c)3~~160.2(c)3.

E. **Envelope**. Envelope heating and cooling loads shall be calculated using envelope characteristics, including square footage, thermal conductance, Solar Heat Gain Coefficient or shading coefficient, and air leakage, consistent with the proposed design.

F. **Lighting.** Lighting heating and cooling loads shall be based on actual design lighting levels or power densities as specified in Section ~~140.6~~170.2(e)1.

G. **People.** Occupant density shall be based on the expected occupancy of the building and shall be the same as determined under Section ~~120.1(c)3A~~160.2(c)3A, if used. Sensible and latent heat gains shall be as listed in the 2017 ASHRAE Handbook- Fundamentals, Chapter 18.

H. **Process loads.** Loads caused by a process shall be based upon actual information on the intended use of the building.

I. **Miscellaneous equipment.** Equipment loads other than process loads shall be calculated using design data compiled from one or more of the following sources:

i. Actual information based on the intended use of the building; or

ii. Published data from manufacturer's technical publications or from technical societies, such as the ASHRAE Handbook, Applications Volume; or

iii. Other data based on the designer's experience of expected loads and occupancy patterns.

J. **Internal heat gains.** Internal heat gains may be ignored for heating load calculations.

K. **Safety factor.** Calculated design loads based on ~~140.4(b)1~~ 170.2(c)1 A through ~~10~~K may be increased by up to 10 percent to account for unexpected loads or changes in space usage.

L. **Other loads.** Loads such as warm-up or cool-down shall be calculated from principles based on the thermal capacity of the building and its contents, the degree of setback, and desired recovery time; or may be assumed to be no more than 30 percent for heating and 10 percent for cooling of the steady-state design loads. In addition, the steady-state load may include a safety factor in accordance with Section ~~140.4(b)11~~170.2(c)1K.

3. All space heating and space cooling equipment serving individual dwelling units shall ~~comply with minimum Appliance Efficiency Regulations as specified in Sections 110.0 through 110.2 and~~ meet all applicable requirements of Sections ~~150.0~~ 160.3(b) and ~~150.1(c)7A~~ 170.2(c)2.

A. **~~Refrigerant Charge~~.** When refrigerant charge verification or fault indicator display is shown as required by TABLE ~~150.1-A or B~~170.2-H, the system shall comply with either ~~150.1(c)7Ai~~170.2(c)3Ai or ~~150.1(c)7Aii~~170.2(c)3Aii:

i. Aair-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted packaged systems, small duct high velocity systems, and mini-split systems, shall comply with subsections a~~,~~ and b ~~and c~~, unless the system is of a type that cannot be verified using the specified procedures:

a. Have measurement access holes (MAH) installed according to the specifications in the Reference Residential Appendix Section RA3.2.2.3; and

~~b. System airflow rate in accordance with subsection I or II below, shall be confirmed through field verification and diagnostic testing in accordance with all applicable procedures specified in Reference Residential Appendix Section RA3. 3 or an approved alternative procedure as specified by RA1; and~~

~~I. For small duct high velocity systems the system airflow rate shall be greater than or equal to 250 cfm per ton; or~~

~~II. For all other air-cooled air conditioner or air-source heat pump systems the system airflow rate shall be greater than or equal to 350 cfm per ton.~~

c. The installer shall charge the system according to manufacturer's specifications. Refrigerant charge shall be verified according to one of the following options, as applicable:

I. The installer and rater shall perform the standard charge procedure as specified by Reference Residential Appendix Section RA3.2.2 or an approved alternative procedure as specified by RA1; or

II. The system shall be equipped with a fault indicator display (FID) device that meets the specifications of Reference Joint Appendix JA6. The installer shall verify the refrigerant charge and FID device in accordance with the procedures in Reference Residential Appendix Section RA3.4.2. The HERS Rater shall verify FID device in accordance with the procedures in Section RA3.4.2; or

III. The installer shall perform the weigh-in charging procedure as specified by Reference Residential Appendix Section RA3.2.3.1 provided the system is of a type that can be verified using the RA3.2.2 standard charge verification procedure and RA3.3 airflow rate verification procedure or approved alternatives in RA1. The HERS Rater shall verify the charge using RA3.2.2 and RA3.3 or approved alternatives in RA1.

EXCEPTION to Section ~~150.1(c)7Aia~~170.2(c)3Aia: Systems that cannot conform to the specifications for hole location in Reference Residential Appendix Figure RA3.2-1, shall not be required to provide holes as described in Figure RA3.2-1.

EXCEPTION to Section ~~150.1(c)7Aib~~170.2(c)3Aib: Standard ducted systems without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in TABLE ~~150.0-B~~160.3-A and TABLE ~~150.0-C~~160.3-B.as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Section RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section ~~150.0(m)12~~160.2(a)1D for the system air filter device(s) shall conform to the requirements given in TABLE ~~150.0-B~~160.3-A and TABLE ~~150.0-C~~160.3-B.

EXCEPTION 1 to ~~150.1(c)7Aic~~170.2(c)3Aic: When the outdoor temperature is less than 55 degrees F and the installer utilizes the weigh-in charging procedure in Reference Residential Appendix Section RA3.2.3.1 to verify the refrigerant charge, the installer may elect to utilize the HERS Rater verification procedure in Reference Residential Appendix Section RA3.2.3.2. If the HERS Rater verification procedure in Section RA3.2.3.2 is used for compliance, the system's thermostat shall conform to the specifications in Section 110.12. Ducted systems shall comply with minimum system airflow rate requirement in Section ~~150.1(c)7Aib~~170.2(c)3Aib**.**

ii. Air-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted packaged systems, small duct high velocity systems and mini-split systems, which are of a type that cannot comply with the requirements of ~~150.1(c)7Ai~~170.2(c)3Ai shall comply with subsections a and b, as applicable.

a. The installer shall confirm the refrigerant charge using the weigh-in charging procedure specified in Reference Residential Appendix Section RA3.2.3.1, as verified by a HERS Rater according to the procedures specified in Reference Residential Appendix Section RA3.2.3.2; and

~~b. Systems that utilize forced air ducts shall comply with the minimum system airflow rate requirement in Section 150.1(c)7Aib provided the system is of a type that can be verified using the procedures in RA3.3 or an approved alternative procedure in RA1.~~

EXCEPTION to Section ~~150.1(c)7A~~170.2(c)3A: Packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in ~~150.1(c)7Aib~~170.2(c)3Aib, provided that the system is of a type that can be verified using the procedure specified in RA3.3 or an approved alternative in RA1.

B. **Space Conditioning Distribution Systems.** All space conditioning systems shall meet all applicable requirements of ~~A or B~~i or ii below:

i. High performance attics. Air handlers or ducts are allowed to be in ventilated attic spaces when the roof and ceiling insulation level meet Option B in TABLE ~~150.1-A or B~~170.2-H. ~~Duct insulation levels shall meet the requirements in TABLE 150.1-A or B.~~

ii. Duct and air handlers located in conditioned space. Duct systems and air handlers of HVAC systems shall be located in conditioned space, and confirmed by field verification and diagnostic testing to meet the criterion of Reference Residential Appendix RA3.1.4.3.8. ~~Duct insulation levels shall meet the requirements in TABLE 150.1-A or B.~~

~~**NOTE:** Gas heating appliances installed in conditioned spaces must meet the combustion air requirements of the California Mechanical Code Chapter 7, as applicable.~~

C. Central Fan Integrated Ventilation Systems. Central forced air system fans used to provide outside air, shall have an air-handling unit fan efficacy less than or equal to the maximum W/CFM specified in ~~A or B~~a or b below. The airflow rate and fan efficacy requirements in this section shall be confirmed through field verification and diagnostic testing in accordance with all applicable procedures specified in Reference Residential Appendix RA3.3. Central Fan Integrated Ventilation Systems shall be certified to the Energy Commission as Intermittent Ventilation Systems as specified in Reference Residential Appendix RA3.7.4.2.

i. 0.45 W/CFM for gas furnace air-handling units; or

ii. 0.58 W/CFM for air-handling units that are not gas furnaces.

~~**EXCEPTION to Section 151.0(c)10A:** Gas furnace air-handling units manufactured prior to July 3, 2019 shall comply with a fan efficacy value less than or equal to 0.58 w/cfm as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.~~

D. **HVAC System Bypass Ducts.** Bypass ducts that deliver conditioned supply air directly to the space conditioning system return duct airflow shall not be used.

4. **Central Systems Serving Multiple Dwelling Units and Common Use Area Space Conditioning Systems.** A building complies with this section by being designed with and having constructed and installed a space-conditioning system that meets the applicable requirements of Subsections ~~(a)~~A through ~~(o)~~M.

A. **Fan Systems.** Each fan system having a total fan system motor nameplate horsepower exceeding 5 hp used for space conditioning shall meet the requirements of Items ~~1, 2, and 3~~i, ii, and iii below. Total fan system power demand equals the sum of the power demand of all fans in the system that are required to operate at design conditions in order to supply air from the heating or cooling source to the conditioned space, and to return it back to the source or to exhaust it to the outdoors.

i. **Fan Power Limitation**. At design conditions each fan system shall not exceed the allowable fan system power of option 1 or 2 as specified in Table ~~140.4-A~~170.2-B

TABLE ~~140.4-A~~170.2-B Fan Power Limitation

	Limit	Constant Volume	Variable Volume
Option 1: Fan system motor nameplate hp	Allowable motor nameplate hp	hp ≤ cfm_s x 0.0011	hp ≤ cfm_s x 0.0015
Option 2: Fan system bhp	Allowable fan system bhp	bhp ≤ cfm_s x 0.00094 + *A*	bhp ≤ cfm_s x 0.0013 + *A*
[1]cfm_s = maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute hp = maximum combined motor nameplate horsepower for all fans in the system bhp = maximum combined fan-brake horsepower for all fans in the system *A* = sum of (PD x cfm_D/4131) PD = each applicable pressure drop adjustment from Table 140.4 – B, in inches of water cfm_D = the design airflow through each applicable device from Table 140.4 – B, in cubic feet per minute			

TABLE ~~140.4-B~~170.2-C – Fan Power Limitation Pressure Drop Adjustment

Device	Adjustment Credits
Return or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms	0.5 in. of water
Return and/or exhaust airflow control devices	0.5 in. of water
Exhaust filters, scrubbers, or other exhaust treatment	The pressure drop of device calculated at fan system design condition
Particulate Filtration Credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2 x clean filter pressure drop at fan system design condition
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition
Biosafety cabinet	Pressure drop of device at fan system design condition
Energy recovery device, other than coil runaround loop	For each airstream [(2.2 x Energy Recovery Effectiveness) – 0.5] in. of water
Coil runaround loop	0.6 in. of water for each airstream
Exhaust systems serving fume hoods	0.35 in. of water

ii. **Variable air volume (VAV) systems.**

a. Static Pressure Sensor Location. Static pressure sensors used to control variable air volume fans shall be placed in a position such that the controller set point is no greater than one-third the total design fan static pressure, except for systems with zone reset control complying with Section ~~140.4(c)2B~~ 170.2(c)4Aiib. If this results in the sensor being located downstream of any major duct split, multiple sensors shall be installed in each major branch with fan capacity controlled to satisfy the sensor furthest below its setpoint; and

b. Setpoint Reset. For systems with direct digital control of individual zone boxes reporting to the central control panel, static pressure setpoints shall be reset based on the zone requiring the most pressure; i.e., the set point is reset lower until one zone damper is nearly wide open.

iii. **Fractional HVAC Motors for Fans.** HVAC motors for fans that are less than1 hp and 1/12 hp or greater shall be electronically-commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with NEMA Standard MG 1-2006 at full load rating conditions. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of a varying motor speed.

EXCEPTION 1 to Section ~~140.4(c)3~~170.2(c)4Aiii: Motors in fan-coils and terminal units that operate only when providing heating to the space served.

EXCEPTION 2 to Section ~~140.4(c)3~~170.2(c)4Aiii: Motors in space conditioning equipment certified under Section 110.1 or 110.2

EXCEPTION 1 to ~~140.4(c)~~170.2(c)4A: fan system power caused solely by process loads.

~~**EXCEPTION 2 to 140.4(c):** Systems serving healthcare facilities.~~

B. Each space-conditioning zone shall have controls designed in accordance with ~~1 or 2~~i or ii:

i. Each space-conditioning zone shall have controls that prevent:

a. Reheating; and

b. Recooling; and

c. Simultaneous provisions of heating and cooling to the same zone, such as mixing or simultaneous supply of air that has been previously mechanically heated and air that has been previously cooled either by cooling equipment or by economizer systems; or

ii. Zones served by variable air-volume systems that are designed and controlled to reduce, to a minimum, the volume of reheated, recooled, or mixed air are allowed only if the controls meet all of the following requirements:

a. For each zone with direct digital controls (DDC):

I. The volume of primary air that is reheated, recooled or mixed air supply shall not exceed the larger of:

A. 50 percent of the peak primary airflow; or

B. The design zone outdoor airflow rate as specified by Section ~~120.1(c)3~~160.2(c)3.

II. The volume of primary air in the deadband shall not exceed the larger of:

A. 20 percent of the peak primary airflow; or

B. The design zone outdoor airflow rate as specified by Section ~~120.1(c)3~~160.2(c)3.

III. The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint no higher than 95ºF while the airflow is maintained at the dead band flow rate.

IV. The second stage of heating consists of modulating the airflow rate from the dead band flow rate up to the heating maximum flow rate.

b. For each zone without DDC, the volume of primary air that is reheated, re-cooled, or mixed air supply shall not exceed the larger of the following:

I. 30 percent of the peak primary airflow; or

II. The design zone outdoor airflow rate as specified by Section ~~120.1(c)3~~160.2(c)3.

EXCEPTION 1 to Section ~~140.4(d)~~170.2(c)4B: Zones with special pressurization relationships or cross-contamination control needs.

EXCEPTION 2 to Section ~~140.4(d)~~170.2(c)4B Zones served by space-conditioning systems in which at least 75 percent of the energy for reheating, or providing warm air in mixing systems, is provided from a site-recovered or site-solar energy source.

EXCEPTION 3 to Section ~~140.4(d)~~170.2(c)4B: Zones in which specific humidity levels are required to satisfy exempt process loads. Computer rooms or other spaces where the only process load is from IT equipment may not use this exception.

EXCEPTION 4 to Section ~~140.4(d)~~170.2(c)4B: Zones with a peak supply-air quantity of 300 cfm or less.

~~**EXCEPTION 5 to Section 140.4(d):** Systems serving healthcare facilities.~~

C. **Economizers**.

i. Each cooling air handler that has a design total mechanical cooling capacity over 54,000 Btu/hr, or chilled-water cooling systems without a fan or that use induced airflow that has a cooling capacity greater than the systems listed in TABLE ~~140.4-C~~170.2-D, shall include either:

a. An air economizer capable of modulating outside-air and return-air dampers to supply 100 percent of the design supply air quantity as outside-air; or

b. A water economizer capable of providing 100 percent of the expected system cooling load, at outside air temperatures of 50°F dry-bulb and 45°F wet-bulb and below.

EXCEPTION 1 to Section ~~140.4(e)1~~170.2(c)4Ci: Where special outside air filtration and treatment, for the reduction and treatment of unusual outdoor contaminants, makes compliance infeasible.

EXCEPTION 2 to Section ~~140.4(e)1~~170.2(c)4Ci: Where the use of outdoor air for cooling will affect other systems, such as humidification~~,~~ or dehumidification, ~~or supermarket refrigeration systems~~, so as to increase overall building TDV energy use.

EXCEPTION 3 to Section ~~140.4(e)1~~170.2(c)4Ci: Systems serving ~~high-rise residential living quarters and hotel/motel guest rooms~~ dwelling units.

EXCEPTION 4 to Section ~~140.4(e)1~~170.2(c)4Ci: Where comfort cooling systems have the cooling efficiency that meets or exceeds the cooling efficiency improvement requirements in TABLE ~~140.4-D~~170.2-E.

EXCEPTION 5 to Section 140.4(e)1: Fan systems primarily serving computer rooms. See Section 140.9(a) for computer room economizer requirements.

EXCEPTION 6 to Section ~~140.4(e)1~~170.2(c)4Ci: Systems design to operate at 100 percent outside air at all times.

TABLE ~~140.4-C~~170.2-D CHILLED WATER SYSTEM COOLING CAPACITY

Climate Zones	Total Building Chilled Water System Capacity, Minus Capacity of the Cooling units with Air Economizers	
	Building Water-Cooled Chilled Water System	Air-Cooled Chilled Water Systems or District Chilled Water Systems
15	≥ 960,000 Btu/h (280 kW)	≥ 1,250,000 Btu/h (365 kW)
1-14	≥720,000 Btu/h (210 kW)	≥940,000 Btu/h (275 kW)
16	≥1,320,000 Btu/h (385 kW)	≥1,720,000 Bu/h (505 kW)

TABLE ~~140.4-D~~ 170.2-E ECONOMIZER TRADE-OFF TABLE FOR COOLING SYSTEMS

Climate Zone	Efficiency Improvement [a]	
1	70%	[a] If a unit is rated with an IPLV, IEER or SEER, then to eliminate the required air or water economizer, the applicable minimum cooling efficiency of the HVAC unit must be increased by the percentage shown. If the HVAC unit is only rated with a full load metric, such as EER or COP cooling, then that metric must be increased by the percentage shown.
2	65%	
3	65%	
4	65%	
5	70%	
6	30%	
7	30%	
8	30%	
9	30%	
10	30%	
11	30%	
12	30%	
13	30%	
14	30%	
15	30%	
16	70%	

ii. If an economizer is required by Section ~~140.4(e)1~~170.2(c)4Ci, and an air economizer is used to meet the requirement, then it shall be:

a. Designed and equipped with controls so that economizer operation does not increase the building heating energy use during normal operation; and

EXCEPTION to Section ~~140.4(e)2A~~ 170.2(c)4Ciia: Systems that provide 75 percent of the annual energy used for mechanical heating from site-recovered energy or a site-solar energy source.

b. Capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

c. Designed and equipped with a device type and high limit shut off complying with TABLE ~~140.4-E~~170.2-F.

TABLE ~~140.4-E~~170.2-F AIR ECONOMIZER HIGH LIMIT SHUT OFF CONTROL REQUIREMENTS

Device Type[a]	Climate Zones	Required High Limit (Economizer Off When):	
		Equation[b]	Description
Fixed Dry Bulb	1, 3, 5, 11-16	T_{OA} > 75°F	Outdoor air temperature exceeds 75°F
	2, 4, 10	T_{OA} > 73°F	Outdoor air temperature exceeds 73°F
	6, 8, 9	T_{OA} > 71°F	Outdoor air temperature exceeds 71°F
	7	T_{OA} > 69°F	Outdoor air temperature exceeds 69°F
Differential Dry Bulb	1, 3, 5, 11-16	T_{OA} > T_{RA}°F	Outdoor air temperature exceeds return air temperature
	2, 4, 10	T_{OA} > T_{RA}-2°F	Outdoor air temperature exceeds return air temperature minus 2°F
	6, 8, 9	T_{OA} > T_{RA}-4°F	Outdoor air temperature exceeds return air temperature minus 4°F
	7	T_{OA} > T_{RA}-6°F	Outdoor air temperature exceeds return air temperature minus 6°F
Fixed Enthalpy[c] + Fixed Drybulb	All	h_{OA} > 28 Btu/lb[c] or T_{OA} > 75°F	Outdoor air enthalpy exceeds 28 Btu/lb of dry air[c] or Outdoor air temperature exceeds 75°F

[a] Only the high limit control devices listed are allowed to be used and at the setpoints listed. Others such as Dew Point, Fixed Enthalpy, Electronic Enthalpy, and Differential Enthalpy Controls, may not be used in any Climate Zone for compliance with Section ~~140.4(e)1~~170.2(c)4Ci unless approval for use is provided by the Energy Commission Executive Director.

[b] Devices with selectable (rather than adjustable) setpoints shall be capable of being set to within 2°F and 2 Btu/lb of the setpoint listed.

[c] At altitudes substantially different than sea level, the Fixed Enthalpy limit value shall be set to the enthalpy value at 75°F and 50% relative humidity. As an example, at approximately 6,000 foot elevation, the fixed enthalpy limit is approximately 30.7 Btu/lb.

d. The air economizer and all air dampers shall have the following features:

I. **Warranty.** 5-year Manufacturer warranty of economizer assembly.

II. **Damper reliability testing.** Suppliers of economizers shall certify that the economizer assembly, including but not limited to outdoor air damper, return air damper, drive linkage, and actuator, have been tested and are able to open and close against the rated airflow and pressure of the system for 60,000 damper opening and closing cycles.

III. **Damper leakage.** Economizer outdoor air and return air dampers shall have a maximum leakage rate of 10 cfm/sf at 250 Pascals (1.0 in. of water) when tested in accordance with AMCA Standard 500-D. The economizer outside air and return air damper leakage rates shall be certified to the Energy Commission in accordance with Section 110.0.

IV. **Adjustable setpoint.** If the high-limit control is fixed dry-bulb or fixed enthalpy + fixed dry-bulb then the control shall have an adjustable setpoint.

V. **Sensor accuracy.** Outdoor air, return air, mixed air, and supply air sensors shall be calibrated within the following accuracies.

A. Drybulb and wetbulb temperatures accurate to ±2°F over the range of 40°F to 80°F;

B. Enthalpy accurate to ±3 Btu/lb over the range of 20 Btu/lb to 36 Btu/lb;

C. Relative humidity (RH) accurate to ±5 percent over the range of 20 percent to 80 percent RH;

VI. **Sensor calibration data.** Data used for control of the economizer shall be plotted on a sensor performance curve.

VII. **Sensor high limit control.** Sensors used for the high limit control shall be located to prevent false readings, including but not limited to being properly shielded from direct sunlight.

VIII. **Relief air system.** Relief air systems shall be capable of providing 100 percent outside air without over-pressurizing the building.

e. The space conditioning system shall include the following:

I. Unit controls shall have mechanical capacity controls interlocked with economizer controls such that the economizer is at 100 percent open position when mechanical cooling is on and does not begin to close until the leaving air temperature is less than 45°F.

II. Direct Expansion (DX) units greater than 65,000 Btu/hr that control the capacity of the mechanical cooling directly based on occupied space temperature shall have a minimum of 2 stages of mechanical cooling capacity.

III. DX units not within the scope of Section ~~140.4(e)2E,B~~ 170.2(c)4Ciib shall (i) comply with the requirements in TABLE ~~140.4 F~~170.2-G, and (ii) shall have controls that do not false load the mechanical cooling system by limiting or disabling the economizer or by any other means except at the lowest stage of mechanical cooling capacity.

TABLE ~~140.4 F~~170.2-G DIRECT EXPANSION (DX) UNIT REQUIREMENTS FOR COOLING STAGES AND COMPRESSOR DISPLACEMENT

Cooling Capacity	Minimum Number of Mechanical Cooling Stages	Minimum Compressor Displacement
≥ 65,000 Btu/h and < 240,000 Btu/h	3 stages	≤ 35% full load
≥ 240,000 Btu/h	4 stages	≤ 25% full load

iii. Systems that include a water economizer to meet Section ~~140.4(e)1~~ 170.2(c)4Cishall include the following:

a. Maximum pressure drop. Precooling coils and water-to-water heat exchangers used as part of a water economizer shall either have a waterside pressure drop of less than 15 feet of water, or a secondary loop shall be installed so that the coil or heat exchanger pressure drop is not contributing to pressure drop when the system is in the normal cooling (non-economizer) mode.

b. Economizer systems shall be integrated with the mechanical cooling system so that they are capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load. Controls shall not false load the mechanical cooling system by limiting or disabling the economizer or by any other means, such as hot gas bypass, except at the lowest stage of mechanical cooling.

D. **Supply Air Temperature Reset Controls.** Space-conditioning systems supplying heated or cooled air to multiple zones shall include controls that automatically reset supply-air temperatures. Air distribution systems serving zones that are likely to have constant loads shall be designed for the air flows resulting from the fully reset supply air temperature. Supply air temperature reset controls shall be:

i. In response to representative building loads or to outdoor air temperature; and

ii. At least 25 percent of the difference between the design supply-air temperature and the design room air temperature.

EXCEPTION 1 to Section ~~140.4(f)~~170.2(c)4D: Systems that meet the requirements of Section ~~140.4(d)1~~170.2(c)3Bi, without using Exception 1 to that section.

EXCEPTION 2 to Section ~~140.4(f)~~170.2(c)4D: Where supply-air temperature reset would increase overall building energy use.

EXCEPTION 3 to Section ~~140.4(f)~~170.2(c)4D: Systems supplying zones in which specific humidity levels are required to satisfy process loads. Computer Rooms or other spaces with only IT equipment may not use this exception.

~~**EXCEPTION 4 to Section 140.4(f):** Systems serving healthcare facilities.~~

E. **Electric Resistance Heating.** Electric resistance heating systems shall not be used for space heating.

EXCEPTION 1 to Section ~~140.4(g)~~170.2(c)4E: Where an electric-resistance heating system supplements a heating system in which at least 60 percent of the annual energy requirement is supplied by site-solar or recovered energy.

EXCEPTION 2 to Section ~~140.4(g)~~170.2(c)4E: Where an electric-resistance heating system supplements a heat pump heating system, and the heating capacity of the heat pump is more than 75 percent of the design heating load calculated in accordance with Section ~~140.4(a)~~170.2(c)1 at the design outdoor temperature specified in Section ~~140.4(b)4~~170.2(c)2.

EXCEPTION 3 to Section ~~140.4(g)~~170.2(c)4E: Where the total capacity of all electric-resistance heating systems serving the entire building is less than 10 percent of the total design output capacity of all heating equipment serving the entire building.

EXCEPTION 4 to Section ~~140.4(g)~~170.2(c)4E: Where the total capacity of all electric-resistance heating systems serving the entire building, excluding those allowed under Exception 2, is no more than 3 kW.

~~**EXCEPTION 5 to Section 140.4(g):** Where an electric resistance heating system serves an entire building that is not a high-rise residential or hotel/motel building; and has a conditioned floor area no greater than 5,000 square feet; and has no mechanical cooling; and is in an area where natural gas is not currently available.~~

EXCEPTION ~~6~~5 to Section ~~140.4(g)~~170.2(c)4E: heating systems serving as emergency backup to gas heating equipment.

F. Heat Rejection Systems. Heat rejection equipment used in comfort cooling systems such as air-cooled condensers, open cooling towers, closed-circuit cooling towers, and evaporative condensers shall include the following:

i. **Fan Speed Control.** Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at 2/3 of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature or pressure of the heat rejection device.

EXCEPTION 1 to Section ~~140.4(h)1~~170.2(c)4Fi: Heat rejection devices included as an integral part of the equipment listed in TABLE 110.2-A through TABLE 110.2-I.

EXCEPTION 2 to Section ~~140.4(h)1~~170.2(c)4Fi: Condenser fans serving multiple refrigerant circuits.

EXCEPTION 3 to Section ~~140.4(h)1~~170.2(c)4Fi: Condenser fans serving flooded condensers.

EXCEPTION 4 to Section ~~140.4(h)1~~170.2(c)4Fi: Up to one third of the fans on a condenser or tower with multiple fans where the lead fans comply with the speed control requirement.

ii. **Tower Flow Turndown.** Open cooling towers configured with multiple condenser water pumps shall be designed so that all cells can be run in parallel with the larger of:

a. The flow that is produced by the smallest pump; or

b. 50 percent of the design flow for the cell.

iii. **Limitation on Centrifugal Fan Cooling Towers.** Open cooling towers with a combined rated capacity of 900 gpm and greater at 95°F condenser water return, 85°F condenser water supply, and 75°F outdoor wet-bulb temperature, shall use propeller fans and shall not use centrifugal fans.

EXCEPTION 1 to Section ~~140.4(h)3~~170.2(c)4Fiii: Cooling towers that are ducted (inlet or discharge) or have an external sound trap that requires external static pressure capability.

EXCEPTION 2 to Section ~~140.4(h)3~~170.2(c)4Fiii: Cooling towers that meet the energy efficiency requirement for propeller fan towers in Section 110.2, TABLE 110.2-G.

iv. **Multiple Cell Heat Rejection Equipment.** Multiple cell heat rejection equipment with variable speed fan drives shall:

a. Operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components, and

b. Control all operating fans to the same speed. Minimum fan speed shall comply with the minimum allowable speed of the fan drive as specified by the manufactures recommendation. Staging of fans is allowed once the fans are at their minimum operating speed.

v. **Cooling tower efficiency.** Axial fan, open-circuit cooling towers serving condenser water loops for chilled water plants with a total of 900 gpm or greater, shall have a rated efficiency of no less than 60 gpm/hp when rated in accordance with the conditions as listed in Table 110.2-G.

EXCEPTION 1 to Section ~~140.4(h)5~~170.2(c)4Fv: Replacement of existing cooling towers that are inside an existing building or on an existing roof.

EXCEPTION 2 to Section ~~140.4(h)5~~170.2(c)4Fv: Cooling towers serving buildings in Climate Zone 1 or 16.

G. **Minimum Chiller Efficiency.** Chillers shall meet or exceed Path B from TABLE 110.2-D

EXCEPTION 1 to Section ~~140.4(i)~~170.2(c)4G: Chillers with electrical service > 600V.

EXCEPTION 2 to Section ~~140.4(i)~~170.2(c)4G: Chillers attached to a heat recovery system with a design heat recovery capacity > 40 percent of the design chiller cooling capacity.

EXCEPTION 3 to Section ~~140.4(i)~~170.2(c)4G: Chillers used to charge thermal energy storage systems where the charging temperature is < 40 °F.

EXCEPTION 4 to Section ~~140.4(i)~~170.2(c)4G: In buildings with more than 3 chillers, only 3 chillers are required to meet the Path B efficiencies

H. **Limitation of Air-Cooled Chillers.** Chilled water plants shall not have more than 300 tons provided by air-cooled chillers.

EXCEPTION 1 to Section ~~140.4(j)~~170.2(c)4H: Where the water quality at the building site fails to meet manufacturer's specifications for the use of water-cooled chillers.

EXCEPTION 2 to Section ~~140.4(j)~~170.2(c)4H: Chillers that are used to charge a thermal energy storage system with a design temperature of less than 40 degrees F (4 degrees C).

~~**EXCEPTION 3 to Section 140.4(j):** Systems serving healthcare facilities~~

I. **Hydronic System Measures**.

i. **Hydronic Variable Flow Systems.** HVAC chilled and hot water pumping shall be designed for variable fluid flow and shall be capable of reducing pump flow rates to no more than the larger of: a) 50 percent or less of the design flow rate; or b) the minimum flow required by the equipment manufacturer for the proper operation of equipment served by the system.

EXCEPTION 1 to Section ~~140.4(k)1~~170.2(c)4I: Systems that include no more than three control valves.

EXCEPTION 2 to Section ~~140.4(k)1~~170.2(c)4I: Systems having a total pump system power less than or equal to 1.5 hp.

ii. **Chiller Isolation.** When a chilled water system includes more than one chiller, provisions shall be made so that flow through any chiller is automatically shut off when that chiller is shut off while still maintaining flow through other operating chiller(s). Chillers that are piped in series for the purpose of increased temperature differential shall be considered as one chiller.

iii. **Boiler Isolation.** When a hot water plant includes more than one boiler, provisions shall be made so that flow through any boiler is automatically shut off when that boiler is shut off while still maintaining flow through other operating boiler(s).

iv. **Chilled and Hot Water Temperature Reset Controls.** Systems with a design capacity exceeding 500,000 Btu/hr supplying chilled or heated water shall include controls that automatically reset supply water temperatures as a function of representative building loads or outside air temperature.

EXCEPTION 1 to Section ~~140.4(k)41~~170.2(c)4Iiv: Hydronic systems that use variable flow to reduce pumping energy in accordance with Section ~~140.4(k)1~~170.2(c)4Ii.

~~**EXCEPTION 2 to Section 140.4(k)41:** Systems serving healthcare facilities.~~

v. Water-Cooled Air Conditioner and Hydronic Heat Pump Systems. Water circulation systems serving water-cooled air conditioners, hydronic heat pumps, or both, that have total pump system power exceeding 5 hp shall have flow controls that meet the requirements of Section ~~140.4(k)6~~170.2(c)4Ivi. Each such air conditioner or heat pump shall have a two-position automatic valve interlocked to shut off water flow when the compressor is off.

vi. Variable Flow Controls.

a. Variable Speed Drives. Individual pumps serving variable flow systems and having a motor horsepower exceeding 5 hp shall have controls or devices (such as variable speed control) that will result in pump motor demand of no more than 30 percent of design wattage at 50 percent of design water flow. The pumps shall be controlled as a function of required differential pressure.

b. Pressure Sensor Location and Setpoint.

c. For systems without direct digital control of individual coils reporting to the central control panel, differential pressure shall be measured at the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure.

d. For systems with direct digital control of individual coils with a central control panel, the static pressure set point shall be reset based on the valve requiring the most pressure, and the setpoint shall be no less than 80 percent open. Pressure sensors may be mounted anywhere.

EXCEPTION 1 to Section ~~140.4(k)6~~170.2(c)4Ivi: Heating hot water systems.

EXCEPTION 2 to Section ~~140.4(k)6~~170.2(c)4Ivi: Condenser water systems serving only water-cooled chillers.

vii. Hydronic Heat Pump (WLHP) Controls. Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are capable of providing a heat pump water supply temperature deadband of at least 20°F between initiation of heat rejection and heat addition by the central devices.

EXCEPTION to Section ~~140.4(k)7~~170.2(c)4Ivii: Where a system loop temperature optimization controller is used to determine the most efficient operating temperature based on real-time conditions of demand and capacity, dead bands of less than 20°F shall be allowed**.**

J. **Air Distribution System Duct Leakage Sealing.** Duct systems shall be sealed in accordance with 1 or 2 below: Systems serving ~~high-rise residential~~ multifamily buildings~~, hotel/motel buildings and nonresidential buildings other than healthcare facilities~~, the duct system shall be sealed to a leakage rate not to exceed 6 percent of the nominal air handler airflow rate as confirmed through field verification and diagnostic testing, in accordance with the applicable procedures in Reference Nonresidential Appendices NA1 and NA2 if the criteria in Subsections A, B and C below are met:

i. The duct system provides conditioned air to an occupiable space for a constant volume, single zone, space-conditioning system; and

ii. The space conditioning system serves less than 5,000 square feet of conditioned floor area; and

iii. The combined surface area of the ducts located in the following spaces is more than 25 percent of the total surface area of the entire duct system:

a. Outdoors; or

b. In a space directly under a roof that

I. Has a U-factor greater than the U-factor of the ceiling, or if the roof does not meet the requirements of Section ~~140.3(a)1B~~170.2(a)1, or

II. Has fixed vents or openings to the outside or unconditioned spaces; or

c. In an unconditioned crawlspace; or

d. In other unconditioned spaces.

K. Fan Control. Each cooling system listed in TABLE ~~140.4-G~~170.2-H shall be designed to vary the indoor fan airflow as a function of load and shall comply with the following requirements:

iv. DX and chilled water cooling systems that control the capacity of the mechanical cooling directly based on occupied space temperature shall (i) have a minimum of 2 stages of fan control with no more than 66 percent speed when operating on stage 1; and (ii) draw no more than 40 percent of the fan power at full fan speed, when operating at 66 percent speed.

v. All other systems, including but not limited to DX cooling systems and chilled water systems that control the space temperature by modulating the airflow to the space, shall have proportional fan control such that at 50 percent air flow the power draw is no more than 30 percent of the fan power at full fan speed.

vi. Systems that include an air side economizer to meet ~~140.4(e)1~~170.2(c)4Ci shall have a minimum of two speeds of fan control during economizer operation.

EXCEPTION 1 to Section ~~140.4(m)~~170.2(c)4K: Modulating fan control is not required for chilled water systems with all fan motors <1 HP, or for evaporative systems with all fan motors < 1 HP, if the systems are not used to provide ventilation air and all indoor fans cycle with the load.

~~**EXCEPTION 2 to Section 140.0(m):** Systems serving healthcare facilities.~~

L. Mechanical System Shut-off. Any directly conditioned space with operable wall or roof openings to the outdoors shall be provided with interlock controls that disable or reset the temperature setpoint to 55°F for mechanical heating and disable or reset the temperature setpoint to 90°F for mechanical cooling to that space when any such opening is open for more than 5 minutes.

EXCEPTION 1 to Section ~~140.4(n)~~170.2(c)4L: Interlocks are not required on doors with automatic closing devices**.**

EXCEPTION 2 to Section ~~140.4(n)~~170.2(c)4L: Any space without a thermostatic control (thermostat or a space temperature sensor used to control heating or cooling to the space).

~~**EXCEPTION 3 to Section 140.4(n):** Healthcare facilities.~~

EXCEPTION ~~4~~3 to Section ~~140.4(n)~~170.2(c)4L: ~~High-rise residential~~ Multifamily dwelling units.

M. Exhaust System Transfer Air. Conditioned supply air delivered to any space with mechanical exhaust shall not exceed the greater of:

i. The supply flow required to meet the space heating or cooling load; or

ii. The ventilation rate required by the authority having jurisdiction, the facility Environmental Health and Safety Department, or by Section ~~120.1(c)3~~160.2(c)3; or

iii. The mechanical exhaust flow minus the available transfer air. Available transfer air shall be from another conditioned space or return air plenums on the same floor and same smoke or fire compartment, and that at their closest point are within 15 feet of each other.

~~**EXCEPTION 1 to Section 140.4(o):** Biosafety level classified laboratories 3 or higher.~~

~~**EXCEPTION 2 to Section 140.4(o):** Vivarium spaces.~~

EXCEPTION ~~3~~1 to Section ~~140.4(o)~~170.2(c)4M: Spaces that are required by applicable codes and standards to be maintained at a positive pressure differential relative to adjacent spaces.

EXCEPTION ~~4~~2 to Section ~~140.4(o)~~170.2(c)4M: Spaces where the highest amount of transfer air that could be used for exhaust makeup may exceed the available transfer airflow rate and where the spaces have a required negative pressure relationship.

~~**EXCEPTION 5 to Section 140.4(o):** Healthcare facilities.~~

(d) **Water Heating Systems.** Water-heating systems shall meet the requirements of either ~~A B or C~~ 1 or 2. For recirculation distribution systems ~~serving individual dwelling units~~, only Demand Recirculation Systems with manual on/off control as specified in the Reference Appendix RA4.4.9 shall be used:

1. For systems serving individual dwelling units, the water heating system shall meet the requirement of either ~~i, ii, iii, iv, or v~~A, B, C, D, or E:

   A. One or more gas or propane instantaneous water heater with an input of 200,000 Btu per hour or less and no storage tank.

   B. A single gas or propane storage type water heater with an input of 75,000 Btu per hour or less, rated volume less than or equal to 55 gallons and that meets the requirements of Sections 110.1 and 110.3. The dwelling unit shall have installed fenestration products with a weighted average U-factor no greater than 0.24, and in addition one of the following shall be installed:

      i. A compact hot water distribution system that is field verified as specified in the Reference Appendix RA4.4.16; or

      ii. A drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9.

   C. A single gas or propane storage type water heater with an input of 75,000 Btu per hour or less, rated volume of more than 55 gallons.

   D. A single heat pump water heater. The storage tank shall be located in the garage or conditioned space. In addition, one of the following:

      i. A compact hot water distribution system as specified in the Reference Appendix RA4.4.6 and a drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9; or

      ii. For Climate Zones 2 through 15, a photovoltaic system capacity of 0.3 kWdc larger than the requirement specified in Section ~~150.1(c)14~~170.2(f); or

      iii. For Climate Zones 1 and 16, a photovoltaic system capacity of 1.1 kWdc larger than the requirement specified in Section ~~150.1(c)14~~170.2(f).

   E. A single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher. The storage tank shall be located in the garage or conditioned space. In addition, for Climate Zones 1 and 16, a photovoltaic system capacity of 0.3 kWdc larger than the requirement specified in Section ~~150.1(c)14~~170.2(f) or a compact hot water distribution system as specified in the Reference Appendix RA4.4.6.

2. For systems serving multiple dwelling units, a central water-heating system that includes the following components shall be installed:

   A. Gas or propane water heating system; and

   B. A recirculation system that meets the requirements of Sections 110.3(c)2 and 110.3(c)5, includes two or more separate recirculation loops serving separate dwelling units, and is capable of automatically controlling the recirculation pump operation based on measurement of hot water demand and hot water return temperature; and

      EXCEPTION to Section ~~150.1(c)8Bii~~170.2(d)2B: Buildings with eight or fewer dwelling units may use a single recirculation loop.

   C. A solar water-heating system meeting the installation criteria specified in Reference Residential Appendix RA4 and with a minimum solar savings fraction of either a or b below:

      i. A minimum solar savings fraction of 0.20 in Climate Zones 1 through 9 or a minimum solar savings fraction of 0.35 in Climate Zones 10 through 16; or

      ii. A minimum solar savings fraction of 0.15 in Climate Zones 1 through 9 or a minimum solar savings fraction of 0.30 in Climate Zones 10 through 16. In addition, a drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9.

      iii. A water-heating system serving multiple dwelling units determined by the Executive Director to use no more energy than the one specified in subsection B above.

TABLE ~~150.1-B~~170.2-H MECHANICAL COMPONENT PACKAGE – Multifamily Standard Building Design

Multifamily				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
~~Dwelling~~ Unit HVAC System	~~Space Heating~~[8]	~~Electric Resistance Allowed~~		~~No~~	~~No~~	~~No~~	~~No~~	~~No~~	~~No~~	~~No~~	~~No~~	~~No~~	~~No~~	~~No~~	~~No~~	~~No~~	~~No~~	~~No~~	~~No~~
		~~If gas, AFUE~~		~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~
		~~If Heat Pump, HSPF~~[7]		~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~
	Space cooling	~~SEER~~		~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~	~~MIN~~
		Refrigerant Charge Verification or Fault Indicator Display		NR	REQ	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
	Central System Air Handlers	Central Fan Integrated Ventilation System Fan Efficacy		REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
	~~Ducts~~[9]	~~Roof/Ceiling Options B~~	~~Duct Insulation~~	~~R-8~~	~~R-8~~	~~R-6~~	~~R-8~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-8~~	~~R-8~~	~~R-8~~	~~R-8~~	~~R-8~~	~~R-8~~	~~R-8~~	~~R-8~~	~~R-8~~
		~~Duct and/or air handler outside of conditioned space~~	~~§150.1(c)9A~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~	~~NA~~
		~~Roof/Ceiling Option C~~	~~Duct Insulation~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~	~~R-6~~
		~~Ducts and air handlers in conditioned space~~	~~§150.1(c)9B~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~	~~REQ~~
Water Heating	All Buildings			System Shall meet Section ~~150.1(c)8~~170.2(c)															

Footnote requirements to TABLE ~~150.1-B~~170.2-H:

~~7. HSPF means "heating seasonal performance factor."~~

~~8. A supplemental heating unit may be installed in a space served directly or indirectly by a primary heating system, provided that the unit thermal capacity does not exceed 2 kilowatts or 7,000 Btu/hr and is controlled by a time-limiting device not exceeding 30 minutes.~~

~~9~~1. For duct and air handler location: REQ denotes location in conditioned space. When the table indicates ducts and air handlers are in conditioned space, a HERS verification is required as specified by Reference Residential Appendix RA3.1.4.3.8.

(e) **Lighting.** Dwelling unit lighting shall meet the applicable mandatory requirements of Section 160.6.

1. **Interior Common Use Area Lighting.** A building complies with this section if:

   i. The Calculation of Adjusted Indoor Lighting Power of all proposed building areas combined, calculated under Subsection ~~(a)~~ A is no greater than the Calculation of Allowed Indoor Lighting Power, Specific Methodologies calculated under Subsection (c); and

   ii. The Calculation of Allowed Indoor Lighting Power, General Rules comply with Subsection ~~(b)~~B; and

   iii. General lighting complies with the Automatic Daylighting Controls in Secondary Daylit Zone requirements in Subsection ~~(d)~~D.

   The prescriptive limits on indoor lighting power are the smaller of the Actual and Allowed Indoor Lighting Power values determined in accordance with item i.

A. **Calculation of Adjusted Indoor Lighting Power.** The adjusted indoor Lighting Power of all proposed building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building; subject to the applicable adjustments under Subdivisions 1 through 4 of this subsection.

   i. **Two interlocked lighting systems**: No more than two lighting systems may be used for an area, and if there are two they must be interlocked. Where there are two interlocked lighting systems, the watts of the lower wattage system may be excluded from the Adjusted Indoor Lighting Power if:

      a. An Installation Certificate detailing compliance with Section ~~140.6(a)1~~170.2(e)1A is submitted in accordance with Section 10-103 and Section ~~130.4~~160.5(e); and

      b. The area or areas served by the interlocking systems is an auditorium, ~~a convention center,~~ a conference room, a multipurpose room, or a theater; and

      c. The two lighting systems are interlocked with a Nonprogrammable Double-Throw Switch to prevent simultaneous operation of both systems.

         For compliance with Part 6 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.

   ii. **Reduction of wattage through controls.** In calculating Adjusted Indoor Lighting Power, the installed watts of a luminaire providing general lighting in an area listed in TABLE ~~140.6-A~~170.2-I may be reduced by the product of (i) the number of watts controlled as described in TABLE ~~140.6-A~~170.2-I, times (ii) the applicable Power Adjustment Factor (PAF), if all of the following conditions are met:

      a. An Installation Certificate is submitted in accordance with Section ~~130.4(b)~~160.5(e)1B; and

      b. Luminaires and controls meet the applicable requirements of Section 110.9, and Sections ~~130.0~~ 160.5 through ~~130.5~~160.6; and

      c. The controlled lighting is permanently installed general lighting systems and the controls are permanently installed nonresidential-rated lighting controls.

         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:

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

         II. The furniture mounted luminaires shall be permanently hardwired; and

         III. The furniture mounted lighting system shall be designed to provide indirect general lighting; and

IV. 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; and

V. The lighting control for the furniture mounted luminaire complies with all other applicable requirements in Section ~~140.6(a)2~~170.2(e)1Aii.

d. At least 50 percent of the light output of the controlled luminaire is within the applicable area listed in TABLE ~~140.6-A~~170.2-I. Luminaires on lighting tracks shall be within the applicable area in order to qualify for a PAF.

e. Only one PAF from TABLE ~~140.6-A~~170.2-I may be used for each qualifying luminaire. PAFs shall not be added together unless allowed in TABLE ~~140.6-A~~170.2-I.

f. Only lighting wattage directly controlled in accordance with Section ~~140.6(a)2~~170.2(e)1Aii shall be used to reduce the installed watts as allowed by Section ~~140.6(a)2~~170.2(e)1Aii for calculating the Adjusted Indoor Lighting Power. If only a portion of the wattage in a luminaire is controlled in accordance to Section ~~140.6(a)2~~170.2(e)1Aii, then only that portion of controlled wattage may be reduced in calculating Adjusted Indoor Lighting Power.

g. Lighting controls used to qualify for a PAF shall be designed and installed in addition to manual, multilevel, and automatic lighting controls required in Section ~~130.1~~160.5(b)4, and in addition to any other lighting controls required by any provision of Part 6. PAFs shall not be available for lighting controls required by Part 6.

h. To qualify for the PAF for daylight dimming plus OFF control, the daylight control and controlled luminaires shall comply with Section ~~130.1(d)~~160.5(b)4D, ~~130.4(a)3~~160.5(e)1C and ~~130.4(a)7~~160.5(e)1G, and shall additionally 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. The PAF shall apply only to the luminaires in the primary sidelit daylit zone and the skylit daylit zone.

i. 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~~170.2-I, the following requirements shall be met:

I. The open plan office area shall be greater than 250 square feet; and

II. This PAF shall be available only in office areas which contain workstations; and

III. Controlled luminaires shall only be those that provide general lighting directly above the controlled area, or furniture mounted luminaires that comply with Section ~~140.6(a)2~~170.2(e)1Aii and provide general lighting directly above the controlled area; and

IV. Qualifying luminaires shall be controlled by occupant sensing controls that meet all of the following requirements, as applicable:

A. Infrared sensors shall be equipped by the manufacturer, of fitted in the field by the installer, with lenses or shrouds to prevent them from being triggered by movement outside of the controlled area.

B. Ultrasonic sensors shall be tuned to reduce their sensitivity to prevent them from being triggered by movements outside of the controlled area.

C. All other sensors shall be installed and adjusted as necessary to prevent them from being triggered by movements outside of the controlled area.

j. To qualify for the PAF for an Institutional Tuning in TABLE ~~140.6-A~~170.2-I, the tuned lighting system shall comply with all of the following requirements:

I. 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; and

II. The means of setting the limit is accessible only to authorized personnel; and

III. The setting of the limit is verified by the acceptance test required by Section ~~130.4(a)7~~160.5(e)1G; and

I. The construction documents specify which lighting systems shall have their maximum light output or maximum power draw set to no greater than 85% of full light output or full power draw.

k. To qualify for the PAF for a Demand Responsive Control in TABLE ~~140.6-A~~170.2-I, a Demand Responsive Control shall meet all of the following requirements:

I. The common use area of the building shall be 10,000 square feet or smaller; and

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

III. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in TABLE ~~130.1-A~~160.5-B; and

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

l. To qualify for the PAFs for clerestory fenestration, horizontal slats, or light shelves in TABLE ~~140.6-A~~170.2-I, the daylighting design shall meet the requirements in Section 140.3(d). The PAFs shall only apply to lighting in a primary or secondary sidelit daylit zone where continuous dimming daylighting controls meeting the requirements of Section ~~130.1(d)~~160.5(b)4D) are installed.

iii. **Lighting wattage excluded.** The watts of the following indoor lighting applications may be excluded from Adjusted Indoor Lighting Power. (Indoor lighting not listed below shall comply with all applicable nonresidential indoor lighting requirements in Part 6.):

a. Lighting installed by the manufacturer in walk-in coolers or freezers, vending machines, and food preparation equipment~~, and scientific and industrial equipment~~.

b. Lighting that is required for exit signs subject to the CBC. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.

c. Exit way or egress illumination that is normally off and that is subject to the CBC.

~~d. In high-rise residential buildings: Lighting in dwelling units (Lighting in high-rise residential dwelling units shall comply with Section 130.0(b). (Indoor lighting not in dwelling units shall comply with all applicable nonresidential lighting requirements in Part 6.)~~

d. Temporary lighting systems. (As defined in Section 100.1.)

e. Lighting systems in qualified historic buildings, as defined in the California Historical Building Code (Title 24, Part 8), are exempt from the Lighting Power Density 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 Density allowances.

f. Lighting for signs: Lighting for signs shall comply with Section 140.8.

g. Lighting in elevators where the lighting meets the requirements in Section 120.6(f).

h. Lighting connected to a Life Safety Branch or Critical Branch, as specified in Section 517 of the California Electrical Code.

iv. **Luminaire Classification and Power Adjustment**

a. Luminaire Classification and Power shall be determined in accordance with Section ~~130.0(c)~~ 160.5(c)1.

b. Small Aperture Tunable-White and Dim-to-Warm Luminaires Lighting Power Adjustment. For qualifying small aperture tunable-white and dim-to-warm LED luminaires, the adjusted indoor lighting power of these luminaires shall be calculated by multiplying their maximum rated wattage by 0.75. Qualifying luminaires shall meet all of the following:

I. Small Aperture. Qualifying luminaires longer than 18 inches shall be no wider than four inches. Qualifying luminaires with a length of 18 inches or less shall be no wider than eight inches.

II. Color Changing. Qualifying tunable-white luminaires shall be capable of a color change greater than or equal to 2000 Kelvin correlated color temperature (CCT). Qualifying dim-to-warm luminaires shall be capable of color change greater than or equal to 500 Kelvin CCT.

III. Controls. Qualifying luminaires shall be connected to controls that allows color changing of the luminaires.

c. Tailored Method Display Lighting Mounting Height Lighting Power Adjustment. For wall display luminaires or floor display luminaires meeting Tailored Method Section ~~140.6(e)3G~~170.2(e)1Ciig and H and where the bottom of luminaires are 10 feet 7 inches and greater above the finished floor, the adjusted indoor lighting power of these luminaires shall be calculated by multiplying their maximum rated wattage and the appropriated mounting height adjustment factor from TABLE ~~140.6-E~~170.2-L. Luminaire mounting height is the distance from the finished floor to the bottom of the luminaire. General lighting shall not qualify for a mounting height multiplier.

B. Calculation of Allowed Indoor Lighting Power: General Rules.

i. The allowed Indoor Lighting Power allotment for conditioned areas shall be calculated separately from the allowed Lighting Power allotment for unconditioned areas. Each allotment is applicable solely to the area to which it applies, and there shall be no trade-offs between conditioned and unconditioned area allotments.

ii. Allowed Indoor Lighting Power allotment shall be calculated separately from the allowed Outdoor Lighting Power allotment. Each allotment is applicable solely to the area to which it applies, and there shall be no trade-offs between the separate Indoor and Outdoor allotments.

iii. The Allowed Indoor Lighting Power allotment for general lighting shall be calculated as follows:

a. The Area Category Method, as described in Section ~~140.6(e)2~~170.2(e)1Ci, shall be used either by itself for all common use areas in the building, or when some areas in the building use the Tailored Method described in Section ~~140.6(e)3~~170.2(e)1Cii. Under the Area Category Method (either by itself or in conjunction with the Tailored Method), as described more fully in Section ~~140.6(e)2~~170.2(e)1Ci, and subject to the adjustments listed there, the allowed Indoor Lighting Power allotment for general lighting shall be calculated for each area in the building as follows:

I. For conditioned areas, by multiplying the conditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in TABLE ~~140.6-C~~170.2-J (or TABLE ~~140.6-D~~170.2-K if the Tailored Method is used for that area).

II. For unconditioned areas, by multiplying the unconditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in TABLE ~~140.6-C~~170.2-J (or TABLE ~~140.6-D~~170.2-K if the Tailored Method is used for that area).

The Allowed Indoor Lighting Power allotment for general lighting for one area for which the Area Category Method was used may be increased up to the amount that the Allowed Indoor Lighting Power allotment for general lighting for another area using the Area Category Method or Tailored Method is decreased, except that such increases and decreases shall not be made between conditioned and unconditioned space.

b. The Tailored Method, as described in Section ~~140.6(e)3~~170.2(e)1Cii, shall be used either by itself for all areas in the building, or when some areas in the building use the Area Category

Method described in Section ~~140.6(c)2~~170.2(e)1Ci. Under the Tailored Method (either by itself or in conjunction with the Area Category Method) as described more fully in Section ~~140.6(c)3~~170.2(e)1Cii, and subject to the adjustments listed there, allowed Indoor Lighting Power allotment for general lighting shall be calculated for each area in the building as follows:

I. For conditioned areas, by multiplying the conditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in TABLE ~~140.6-D~~170.2-K (or TABLE ~~140.6-C~~170.2-J if the Area Category Method is used for that area);

II. For unconditioned areas, by multiplying the unconditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in TABLE ~~140.6-D~~170.2-J (or TABLE ~~140.6-C~~170.2-J if the Area Category Method is used for that area);

The Allowed Indoor Lighting Power allotment for general lighting for one area for which the Tailored Method was used may be increased up to the amount that the Allowed Indoor Power Lighting for general lighting for another area is decreased, but only if the Tailored Method or Area Category Method was used for the other area, except that such increases and decreases shall not be made between conditioned and unconditioned space.

c. If the Area Category Method is used for an area, the Tailored Method may not be used for that area. If the Tailored Method is used for an area, the Area Category Method may not be used for that area.

C. **Calculation of Allowed Indoor Lighting Power: Specific Methodologies.** The allowed indoor Lighting Power for each ~~building type, or each~~ common use primary function area shall be calculated using only one of the methods in Subsection ~~1, 2 or 3~~ i, ii, or iii below as applicable.

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

a. The Area Category Method shall be used only for primary function areas, as defined in Section 100.1, that are listed in TABLE ~~140.6-C~~170.2-J. For primary function areas not listed, selection of a reasonably equivalent type shall be permitted.

~~b. Primary Function Areas in TABLE 140.6-C170.2-J shall not apply to a complete building. Each primary function area shall be determined as a separate area.~~

c. For purposes of compliance with Section ~~140.6(c)2~~170.2(e)1Ci, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in TABLE ~~140.6-C~~170.2-J.

d. 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.

~~e. If at the time of permitting for a newly constructed building, a tenant is not identified for a multi-tenant area, a maximum of 0.4 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.~~

e. ~~Under the Area Category Method, t~~The allowed indoor Lighting Power for each primary function area is the Lighting Power Density value in TABLE ~~140.6-C~~170.2-J times the square feet of the primary function area. The total allowed indoor Lighting Power for the building is the sum of all allowed indoor Lighting Power for all areas in the building.

f. In addition to the allowed indoor Lighting Power calculated according to Sections ~~140.6(c)2A through F~~170.2(e)1Cia through f, the building may add additional lighting power allowances for qualifying lighting systems as specified in the Qualifying Lighting Systems column in TABLE ~~140.6-C~~170.2-J under the following conditions:

I. Only primary function areas having a lighting system as specified in the Qualifying Lighting Systems column in TABLE ~~140.6-C~~170.2-J and in accordance with the

corresponding footnote of the TABLE shall qualify for the additional lighting power allowances; and

II. 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; and

III. 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; and

IV. The additional lighting power allowances shall not utilize any type of luminaires that are used for general lighting in the building; and

~~V. 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; and~~

V. The additional lighting power allowed is the smaller of:

A. the lighting power density listed in the "Allowed Additional Lighting LPD" column in TABLE ~~140.6-C~~170.2-J, times the square feet of the primary function, or

B. the Adjusted Indoor Lighting Power of the applicable lighting; and

VI. In addition to all other additional lighting power allowed under Sections ~~140.6(e)2Gi~~ 170.2(e)1CigI through ~~vi~~V, up to 1.0 watts per square foot of additional lighting power shall be allowed in a videoconferencing studio, as defined in Section 100.1, provided the following conditions are met:

A. A completed and signed Installation Certificate is prepared and submitted in accordance with Section ~~130.4(b)~~160.5(e)1B, specifically detailing compliance with the applicable requirements of Section ~~140.6(e)2Gvii~~170.2(e)1CigVI; and

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; and

C. General lighting is switched in accordance with TABLE ~~130.1-A~~160.5-B; and

D. Wall wash lighting is separately switched from the general lighting system; and

E. All of the lighting in the studio, including general lighting and additional lighting power allowed by Section ~~140.6(e)2Gvii~~170.2(e)1CigVI is controlled by a multiscene programmable control system (also known as a scene preset control system).

ii. Tailored Method. Requirements for using the Tailored Method include all of the following:

a. The Tailored Method shall be used only for primary function areas listed in TABLE ~~140.6-D~~170.2-K, as defined in Section 100.1.

b. Allowed Indoor Lighting Power allotments for general lighting shall be determined according to Section ~~140.6(e)3F~~170.2(e)1Ciif, as applicable.

c. For compliance with Section ~~140.6(e)3~~170.2(e)1Cii, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in TABLE ~~140.6-D~~170.2-K.

d. 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.

e. In addition to the allowed indoor Lighting Power allotments for general lighting calculated according to Section ~~140.6(e)3F~~170.2(e)1Ciiif, as applicable, the building may add additional lighting power allowances for wall display lighting, ~~floor display lighting and~~ task lighting,and ornamental/special effects lighting, ~~and very valuable display cases lighting~~ according to Section ~~140.6(e)3G~~ 170.20(e)1Ciig through ~~J~~j.

f. Determine allowed indoor Lighting Power allotments for general lighting for primary function areas listed in TABLE ~~140.6-D~~170.2-K as follows:

I. Use the General Illumination Level (Lux) listed in Column 2 of TABLE ~~140.6-D~~170.2-K to determine the Allowed General Lighting Power Density allotments for the area.

II. Determine the room cavity ratio (RCR) for the area. The RCR shall be calculated according to the applicable equation in TABLE ~~140.6-F~~170.2-M.

III. Find the allowed General Lighting Power Density allotments in TABLE ~~140.6-G~~170.2-N that is applicable to the General Illuminance Level (Lux) from Column 2 of TABLE ~~140.6-D~~170.2-K (as described in Item i.) and the RCR determined in accordance with TABLE ~~140.6-F~~170.2-M (as described in Item ii).

IV. Determine the square feet of the area in accordance with Section ~~140.6(c)3C~~ 170.2(e)1Ciic-and ~~D~~d.

~~V.~~ Multiply the allowed Lighting Power Density allotment, as determined in accordance with Item iii by the square feet of each primary function area, as determined in accordance with Item iv. The product is the Allowed Indoor Lighting Power allotment for general lighting for the area.

g. Determine additional allowed power for wall display lighting according to column 3 of TABLE ~~140.6-D~~170.2-K for each primary function area as follows:

~~I. Floor displays shall not qualify for wall display allowances.~~

I. Qualifying wall lighting shall:

A. Be mounted within 10 feet of the wall having the wall display. 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, portions of track more than 10 feet from the wall shall not be used for the wall display allowance.

B. Be a lighting system type appropriate for wall lighting. 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 luminaires providing directional display light.)

i. Additional allowed power for wall display lighting is available only for lighting that illuminates walls having wall displays. 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. Permanent full height interior partitions are those that (I) extend from the floor to within two feet of the ceiling or are taller than ten feet and (II) are permanently anchored to the floor.

ii. For wall display lighting where the bottom of the luminaire is greater than 10 feet 6 inches above the finished floor, the mounting height adjustment factor from TABLE ~~140.6-E~~170.2-L can be used to adjust the installed luminaire wattage as specified in Section ~~140.6(a)4C~~170.2(e)1Aivc.

iii. The allowed power for wall display lighting shall be the smaller of:

a. the "wall display lighting power density" determined in accordance with TABLE ~~140.6-D~~170.2-K, multiplied by the wall display lengths determined in accordance with Item iii; and

b. The Adjusted Indoor Lighting Power used for the wall display lighting systems.

iv. Lighting internal to display cases that are attached to a wall or directly adjacent to a wall are counted as wall display lighting as specified in Section ~~140.6(c)3C~~170.2(e)1Ciig. All other lighting internal to display cases are counted

as floor display lighting as specified in Section ~~140.6(e)3H~~170.2(e)1Ciih, or as very valuable display case lighting as specified in Section ~~140.6(e)3J~~170.2(e)1Ciij.

h. Determine additional allowed power for ~~floor display lighting and~~ task lighting as follows:

~~I. Displays that are installed against a wall shall not qualify for the floor display lighting power allowances.~~

~~II. Lighting internal to display cases that are not attached to a wall and not directly adjacent to a wall, shall be counted as floor display lighting in accordance with Section 140.6(c)3H; or very valuable display case lighting in accordance with Section 140.6(c)3J.~~

~~III. Additional allowed power for floor display lighting, and additional allowed power for task lighting, may be used by qualifying floor display lighting systems, qualifying task lighting systems, or a combination of both. 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.~~

~~IV. Qualifying floor display lighting shall:~~

~~A. Be mounted no closer than 2 feet to a wall.~~

~~B. Consist of only (I) directional lamp types, such as PAR, R, MR, AR; or (II) luminaires providing directional display light.~~

~~C. If track lighting is used, shall be only track heads that are classified as direction lighting types.~~

Qualifying task lighting shall:

I. Be located immediately adjacent to and capable of illuminating the task for which it is installed.

II. Be of a type different from the general lighting system.

III. Be separately switched from the general lighting system.

~~IV. If there are illuminated floor displays, floor display lighting power shall be used only if allowed by column 4 of TABLE 140.6.~~

~~V. The square footage of floor displays or the square footage of task areas shall be determined in accordance with Section 140.6(c)3C and Dd, except that 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.~~

~~VI. For floor display lighting where the bottom of the luminaire is greater than 10.6 feet above the finished floor, multiply the floor display installed watts by the appropriate mounting height adjustment factor from TABLE 140.6 to calculate the Adjusted Indoor Lighting Power as specified in Section 140.6(a)4C.~~

~~VII. The allowed power for floor display lighting for each applicable area shall be the smaller of:~~

~~A. The allowed floor display and task lighting power determined in accordance with Section 140.6(c) by the floor square footage determined in accordance with Section 140.6(c); and~~

~~B. The Adjusted Indoor Lighting Power used for the floor display lighting systems.~~

i. Determine additional allowed power for ornamental/special effects lighting as follows:

I. Qualifying ornamental lighting includes 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.

II. Additional lighting power for ornamental/special effects lighting shall be used only if allowed by Column 5 of TABLE ~~140.6-D~~170.2-K.

III. Additional lighting power for ornamental/special effects lighting shall be used only in areas having ornamental/special effects lighting. The square footage of the floor area shall be determined in accordance with Section ~~140.6(e)3C~~170.2(e)1Ciic and ~~D~~d, and it shall not include floor areas not having ornamental/special effects lighting.

IV. The additional allowed power for ornamental/special effects lighting for each applicable area shall be the smaller of:

A. The product of the "allowed ornamental/special effects lighting power" determined in accordance with Section ~~140.6(e)3Kii~~170.2(e)1CiikII, multiplied by the floor square footage determined in accordance with Section ~~140.6(e)3Kiii~~170.2(e)1CiikIII; and

B. The Adjusted Indoor Lighting Power of allowed ornamental/special effects lighting.

~~j. Determine additional allowed power for very valuable display case lighting as follows:~~

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

~~I. 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.~~

~~II. 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.~~

~~III. If there is qualifying very valuable display case lighting, in accordance with Section 140.6(c)3Jii, the smallest of the following separate lighting power for display cases presenting very valuable display items is permitted:~~

~~A. The product of the area of the primary function and 0.55 watt per square foot; or~~

~~B. The product of the area of the display case and 8 watts per square foot; or~~

~~C. The Adjusted Indoor Lighting Power of lighting for very valuable displays~~.

D. **Automatic Daylighting Controls in Secondary Daylit Zones.** All luminaires providing general lighting that is in, or partially in a Secondary Sidelit Daylit Zone, and that is not in a Primary Sidelit Daylit Zone shall:

i. Be controlled independently from all other luminaires by automatic daylighting controls that meet the applicable requirements of Section 110.9; and

ii. Be controlled in accordance with the applicable requirements in Section ~~130.1(d)~~160.5(b)4D; and

iii. All Secondary Sidelit Daylit Zones shall be shown on the plans submitted to the enforcing agency.

EXCEPTION 1 to Section ~~140.6(d)~~170.2(e)1D: Luminaires in Secondary Sidelit Daylit Zone(s) in an enclosed space in which the combined total general lighting power in Secondary Daylit Zone(s) is less than 120 watts, or where the combined total general lighting power in Primary and Secondary Daylit Zone(s) is less than 240 watts.

EXCEPTION 2 to Section ~~140.6(d)~~170.2(e)1D: Luminaires in parking garages complying with Section ~~130.1(d)3~~160.5(b)4Diii.

EXCEPTION 3 to Section ~~140.6(d)~~170.2(e)1D: Areas adjacent to vertical glazing below an overhang, where there is no vertical glazing above the overhang and where the ratio of the overhang projection to the overhang rise is greater than 1.5 for South, East and West orientations, or where the ratio of the overhang projection to the overhang rise is greater than 1 for North orientations.

EXCEPTION 4 to Section ~~140.6(d)~~170.2(e)1D: Rooms that have a total glazing area of less than 24 square feet, or parking garage areas with a combined total of less than 36 square feet of glazing or opening.

~~**EXCEPTION 5 to Section 140.6(d):** Luminaires in sidelit daylit zones in retail merchandise sales and wholesale showroom areas.~~

TABLE ~~140.6-A~~170.2-I LIGHTING POWER ADJUSTMENT FACTORS (PAF)

TYPE OF CONTROL	TYPE OF AREA		FACTOR
a. To qualify for any of the Power Adjustment Factors in this table, the installation shall comply with the applicable requirements in Section ~~140.6~~170.2(e)1Aii b. Only one PAF may be used for each qualifying luminaire unless combined below. c. Lighting controls that are required for compliance with Part 6 shall not be eligible for a PAF			
1. Daylight Dimming plus OFF Control	Luminaires in skylit daylit zone or primary sidelit daylit zone		0.10
2. Occupant Sensing Controls in Large Open Plan Offices	In open plan offices > 250 square feet: One sensor controlling an area that is:	No larger than 125 square feet	0.40
		From 126 to 250 square feet	0.30
		From 251 to 500 square feet	0.20
3.Institutional Tuning	Luminaires in non-daylit areas. Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.		0.10
	Luminaires in daylit areas. Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.		0.05
4. Demand Responsive Control	All building types of 10,000 square feet or smaller. Luminaires that qualify for other PAFs in this table may also qualify for this demand responsive control PAF		0.05
5. Clerestory Fenestration	Luminaires in daylit areas adjacent to the clerestory. Luminaires that qualify for daylight dimming plus OFF control may also qualify for this PAF.		0.05
6. Horizontal Slats	Luminaires in daylit areas adjacent to vertical fenestration with interior or exterior horizontal slats. Luminaires that qualify for daylight dimming plus OFF control may also qualify for this PAF.		0.05
7.Light Shelves	Luminaires in daylit areas adjacent to clerestory fenestration with interior or exterior light shelves. This PAF may be combined with the PAF for clerestory fenestration. Luminaires that qualify for daylight dimming plus OFF control may also qualify for this PAF		0.10

TABLE ~~140.6-C~~170.2-J AREA CATEGORY METHOD - LIGHTING POWER DENSITY VALUES (WATTS/FT²)

Primary Function Area		Allowed Lighting Power Density for General Lighting (W/ft²)	Additional Lighting Power[1]	
			Qualified Lighting Systems	Additional Allowance (W/ft², unless noted otherwise)
~~Auditorium Area~~		~~0.70~~	~~Ornamental~~	~~0.30~~
			~~Accent, display and feature[3]~~	~~0.20~~
~~Auto Repair / Maintenance Area~~		~~0.55~~	~~Detailed Task Work[7]~~	~~0.20~~
~~Audience Seating Area~~		~~0.60~~	~~Ornamental~~	~~0.30~~
~~Beauty Salon Area~~		~~0.80~~	~~Detailed Task Work[7]~~	~~0.20~~
			~~Ornamental~~	~~0.30~~
~~Civic Meeting Place Area~~		~~1.00~~	~~Ornamental~~	~~0.30~~
Classroom, Lecture, Training, Vocational Area		0.70	White or Chalk Board[1]	4.50 W/ft
~~Commercial/Industrial Storage~~	~~Warehouse~~	~~0.45~~	~~-~~	~~-~~
	~~Shipping & Handling~~	~~0.60~~	~~-~~	~~-~~
~~Convention,~~ Conference, Multipurpose and Meeting Area		0.85	Ornamental	0.30
Copy Room		0.50	-	-
Corridor Area		0.60	-	-
Dining Area	Bar/Lounge and Fine Dining	0.55	Ornamental	0.30
	Cafeteria/Fast Food	0.40		
	Family and Leisure	0.50		
Electrical, Mechanical, Telephone Rooms		0.40	Detailed Task Work[7]	0.20
Exercise/Fitness Center and Gymnasium Area		0.50	-	-
~~Hotel Function Area~~		~~0.85~~	~~Ornamental~~	~~0.30~~
~~Museum Area~~	~~Exhibition/Display~~	~~0.60~~	~~Accent, display and feature[3]~~	~~0.50~~
	~~Restoration Room~~	~~0.75~~	~~Detailed Task Work[7]~~	~~0.20~~
~~Financial Transaction Area~~		~~0.80~~	~~Ornamental~~	~~0.30~~
~~General/Commercial & Industrial Work Area~~	~~Low Bay~~	~~0.60~~	~~Detailed Task Work[7]~~	~~0.20~~
	~~High Bay~~	~~0.65~~	~~Detailed Task Work[7]~~	~~0.20~~
	~~Precision~~	~~0.85~~	~~Precision Specialized Work[9]~~	~~0.70~~
~~Library~~	~~Reading Area~~	~~0.80~~	~~Ornamental~~	~~0.30~~
	~~Stacks Area~~	~~1.10~~	~~-~~	~~-~~
Main Entry Lobby		0.85	Ornamental	0.30
Locker Room		0.45	-	-
Lounge, Breakroom, or Waiting Area		0.65	Ornamental	0.30
Concourse and Atria Area		0.90	Ornamental	0.30
Office Area	> 250 square feet	0.65	Portable lighting for office areas[6]	0.20
	≤ 250 square feet	0.70		
	Open plan office	0.60		
Parking Garage Area	Parking Zone	0.10	First ATM	100 W
			Additional ATM	50 W each
	Dedicated Ramps	0.25	-	-
	Daylight Adaptation Zones[2]	0.50	-	-

~~Pharmacy Area~~		~~1.10~~	~~Specialized Task Work[8]~~	~~0.35~~
~~Retail Sales Area~~	~~Grocery Sales~~	~~1.05~~	~~Accent, display and feature[3]~~	~~0.20~~
			~~Decorative~~	~~0.15~~
	~~Retail Merchandise Sales~~	~~1.00~~	~~Accent, display and feature[3]~~	~~0.20~~
			~~Decorative~~	~~0.15~~
	~~Fitting Room~~	~~0.60~~	~~External Illuminated Mirror[5]~~	~~40 W/ea~~
			~~Internal Illuminated Mirror[5]~~	~~120 W/ea~~
Theater Area	Motion picture	0.60	Ornamental	0.30
	~~Performance~~	~~1.00~~		
Kitchen/Food Preparation Area		0.95	-	-
~~Scientific Laboratory Area~~		~~1.00~~	~~Specialized Task Work[8]~~	~~0.35~~
~~Healthcare Facility and Hospitals~~	~~Exam/Treatment Room~~	~~1.15~~	~~-~~	~~-~~
	~~Imaging Room~~	~~1.00~~	~~-~~	~~-~~
	~~Medical Supply Room~~	~~0.55~~	~~-~~	~~-~~
	~~Nursery~~	~~0.95~~	~~Tunable white or dim-to-warm[10]~~	~~0.10~~
	~~Nurse's Station~~	~~0.75~~	~~Tunable white or dim-to-warm[10]~~	~~0.10~~
	~~Operating Room~~	~~1.90~~	~~-~~	~~-~~
	~~Patient Room~~	~~0.55~~	~~Decorative~~	~~0.15~~
			~~Tunable white or dim-to-warm[10]~~	~~0.10~~
	~~Physical Therapy Room~~	~~0.85~~	~~Tunable white or dim-to-warm[10]~~	~~0.10~~
	~~Recovery Room~~	~~0.90~~	~~Tunable white or dim-to-warm[10]~~	~~0.10~~
Laundry Area		0.45	-	-
~~Religious Worship Area~~		~~0.95~~	~~Ornamental~~	~~0.30~~
Restrooms		0.65	Accent, display and feature[3]	0.20
			Decorative[4]	0.15
~~Transportation Function~~	~~Baggage Area~~	~~0.40~~	~~-~~	~~-~~
	~~Ticketing Area~~	~~0.45~~	~~Accent, display and feature[3]~~	~~0.20~~
~~Sports Arena – Playing Area~~	~~Class I Facility[13]~~	~~2.25~~	~~-~~	~~-~~
	~~Class II Facility[13]~~	~~1.45~~	~~-~~	~~-~~
	~~Class III Facility[13]~~	~~1.10~~	~~-~~	~~-~~
	~~Class IV Facility[13]~~	~~0.75~~	~~-~~	~~-~~
Stairwell		0.50	Accent, display and feature[3]	0.20
			Decorative[4]	0.15
Videoconferencing Studio		0.90	Videoconferencing	1.00
All other		0.40	-	-
Aging Eye/Low-vision[11]	Main Entry Lobby	0.85	Ornamental	0.30
			Transition Lighting OFF at night[12]	0.95

	Stairwell	0.80	-	-
	Corridor Area	0.80	Decorative[4]	0.15
	Lounge/Waiting Area	0.75	Ornamental	0.30
	Multipurpose Room	0.95	Ornamental	0.30
	~~Religious Worship Area~~	~~1.00~~	~~Ornamental~~	~~0.30~~
	Dining	0.80	Ornamental	0.30
	Restroom	0.80	Accent, display and feature[3]	0.20

Footnotes for this table are listed below.

1. White board or chalk board. – Directional lighting dedicated to a white board or chalk board.

~~2. Daylight Adaptation Zones shall be no longer than 66 feet from the entrance to the parking garage.~~

3. Accent, display and feature lighting – luminaires shall be adjustable or directional.

4. Decorative lighting – primary function shall be decorative and not to provide general lighting.

5. Illuminated mirrors. Lighting shall be dedicated to the mirror.

6. Portable lighting in office areas includes under shelf or furniture-mounted supplemental task lighting qualifies when controlled by a time clock or an occupancy sensor.

7. Detailed task work – Lighting provides high level of visual acuity required for activities with close attention to small elements and/or extreme close up work.

~~8. Specialized task work – Lighting provides for small-scale, cognitive or fast performance visual tasks; lighting required for operating specialized equipment associated with pharmaceutical/laboratorial activities.~~

~~9. Precision specialized work – Lighting for work performed within a commercial or industrial environment that entails working with low contrast, finely detailed, or fast moving objects.~~

~~10. Tunable white luminaires capable of color change greater than or equal to 2000K CCT, or dim-to-warm luminaires capable of color change greater than or equal to 500K CCT, connected to controls that allows color changing of the luminaires.~~

11. Aging Eye/Low-vision areas can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and are or will be licensed by local or state authorities for either senior long-term care, adult day care, senior support, and/or people with special visual needs.

12. Transition lighting OFF at night. Lighting power controlled by astronomical time clock or other control to shut off lighting at night. Additional LPD only applies to area within 30 feet of an exit. Not applicable to lighting in daylit zones.

~~13. Class I Facility is used for competition play for 5000 or more spectators. Class II Facility is used for competition play for up to 5000 spectators. Class III Facility is used for competition play for up to 2000 spectators. Class IV Facility is normally used for recreational play and there is limited or no provision for spectators.~~

TABLE ~~140.6-D~~170.2-K TAILORED METHOD LIGHTING POWER ALLOWANCES

1	2	3	4	5
Primary Function Area	**General Illumination Level (Lux)**	**Wall Display Lighting Power Density (W/ft)**	**~~Allowed Combined Floor Display Power and Task Lighting Power Density (W/ft²)~~**	**Allowed Ornamental/ Special Effect Lighting Power Density (W/ft²)**
~~Auditorium Area~~	~~300~~	~~3.00~~	~~0.20~~	~~0.40~~
~~Convention,~~ Conference, Multipurpose, and Meeting Center Areas	300	2.00	~~0.35~~	0.40
Dining Areas	200	1.25	~~0.50~~	0.40
~~Exhibit, Museum Areas~~	~~150~~	~~11.50~~	~~0.80~~	~~0.40~~
~~Hotel Area:~~				
~~Ballroom/Events~~	~~400~~	~~1.80~~	~~0.12~~	~~0.40~~
~~Lobby~~	~~200~~	~~3.50~~	~~0.20~~	~~0.40~~
Main entry lobby	200	3.50	~~0.20~~	0.40
~~Religious Worship Area~~	~~300~~	~~1.30~~	~~0.40~~	~~0.40~~
~~Retail Sales~~				
~~Grocery~~	~~600~~	~~6.80~~	~~0.70~~	~~0.40~~
~~Merchandise Sales, and Showroom Areas~~	~~500~~	~~11.80~~	~~0.80~~	~~0.40~~
~~Theater Area:~~				
~~Motion picture~~	~~200~~	~~2.00~~	~~0.20~~	~~0.40~~
~~Performance Arts~~	~~200~~	~~7.50~~	~~0.20~~	~~0.40~~

TABLE ~~140.6-E~~170.2-L TAILORED WALL AND FLOOR DISPLAY MOUNTING HEIGHT ADJUSTMENT FACTORSFACTORS

Height in feet above finished floor and bottom of luminaire(s)	**~~Floor Display or~~ Wall Display Mounting Height Adjustment Factor**
< 10’-7”	1.00
10’-7” to 14’-0”	0.85
>14’-0” to 18’-0”	0.75
> 18’-0”	0.70

TABLE ~~140.6-F~~170.2-M ROOM CAVITY RATIO (RCR) EQUATIONS

Determine the Room Cavity Ratio for TABLE ~~140.6-G~~170.2-N using one of the following equations.
Room cavity ratio for rectangular rooms $$RCR = \frac{5 \times H \times (L + W)}{L \times W}$$
Room cavity ratio for irregular-shaped rooms $$RCR = \frac{2.5 \times H \times P}{A}$$
Where: L =Length of room; W = Width of room; H =Vertical distance from the work plane to the centerline of the lighting fixture; P = Perimeter of room, and A = Area of room

TABLE ~~140.6-G~~170.2-N TAILORED METHOD GENERAL LIGHTING POWER ALLOWED – BY ILLUMANCE AND ROOM CAVITY RATIO

	General Lighting Power Density (W/ft²) for the following RCR values[b]values[b]			
General Illuminance Level (lux)[a]	**RCR ≤ 2.0**	**RCR > 2.0 and ≤ 3.5**	**RCR > 3.5 and ≤ 7.0**	**RCR > 7.0**
150	0.40	0.45	0.60	00.75
200	0.45	0.55	0.75	1.00
300	0.65	0.80	1.00	1.40
400	0.75	0.95	1.25	1.50
500	0.90	1.05	1.45	1.85
600	1.08	1.24	1.64	2.38
[a] Illuminance values from Column 2 of TABLE ~~140.6-D~~170.2-K. [b] RCR values are calculated using applicable equations in TABLE ~~140.6-F~~170.2-M.				

2. **Outdoor Lighting.**

A. A~~n~~ multifamily or mixed occupancy outdoor lighting installation complies with this section if it meets the requirements in Subsections ~~(b)~~B and ~~(c)~~C, and the actual outdoor lighting power installed is no greater than the allowed outdoor lighting power calculated under Subsection ~~(d)~~D. The allowed outdoor lighting shall be calculated according to Outdoor Lighting Zone in Title 24, Part 1, Section 10-114.

EXCEPTIONS to Section ~~140.7(a)~~170.2(e)2A: When more than 50 percent of the light from a luminaire falls within one or more of the following applications, the lighting power for that luminaire shall be exempt from Section ~~140.7~~170.2(e)2~~:~~

i. Temporary outdoor lighting.

ii. Lighting required and regulated by the Federal Aviation Administration, and the Coast Guard.

iii. Lighting for public streets, roadways, highways, and traffic signage lighting, including lighting for driveway entrances occurring in the public right-of-way owned or maintained by the local municipality or utility.

iv. Lighting for sports and athletic fields, and children's playgrounds.

~~v. Lighting for industrial sites, including but not limited to, rail yards, maritime shipyards and docks, piers and marinas, chemical and petroleum processing plants, and aviation facilities.~~

vi. Lighting of public monuments.

vii. Lighting of signs complying with the requirements of Sections ~~130.3~~160.5(d) and 140.8.

viii. Lighting of stairs, wheelchair elevator lifts for American with Disabilities Act (ADA) compliance, and ramps that are other than parking garage ramps.

ix. Landscape lighting.

~~x. In theme parks: outdoor lighting only for themes and special effects.~~

xi. Lighting for outdoor theatrical and other outdoor live performances, provided that these lighting systems are additions to area lighting systems and are controlled by a multiscene or theatrical cross-fade control station accessible only to authorized operators.

xii. Outdoor lighting systems for qualified historic buildings, as defined in the California Historic Building Code (Title 24, Part 8), if they consist solely of historic lighting components or replicas of historic lighting components. If lighting systems for qualified historic 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 outdoor lighting systems for qualified historic buildings shall comply with Section ~~140.7~~170.2(e)2.

B. **Outdoor Lighting Power Trade-offs.** Outdoor lighting power trade-offs shall be determined as follows:

i. Allowed lighting power determined according to Section ~~140.7(d)1~~ 170.2(e)2Di for general hardscape lighting allowance may be traded to specific applications in Section ~~140.7(d)2~~ 170.2(e)2Dii, provided the hardscape area from which the lighting power is traded continues to be illuminated in accordance with Section ~~140.7(d)1A~~170.2(e)2Dia.

ii. Allowed lighting power determined according to Section ~~140.7(d)2~~ 170.2(e)2Dii for additional lighting power allowances for specific applications shall not be traded between specific applications, or to hardscape lighting in Section ~~140.7(d)1~~ 170.2(e)2Di.

iii. Trading off lighting power allowances between outdoor and indoor areas shall not be permitted.

C. **Calculation of Actual Lighting Power.** The wattage of outdoor luminaires shall be determined in accordance with Section ~~130.0(c)~~160.5(c)1.

D. **Calculation of Allowed Lighting Power.** The allowed lighting power shall be the combined total of the sum of the general hardscape lighting allowance determined in accordance with Section ~~140.7(d)1~~ 170.2(e)2Di, and the sum of the additional lighting power allowance for specific applications determined in accordance with Section ~~140.7(d)2~~ 170.2(e)2Dii.

i. **General Hardscape Lighting Allowance**. Determine the general hardscape lighting power allowances as follows:

a. The general hardscape area of a site shall include parking lot(s), roadway(s), driveway(s), sidewalk(s), walkway(s), bikeway(s), plaza(s), bridge(s), tunnel(s), and other improved area(s) that are illuminated. Roadway(s) that are illuminated by a lighting system owned or operated by the local municipality or utility shall not be included in the area calculations. In plan view of the site, determine the illuminated hardscape area, which is defined as any hardscape area that is within a square pattern around each luminaire or pole that is ten times the luminaire mounting height with the luminaire in the middle of the pattern, less any areas that are within a building, beyond the hardscape area, beyond property lines, or obstructed by a structure. The illuminated hardscape area shall include portions of planters and landscaped areas that are within the lighting application and are less than or equal to 10 feet wide in the short dimensions and are enclosed by hardscape or other improvement on at least three sides. Multiply the illuminated hardscape area by the Area Wattage Allowance (AWA) from TABLE ~~140.7-A~~ 170.2-O for the appropriate Lighting Zone.

b. Determine the perimeter length of the general hardscape area. The total perimeter shall not include portions of hardscape that is not illuminated according to Section 140.7(d)1A. Multiply the hardscape perimeter by the Linear Wattage Allowance (LWA) for hardscape from Table 140.7-A for the appropriate lighting zone. The perimeter length for hardscape around landscaped areas and permanent planters shall be determined as follows:

I. Landscaped areas completely enclosed within the hardscape area, and which have a width or length less than 10 feet wide, shall not be added to the hardscape perimeter length.

II. Landscaped areas completely enclosed within the hardscape area, and which width or length is a minimum of 10 feet wide, the perimeter of the landscaped areas or permanent planter shall be added to the hardscape perimeter length.

III. Landscaped edges that are not abutting the hardscape shall not be added to the hardscape perimeter length.

b. Determine the Initial Wattage Allowance (IWA) for general hardscape lighting from TABLE ~~140.7-A~~ 170.2-O for the appropriate lighting zone. The hardscape area shall be permitted one IWA per site.

c. The general hardscape lighting allowance shall be the sum of the allowed watts determined from ~~(A), (B) and (C)~~a and b above.

ii. **Additional Lighting Power Allowance for Specific Applications.** Additional lighting power for specific applications shall be the smaller of the additional lighting allowances for specific applications determined in accordance with TABLE 140.7-B170.2-P for the appropriate lighting zone, or the actual installed lighting power meeting the requirements for the allowance.

TABLE ~~140.7-A~~ 170.2-O GENERAL HARDSCAPE MULTIFAILY LIGHTING POWER ALLOWANCE

Type of Power Allowance	**Lighting Zone 0[3]**	**Lighting Zone 1[3]**	**Lighting Zone 2[3]**		**Lighting Zone 3[3]**		**Lighting Zone 4[3]**
	Asphalt/Concrete	Asphalt/Concrete	Asphalt	Concrete[2]	Asphalt	Concrete[2]	Asphalt/Concrete
Area Wattage Allowance (AWA)	No allowance[1]	0.018 W/ft²	0.023 W/ft²	0.025 W/ft²	0.025 W/ft²	0.03 W/ft²	0.03 W/ft²
~~Linear Wattage Allowance (LWA)~~		~~0.15 W/lf~~	~~0.17 W/lf~~	~~0.4 W/lf~~	~~0.25 W/lf~~	~~0.4 W/lf~~	~~0.35 W/lf~~
Initial Wattage Allowance (IWA)		180 W	250 W	250 W	350 W	350 W	400 W

[1]Continuous lighting is explicitly prohibited in Lighting Zone 0. A single luminaire of 15 Watts or less may be installed at an entrance to a parking area, trail head, fee payment kiosk, outhouse, or toilet facility, as required to provide safe navigation of the site infrastructure. Luminaires installed shall meet the maximum zonal lumen limits as specified in Section ~~130.2(b)~~160.5(c)1.

[2]Where greater than 50% of the paved surface of a parking lot is finished with concrete. This does not extend beyond the parking lot, and does not include any other General Hardscape areas.

[3]Narrow band spectrum light sources with a dominant peak wavelength greater than 580 nm – as mandated by local, state, or federal agencies to minimize the impact on local, active professional astronomy or nocturnal habitat of specific local fauna – shall be allowed a 2.0 lighting power allowance multiplier.

TABLE ~~140.7-B~~ 170.2-P ADDITIONAL MULTIFAMILY LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS

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

Lighting Application	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
WATTAGE ALLOWANCE PER APPLICATION. Use all that apply as appropriate.					
Building Entrances or Exits. Allowance per door. Luminaires qualifying for this allowance shall be within 20 feet of the door.	Not applicable	9 watts	15 watts	19 watts	21 watts
Primary Entrances to Senior Care Facilities, ~~Police Stations, Healthcare Facilities, Fire Stations, and Emergency Vehicle Facilities.~~ Allowance per primary entrance(s) only. Primary entrances shall provide access for the general public and shall not be used exclusively for staff or service personnel. This allowance shall be in addition to the building entrance or exit allowance above. Luminaires qualifying for this allowance shall be within 100 feet of the primary entrance.	Not applicable	20 watts	40 watts	57 watts	60 watts
~~**Drive Up Windows.** Allowance per customer service location. Luminaires qualifying for this allowance shall be within 2 mounting heights of the sill of the window.~~	~~Not applicable~~	~~16 watts~~	~~30 watts~~	~~50 watts~~	~~75 watts~~
~~**Vehicle Service Station Uncovered Fuel Dispenser.** Allowance per fueling dispenser. Luminaires qualifying for this allowance shall be within 2 mounting heights of the dispenser.~~	~~Not applicable~~	~~55 watts~~	~~77 watts~~	~~81 watts~~	~~135 watts~~
ATM Machine Lighting. Allowance per ATM machine. Luminaires qualifying for this allowance shall be within 50 feet of the dispenser.	Not applicable	100 watts for first ATM machine, 35 watts for each additional ATM machine.			
~~**WATTAGE ALLOWANCE PER UNIT LENGTH (w/linear ft). May be used for one or two frontage side(s) per site.**~~					
~~**Outdoor Sales Frontage.** Allowance for frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. Luminaires qualifying for this allowance shall be located between the principal viewing location and the frontage outdoor sales area.~~	~~Not applicable~~	~~No Allowance~~	~~11 W/linear ft~~	~~19 W/linear ft~~	~~25 W/linear ft~~
WATTAGE ALLOWANCE PER HARDSCAPE AREA (W/ft²). May be used for any illuminated hardscape area on the site.					
Hardscape Ornamental Lighting. Allowance for the total site illuminated hardscape area. Luminaires qualifying for this allowance shall be rated for 100 watts or less as determined in accordance with Section ~~130.0(d),~~ 160.5(b)2and shall be post-top luminaires, lanterns, pendant luminaires, or chandeliers.	Not applicable	No Allowance	0.007 W/ft²	0.013 W/ft²	0.019 W/ft²
WATTAGE ALLOWANCE PER SPECIFIC AREA (W/ft²). Use as appropriate provided that none of the following specific applications shall be used for the same area.					
Building Facades. Only areas of building façade that are illuminated shall qualify for this allowance. Luminaires qualifying for this allowance shall be aimed at the façade and shall be capable of illuminating it without obstruction or interference by permanent building features or other objects.	Not applicable	No Allowance	0.100 W/ft²	0.170 W/ft²	0.225 W/ft²
~~**Outdoor Sales Lots.** Allowance for uncovered sales lots used exclusively for the display of vehicles or other merchandise for sale. Driveways, parking lots or other non sales areas shall be considered hardscape areas even if these areas are completely surrounded by sales lot on all sides. Luminaires qualifying for this allowance shall be within 5 mounting heights of the sales lot area.~~	~~Not applicable~~	~~0.060 W/ft²~~	~~0.210 W/ft²~~	~~0.280 W/ft²~~	~~0.485 W/ft²~~
~~**Vehicle Service Station Hardscape.** Allowance for the total illuminated hardscape area less area of buildings, under canopies, off property, or obstructed by signs or structures. Luminaires qualifying for this allowance shall be illuminating the hardscape area and shall not be within a building, below a canopy, beyond property lines, or obstructed by a sign or other structure.~~	~~Not applicable~~	~~0.006 W/ft²~~	~~0.068 W/ft²~~	~~0.138 W/ft²~~	~~0.200 W/ft²~~
~~**Vehicle Service Station Canopies.** Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy.~~	~~Not applicable~~	~~0.220 W/ft²~~	~~0.430 W/ft²~~	~~0.580 W/ft²~~	~~1.010 W/ft²~~
~~**Sales Canopies.** Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy.~~	~~Not applicable~~	~~No Allowance~~	~~0.470 W/ft²~~	~~0.622 W/ft²~~	~~0.740 W/ft²~~

~~Non-sales~~ **Canopies and Tunnels.** Allowance for the total area within the drip line of the canopy or inside the tunnel. Luminaires qualifying for this allowance shall be located under the canopy or tunnel.		Not applicable	0.057 W/ft²	0.137 W/ft²	0.270 W/ft²	0.370 W/ft²
~~**Guard Stations.** Allowance up to 1,000 square feet per vehicle lane. Guard stations provide access to secure areas controlled by security personnel who stop and may inspect vehicles and vehicle occupants, including identification, documentation, vehicle license plates, and vehicle contents. Qualifying luminaires shall be within 2 mounting heights of a vehicle lane or the guardhouse.~~		~~Not applicable~~	~~0.081 W/ft²~~	~~0.176 W/ft²~~	~~0.325 W/ft²~~	~~0.425 W/ft²~~
	Student Pick-up/Drop-off zone. Allowance for the area of the student pick-up/drop-off zone, with or without canopy, for preschool through 12th grade school campuses. A student pick-up/drop off zone is a curbside, controlled traffic area on a school campus where students are picked-up and dropped off from vehicles. The allowed area shall be the smaller of the actual width or 25 feet, times the smaller of the actual length or 250 feet. Qualifying luminaires shall be within 2 mounting heights of the student pick-up/drop-off zone.	Not applicable	No Allowance	0.056 W/ft²	0.200 W/ft²	No Allowance
	Outdoor Dining. Allowance for the total illuminated hardscape of outdoor dining. Outdoor dining areas are hardscape areas used to serve and consume food and beverages. Qualifying luminaires shall be within 2 mounting heights of the hardscape area of outdoor dining.	Not applicable	0.004 W/ft²	0.030 W/ft²	0.050 W/ft²	0.075 W/ft²
	Special Security Lighting for Retail Parking and Pedestrian Hardscape. This additional allowance is for illuminated retail parking and pedestrian hardscape identified as having special security needs. This allowance shall be in addition to the building entrance or exit allowance.	Not applicable	0.004 W/ft²	0.005 W/ft²	0.010 W/ft²	No Allowance

(f) **Photovoltaic Requirements**. All ~~low-rise residential~~ multifamily buildings shall have a photovoltaic (PV) system meeting the minimum qualification requirements as specified in Joint Appendix JA11, with annual electrical output equal to or greater than the ~~dwelling's~~ buildings annual electrical usage as determined by Equation ~~150.1-C~~170.2-A:

EQUATION ~~150.1-C~~170.2-A ANNUAL PHOTOVOLTAIC ELECTRICAL OUTPUT

$$kW_{PV} = (CFA \times A)/1000 + (NDwell \times B)$$

WHERE:

kW_{PV} = kWdc size of the PV system

CFA = Conditioned floor area

NDwell = Number of dwelling units

A = Adjustment factor from Table ~~150.1-C~~170.2-Q

B = Dwelling adjustment factor from Table ~~150.1-C~~170.2-Q

EXCEPTION 1 to Section ~~150.1(c)14~~170.2(f): No PV is required if the effective annual solar access is restricted to less than 80 contiguous square feet by shading from existing permanent natural or manmade barriers external to the ~~dwelling~~building, including but not limited to trees, hills, and adjacent structures. The effective annual solar access shall be 70 percent or greater of the output of an unshaded PV array on an annual basis.

EXCEPTION 2 to Section ~~150.1(c)14~~170.2(f): In climate zone 15, the PV size shall be the smaller of a size that can be accommodated by the effective annual solar access or a PV size required by the Equation ~~150.1-C~~170.2-A, but no less than 1.5 Watt DC per square foot of conditioned floor area.

EXCEPTION 3 to Section 150.1(c)14: In all climate zones, for ~~dwelling units~~ multifamily buildings with two habitable stories, the PV size shall be the smaller of a size that can be accommodated by the effective

annual solar access or a PV size required by the Equation 150.1-C, but no less than 1.0 Watt DC per square foot of conditioned floor area

EXCEPTION 4 to Section 150.1(c)14: In all climate zones, for low-rise residential multifamily buildings ~~dwellings with three habitable stories and single family dwellings with~~ three or more habitable stories, the PV size shall be the smaller of a size that can be accommodated by the effective annual solar access or a PV size required by the Equation 150.1-C, but no less than 0.8 Watt DC per square foot of conditioned floor area.

~~**EXCEPTION 5 to Section 150.1(c)14:** For a dwelling unit plan that is approved by the planning department prior to January 1, 2020 with available solar ready zone between 80 and 200 square feet, the PV size is limited to the lesser of the size that can be accommodated by the effective annual solar access or a size that is required by the Equation 150.1-C.~~

EXCEPTION 6 to Section ~~150.1(c)14~~170.2(f): PV sizes from Equation ~~150.1-C~~170.2-A may be reduced by 25 percent if installed in conjunction with a battery storage system. The battery storage system shall meet the qualification requirements specified in Joint Appendix JA12 and have a minimum capacity of 7.5 kWh.

Table ~~150.1-C~~ 170.2-Q– CFA and Dwelling adjustment Factors

Climate Zone	A - CFA	B - Dwelling Units
1	0.793	1.27
2	0.621	1.22
3	0.628	1.12
4	0.586	1.21
5	0.585	1.06
6	0.594	1.23
7	0.572	1.15
8	0.586	1.37
9	0.613	1.36
10	0.627	1.41
11	0.836	1.44
12	0.613	1.40
13	0.894	1.51
14	0.741	1.26
15	1.56	1.47
16	0.59	1.22

SUBCHAPTER 12
MULTIFAMILY BUILDINGS - ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING MULTIFAMILY BUILDINGS

SECTION 180.0 – GENERAL

Additions, alterations, and repairs to existing ~~nonresidential, high-rise residential, and hotel/motel~~ attached dwelling units and common use areas in multifamily buildings, existing outdoor lighting for these occupancies, and internally and externally illuminated signs, shall meet the requirements specified in Sections 100.0 through 110.10, and ~~120.0~~ 160.1 through ~~130.5~~ 170.2 that are applicable to the building project, and either the performance compliance approach (energy budgets) in Section ~~141.0(a)2~~ 180.1(b) (for additions) or ~~141.0(b)3~~ 180.2(c) (for alterations), or the prescriptive compliance approach in Section ~~141.0(a)1~~180.1(a) (for additions) or ~~141.0(b)2~~ 180.2(b) (for alterations), for the Climate Zone in which the building is located. Climate zones are shown in FIGURE 100.1-A.

Covered process requirements for additions, alterations and repairs to existing ~~nonresidential, high-rise residential, and hotel/motel~~ multifamily buildings are specified in Section 141.1.

Nonresidential occupancies in mixed occupancy buildings shall comply with nonresidential requirements in Sections 120, 130 , 140 and 141.

~~**EXCEPTION to Section 141.0:** Alterations to healthcare facilities are not required to comply with this Section.~~

NOTE: For alterations that change the occupancy classification of the building, the requirements specified in Section ~~141.0(b)~~180.2 apply to the occupancy after the alterations.

SECTION 180.1 – ADDITIONS

Additions to existing ~~low-rise residential~~ multifamily buildings shall meet the requirements of Sections 110.0 through 110.9, Sections ~~150.0(a)~~ 160.0 through ~~(q)~~160.7, and either Section ~~150.2(a)1~~180.1(a) or ~~2~~(b).

(a) **Prescriptive approach.** The envelope and lighting of the addition; any newly installed space-conditioning system, electrical power distribution system, or water-heating system; any addition to an outdoor lighting system; and any new sign installed in conjunction with an indoor or outdoor addition shall meet the applicable requirements of Sections 110.0 and 160.0 through ~~120.7~~170.2~~, 120.9 through 130.5, and 140.2 through 140.9~~.

1. **Envelope.**

A. Additions that are greater than 700 square feet shall meet the requirements of Section ~~150.1(c)~~170.2(a), with the following modifications:

i. Framed Walls Extension Extensions of existing wood-framed walls may retain the dimensions of the existing walls and shall install cavity insulation of R-15 in a 2x4 framing and R-21 in a 2x6 framing.

ii. The maximum allowed fenestration area shall be the greater of 175 square feet or 20 percent of the addition floor area, ~~and the maximum allowed west-facing fenestration area shall be the greater of 70 square feet or the requirements of Section 150.1(c).~~

iii. When existing siding of a wood-framed wall is not being removed or replaced, cavity insulation of R-15 in a 2x4 framing and R-21 in a 2x6 framing shall be installed and continuous insulation is not required.

iv. Additions that consist of the conversion of existing spaces from unconditioned to conditioned space shall not be required to perform the following as part of QII:

a. Existing window and door headers shall not be required to be insulated.

b. Air sealing shall not be required when the existing air barrier is not being removed or replaced.

B. Additions that are 700 square feet or less shall meet the requirements of Section ~~150.1(c)~~170.2(a), , with the following modifications.

EXCEPTION to Section ~~150.2(a)1B~~180.1(a)1B: Insulation in an enclosed rafter ceiling shall meet the requirements of Section ~~150.0~~ 160.1(a).

i. Roof and ceiling insulation in an attic shall be insulated to R-38 in climate zones 1, 11-16 or R-30 in climate zones 2-10; and

ii. Radiant Barrier. Radiant barriers shall be installed in climate zones 2-15; and

iii. Extensions of existing wood-framed walls may retain the dimensions of the existing walls and shall install cavity insulation of R-15 in a 2x4 framing and R-21 in a 2x6 framing; and

iv. When existing siding of a wood-framed wall is not being removed or replaced, cavity insulation of R-15 in a 2x4 framing and R-21 in a 2x6 framing shall be installed and continuous insulation is not required

~~v. In Climate Zones 2, 4 and 6-15; the maximum allowed west-facing fenestration area shall not be greater than 60 square feet; and shall also comply with either a or b below:~~

~~a. For additions that are 700 square feet or less but greater than 400 square feet, the maximum allowed fenestration area limit is the greater of 120 square feet or 25 percent of the conditioned floor area of the addition; or~~

~~b. For additions that are 400 square feet or less, the maximum allowed fenestration area is the greater of 75 square feet or 30 percent of the conditioned floor area of the addition.~~

v. Quality Insulation Installation (QII) requirements of Section ~~150.1(c)1E~~ 170.2(a)6 do not apply.

2. **Mechanical Ventilation for Indoor Air Quality.**

A. Additions to an existing dwelling unit that increase the conditioned floor area of the ~~existing dwelling unit~~ building by more than 1,000 square feet shall have mechanical ventilation airflow in accordance with Sections ~~150.0(o)1C~~160.2(b)2iii, ~~150.0(o)1E~~60.2(b)v, or ~~150.0(o)1F~~ 160.2(b)2vi as applicable. The d mechanical ventilation airflow rate shall be based on the conditioned floor area of the entire dwelling unit comprised of the existing dwelling unit conditioned floor area plus the addition conditioned floor area.

B. New dwelling units that are additions to an existing building shall have mechanical ventilation airflow provided in accordance with Sections ~~150.0(o)1C~~160.2(b)2iii, ~~150.0(o)1E~~60.2(b)v, or ~~150.0(o)1F~~ 160.2(b)2vi as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the new dwelling unit.

3. **Water Heater.** When ~~a second~~ additional water heat~~er~~ing equipment is installed as part of the addition, one of the following types of water heaters shall be installed:

A. A water-heating system that meets the requirements of Section ~~150.1(c)8~~170.2(c); or

B. A water-heating system determined by the Executive Director to use no more energy than the one specified in Item ~~i~~ A above

(b) **Performance approach.** Performance calculations shall meet the requirements of Section ~~150.1(a)~~ 170.0 through ~~(c)~~170.2(a), pursuant to the applicable requirements in Items ~~A, B, and C~~1, 2, and 3 below**.**

1. **For additions alone.** The addition complies if the addition alone meets the energy budgets as specified in Section ~~150.1(b)~~170.1.

2. **Existing plus alteration plus addition.** The standard design for existing plus alteration plus addition energy use is the combination of the existing building's unaltered components to remain; existing building altered components that are the more efficient, in TDV energy, of either the existing conditions or the

requirements of Section ~~150.2(b)2~~180.2(c); plus the proposed addition's energy use meeting the requirements of Section ~~150.2(a)1~~180.1(a). The proposed design energy use is the combination of the existing building's unaltered components to remain and the altered components' energy features, plus the proposed energy features of the addition.

EXCEPTION to Section ~~150.2(a)2B~~180.1(b)2: Existing structures with a minimum R-11 insulation in framed walls showing compliance with Section ~~150.2(a)2~~ 180.1(b)are exempt from showing compliance with Section ~~150.0(c).~~160.1(b).

SECTION 180.2 – ALTERATIONS

Alterations to components of existing ~~nonresidential, high-rise residential, hotel/motel, or relocatable public school~~ multifamily buildings, including alterations made in conjunction with a change in building occupancy to a ~~nonresidential, high-rise residential, or hotel/motel~~ multifamily occupancy shall meet item ~~1~~(a), and either Item ~~2~~(b) or ~~3~~(c) below:

EXCEPTION 1 to Section ~~141.0(b)~~180.2: When heating, cooling or service water heating for an alteration are provided by expanding existing systems, the existing systems and equipment need not comply with Sections 110.0 through 110.10, ~~through 120.9~~160.0 through 160.7, and Section ~~140.4~~170.2(c) or ~~140.5~~170.2(d).

EXCEPTION 2 to Section ~~141.0(b)~~180.2: When existing heating, cooling or service water heating systems or components are moved within a building, the existing systems or components need not comply with Sections 110.0 through 110.10, ~~through 120.9~~160.0 through 160.7, and Section ~~140.4~~170.2(c) or ~~140.5~~170.2(d).

EXCEPTION 3 to Section ~~141.0(b)~~180.2: Where an existing system with electric reheat is expanded when adding variable air volume (VAV) boxes to serve an alteration, total electric reheat capacity may be expanded not to exceed 20 percent of the existing installed electric capacity in any one permit and the system need not comply Section ~~140.4(g)~~170.2(b)4E. Additional electric reheat capacity in excess of 20 percent may be added subject to the requirements of the Section ~~140.4(g)~~170.2(b)4E.

EXCEPTION 4 to Section ~~141.0(b)~~180.2: The requirements of Section ~~120.2(i)~~160.3(a)2H shall not apply to alterations of space-conditioning systems or components.

~~**NOTE:** Relocation or moving of a relocatable public school building is not, by itself, considered an alteration for the purposes of Title 24, Part 6.~~

(a) **Mandatory Requirements.** Altered components in a ~~nonresidential, high-rise residential, or hotel/motel~~ multifamily building shall meet the minimum requirements in this Section.

1. **Roof/Ceiling Insulation.** The opaque portions of the roof/ceiling that separate conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Section ~~141.0(b)2Biii~~180.2(b)1B.

2. **Wall Insulation.** For the altered opaque portion of walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items ~~1 through 4~~ A through D below:

   A. **Metal Building.** A minimum of R-13 insulation between framing members, or the weighted average U-factor of the wall assembly shall not exceed U-0.113.

   B. **Metal Framed.** A minimum of R-13 insulation between framing members, or the weighted average U-factor of the wall assembly shall not exceed U-0.217.

   C. **Wood Framed and Others.** A minimum of R-11 insulation between framing members, or the weighted average U-factor of the wall assembly shall not exceed U-0.110.

   D. **Spandrel Panels and Curtain Walls.** A minimum of R-4, or the weighted average U-factor of the wall assembly shall not exceed U-0.280.

   EXCEPTION to Section ~~141.0(b)1B~~180.2(a)2: Light and heavy mass walls.

3. **Floor Insulation.** For the altered portion of raised floors that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items ~~1~~A through ~~3~~C below:

   A. **Raised Framed Floors.** A minimum of R-11 insulation between framing members, or the weighted average U-factor of the floor assembly shall not exceed the U-factor of U-0.071.

   B. **Raised Mass Floors.** A minimum of R-6 insulation, or the weighted average U-factor of the floor assembly shall not exceed the U-factor of U-0.111.

   ~~C. **Raised Mass Floors in Other Occupancies.** No minimum U-factor requirement.~~

(b) **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Section ~~150.0(a)~~ 160.0 through 160.3(b)J, ~~(l); 150.0(m) through 150.0 (m)10~~, ~~Section 150.0(o) through (q)~~ and 160.5; and

1. **Envelope -**

A. **Roofing Products**. Existing roofs being replaced, recovered or recoated, of a ~~nonresidential, high rise residential and hotels/motels~~ multifamily building shall meet the requirements of Section 110.8(i). Roofs with more than 50 percent of the roof area or more than 2,000 square feet of roof, whichever is less, being altered the requirements of i through iii below apply:

i. Low-sloped roofs in Climate Zones 10, 11, ~~13~~, 14 and ~~15~~ shall have a minimum aged solar reflectance of 0.55 and a minimum thermal emittance of 0.75, or a minimum SRI of 64.

ii. Low-sloped roofs in Climate Zones 13 and 15 shall have a 3-year aged solar reflectance equal or greater than 0.63 and a thermal emittance equal or greater than 0.75, or a minimum SRI of 75.

~~**EXCEPTION 1 to Section 150.2(b)1Iii:** Buildings with no ducts in the attic.~~

~~**EXCEPTION 2 to Section 150.2(b)1Iii:** The aged solar reflectance can be met by using insulation at the roof deck specified in TABLE 150.2-B.~~

iii. Steep-sloped roofs Climate Zones 2 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

EXCEPTION 3 to Section ~~141.0(b)2Bi and ii~~180.2(b)1A: The following shall be considered equivalent to Subsection iii:

a. Air-space of 1.0 inch (25 mm) is provided between the top of the roof deck to the bottom of the roofing product; or

b. The installed roofing product has a profile ratio of rise to width of 1 to 5 for 50 percent or greater of the width of the roofing product; or

c. Existing ducts in the attic are insulated and sealed according to Section ~~150.1(c)9~~170.2(c)3B; or

d. Buildings with at least R-38 ceiling insulation; or

e. Buildings with a radiant barrier in the attic meeting the requirements of Section ~~150.1(c)2~~170.2(a)1C; or

f. Buildings that have no ducts in the attic; or

g. ~~In Climate Zones 10-15,~~ R-2or greater insulation above the roof deck.

EXCEPTION 1 to Section ~~141.0(b)2Bi and ii~~180.2(b)1A: Roof area covered by building integrated photovoltaic panels and building integrated solar thermal panels are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

EXCEPTION 2 to Section ~~141.0(b)2Bi and ii~~180.2(b)1A: Roof constructions with a weight of at least 25 lb/ft² are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

B. **Roof/Ceiling Insulation**.

i. **Attic Roof** Ceilings and rafter roofs in an alteration shall be insulated to achieve a weighted average U-factor not exceeding 0.054 or shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-19 or greater.

ii. **Non Attic Roof**. ~~For nonresidential buildings, high-rise residential buildings and hotels/motels, w~~When low-sloped roofs are exposed to the roof deck or to the roof recover boards, and meets Section ~~141.0(b)2Bia or iia~~180.2(b)1A or B, the exposed area shall be insulated to ~~the levels specified in TABLE 141.0-C~~ R-14 continuous insulation or a U-factor of 0.55.

EXCEPTION to Section ~~141.0(b)2Biii~~180.2(b)1Bii

a. Existing roofs that are insulated with at least R-7 insulation or that has a U-factor lower than 0.089 are not required to meet the R-value requirement of ~~TABLE 141.0-C.~~180.2(b)1Bi

b. If mechanical equipment is located on the roof and will not be disconnected and lifted as part of the roof replacement, insulation added may be limited to the maximum insulation thickness that will allow a height of 8 inches (203 mm) from the roof membrane surface to the top of the base flashing.

c. If adding the required insulation will reduce the base flashing height to less than 8 inches (203 mm) at penthouse or parapet walls, the insulation added may be limited to the maximum insulation thickness that will allow a height of 8 inches (203 mm) from the roof membrane surface to the top of the base flashing, provided that the conditions in Subsections i through iv apply:

I. The penthouse or parapet walls are finished with an exterior cladding material other than the roofing covering membrane material; and

II. The penthouse or parapet walls have exterior cladding material that must be removed to install the new roof covering membrane to maintain a base flashing height of 8 inches (203 mm); and

~~III. For nonresidential buildings, the ratio of the replaced roof area to the linear dimension of affected penthouse or parapet walls shall be less than 25 square feet per linear foot for Climate Zones 2, and 10 through 16, and less than 100 square feet per linear foot for Climate Zones 1, and 3 through 9; and~~

III. ~~For high-rise residential buildings, hotels or motels,~~ T~~t~~he ratio of the replaced roof area to the linear dimension of affected penthouse or parapet walls shall be less than 25 square feet per linear foot for all Climate Zones.

d. Tapered insulation may be used which has a thermal resistance less than ~~that prescribed in TABLE 141.0-C~~ R-14 at the drains and other low points, provided that the thickness of insulation is increased at the high points of the roof so that the average thermal resistance equals or exceeds ~~the value that is specified in TABLE 141.0-C~~ R-14.

C. Fenestration alterations other than repair ~~and those subject to Section 141.0(b)2~~ shall meet the requirements below:

NOTE: Glass replaced in an existing sash and frame or sashes replaced in an existing frame are considered repairs. In these cases, Section ~~141.0(c)~~ 180.2(b) requires that the replacement be at least equivalent to the original in performance.

i. ~~**Fenestration replacement**~~. New manufactured fenestration products installed to replace existing fenestration products of the same total area shall meet the U-factor and Solar Heat Gain Coefficient requirements of Section~~s 150.1(c)3A, and 150.1(c)4~~170.2(a)3.

EXCEPTION 1 to Section ~~150.2(b)1B~~180.2(b)1Ci: Replacement of vertical fenestration no greater than 75 square feet with a U-factor no greater than 0.40 in Climate Zones 1-16, and a SHGC value no greater than 0.35 in Climate Zones 2, 4, and 6-15.

EXCEPTION 2 to ~~150.2(b)1B~~180.2(b)1Ci: Replaced skylights must meet a U-factor no greater than 0.55, and a SHGC value no greater than 0.30.

ii. Site-built ~~V~~vertical fenestration alterations shall meet the requirements in TABLE ~~141.0-A~~ 180.2-A.

EXCEPTION 1 to Section ~~141.0(b)2Ai~~180.2(b)1Cii: In an alteration, where 150 square feet or less of the entire building's vertical fenestration is replaced, ~~R~~SHGC ~~and VT~~ requirements of TABLE ~~141.0-A~~ 180.2-A shall not apply.

iii. Alterations that add vertical fenestration and skylight area shall meet the total fenestration area ~~and west-facing fenestration area~~, U-factor, and Solar Heat Gain Coefficient requirements of Section ~~150.1(c)~~ 170.2(a)3 and TABLE ~~150.1-A or B~~ 170.2-A.

EXCEPTION 1 to Section ~~150.2(b)1A~~180.2(b)1Ciii: Alterations that add fenestration area of up to 75 square feet shall not be required to meet the total fenestration area ~~and west-facing fenestration area~~ requirements of Sections ~~150.1(c)3B and C~~170.2(a).

EXCEPTION 2 to Section ~~150.2(b)1A~~180.2(b)1Ciii: Alterations that add up to 16 square feet of new skylight area with a maximum U-factor of 0.55 and a maximum SHGC of 0.30 area shall not be required to meet the total fenestration area ~~and west-facing fenestration area~~ requirements of Sections ~~150.1(c)3B and C~~170.2(a)3.

iv. Added vertical fenestration shall meet the requirements of TABLE ~~140.3-B, C or D~~ 170.2-A.

EXCEPTION 2 to Section ~~141.0(b)2Aii~~180.2(b)1Civ: In an alteration, where 50 square feet or less of vertical fenestration is added, ~~R~~SHGC ~~and VT requirements~~ of TABLE ~~140.3-B, C or D~~ 170.2-A shall not apply.

v. All altered or newly installed site-built skylights shall meet the requirements of TABLE ~~140.3-B, C or D~~ 170.2-A.

EXCEPTION 3 to Section ~~141.0(b)2Aiii~~180.2(b)1Cv: In an alteration, where 50 square feet or less of skylight is added, SHGC ~~and VT~~ requirements of TABLE ~~140.3-B, C or D~~ 170.2-A shall not apply.

Table ~~141.0-A~~ 180.2-AAltered Vertical Fenestration Maximum U-Factor and Maximum ~~R~~SHGC

Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
U-factor	0.47	0.47	0.58	0.47	0.58	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47
~~R~~SHGC	0.41	0.31	0.41	0.31	0.41	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.41
~~VT~~	~~See TABLE 140.3-B, C, and D for all Climate Zones~~															

2. **Space Conditioning Systems**.

A. **Space Conditioning Systems Serving Individual Dwelling Units**.

i. Entirely New or Complete Replacement Space-Conditioning Systems installed as part of an alteration, shall include all the system heating or cooling equipment, including but not limited to . condensing unit and cooling or heating coil for split systems; or complete replacement of a package unit; plus entirely new or replacement duct system (Section ~~150.2(b)1Diia~~180.2(b)2Aiib); plus a new or replacement air handler.

Entirely New or complete replacement space-conditioning systems shall:

a. Meet the requirements of Sections ~~150.0(h), 150.~~**~~0(i)~~** ~~160.3(a)1, 150.0(j)2, 150.0(j)3, 150.0(m)1 through 150.0(m)10; 150.0(m)12; 150.0(m)13C, 150.1(c)6, 150.1(c)7, 150.1(c)10~~ 160.2(a)1, 160.3(a)1, 160.3(b)1 through 3, 160.3(b)5, 160.3(b)6, 160.3(c)1, and 170.2(c)3A and TABLE ~~150.2-A~~180.2-B; and

~~b. Be limited to natural gas, liquefied petroleum gas, or the existing fuel type.~~

~~**EXCEPTION to Section 150.2(b)1Cii 180.2(c)2Ai:** When the fuel type of the replaced heating system was natural gas or liquefied petroleum gas, the new or complete replacement space-conditioning system may be a heat pump.~~

ii. **Altered Duct Systems - Duct Sealing**: In all Climate Zones, when more than 40 feet of new or replacement space-conditioning system ducts are installed, the ducts shall comply with the applicable requirements of subsections i and ii below. Additionally, when altered ducts, air-handling units, cooling or heating coils, or plenums are located in garage spaces, the system shall comply with subsection 150.2(b)1Diic regardless of the length of any new or replacement space-conditioning ducts installed in the garage space.

a. New ducts located in unconditioned space shall meet the applicable requirements of Sections ~~150.0(m)1~~ 160.3(b)5A through ~~150.0(m)11~~K, and the duct insulation requirements of TABLE ~~150.2-A~~180.2-B, and

TABLE ~~150.2-A~~180.2-B DUCT INSULATION R-VALUE

Climate Zone	1 through 10, 12&13	11, 14 through 16
Duct R-Value	R-6	R-8

b. The altered duct system, regardless of location, shall be sealed as confirmed through field verification and diagnostic testing in accordance with all applicable procedures for duct sealing of altered existing duct systems as specified in the Reference Residential Appendix RA3.1, utilizing the leakage compliance criteria specified in Subsection a or b below.

I. **Entirely New or Complete Replacement Duct System.** If the new ducts form an entirely new or complete replacement duct system directly connected to the air handler, the duct system shall meet one of the following requirements:

~~II. For single family dwellings, the measured duct leakage shall be equal to or less than 5 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1.~~

~~III. For multifamily dwellings, regardless of duct system location,~~

A. The total leakage of the duct system shall not exceed 12 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1, or

B. The duct system leakage to outside shall not exceed 6 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4.

C. Entirely new or complete replacement duct systems installed as part of an alteration shall be constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the dwelling unit's existing duct system, including but not limited to registers, grilles, boots, air handler, coil, plenums, duct material; if the reused parts are accessible and can be sealed to prevent leakage.

D. Entirely new or complete replacement duct systems shall also conform to the requirements of Sections ~~150.0(m)12~~160.2(a)1 and **~~150.0(m)13~~160.3(b)5L**.

IV. **Extension of an Existing Duct System**. If the new ducts are an extension of an existing duct system serving ~~single family or~~ multifamily dwellings, the combined new and existing duct system shall meet one of the following requirements:

A. The measured duct leakage shall be equal to or less than 15 percent of nominal system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

B. The measured duct leakage to outside shall be equal to or less than 10 percent of nominal system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or

C. If it is not possible to meet the duct sealing requirements of either Section ~~150.2(b)1DiibI~~180.2(b)2AiibIV, A or B~~150.2(b)1DiibII~~, then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

EXCEPTION to Section ~~150.2(b)1Diib~~180.2(b)2AiibIV: Duct Sealing. Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos.

V. **Altered Ducts and Duct System Components in Garage Spaces.** When new or replacement space-conditioning ducts, air-handling units, cooling or heating coils, or plenums are located in a garage space, compliance with either I or II below is required.

A. The measured system duct leakage shall be less than or equal to 6 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1, or

B. All accessible leaks located in the garage space shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

iii. Altered Space-Conditioning System

a. Duct Sealing. In all Climate Zones, when a space-conditioning system serving a ~~single family or~~ multifamily dwelling is altered by the installation or replacement of space-conditioning system equipment, including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, or cooling or heating coil; the duct system that is connected to the altered space-conditioning system equipment shall be sealed, as confirmed through field verification and diagnostic testing in accordance with the applicable procedures for duct sealing of altered existing duct systems as specified in Reference Residential Appendix RA3.1 and the leakage compliance criteria specified in subsection i, ii, or iii below. ~~Additionally, when altered ducts, air-handling units, cooling or heating coils, or plenums are located in garage spaces, the system shall comply with Section 150.2(b)1Diic~~ regardless of the length of any new or replacement space-conditioning ducts installed in the garage space.

I. The measured duct leakage shall be equal to or less than 15 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

II. The measured duct leakage to outside shall be equal to or less than 10 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or

III. If it is not possible to meet the duct sealing requirements of either Section ~~150.2(b)1Ei or Section 150.2(b)1Eii~~180.2(b)2AiiiaI or II, then, all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

EXCEPTION 1 to Section ~~150.2(b)1Eii~~180.2(b)2Aiiia: **Duct Sealing.** Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in the Reference Residential Appendix RA3.1.

EXCEPTION 2 to Section ~~150.2(b)1Eii~~180.2(b)2Aiiia: Duct Sealing. Duct systems with less than 40 linear feet as determined by visual inspection.

EXCEPTION 3 to Section ~~150.2(b)1Eii~~180.2(b)2Aiiia: Duct Sealing. Existing duct systems constructed, insulated or sealed with asbestos.

iv. Altered Space-Conditioning System Mechanical Cooling. When a space-conditioning system is an air conditioner or heat pump that is altered by the installation or replacement of refrigerant-containing system components such as the compressor, condensing coil, evaporator coil, refrigerant metering device or refrigerant piping, the altered system shall comply with the following requirements:

a. All thermostats associated with the system shall be replaced with setback thermostats meeting the requirements of Section 110.2(c).

b. In Climate Zones 2, 8, 9, 10, 11, 12, 13, 14, and 15, air-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted package systems, small duct high velocity air systems, and minisplit systems, shall comply with subsections a and b, unless the system is of a type that cannot be verified using the specified procedures. Systems

that cannot comply with the requirements of Section ~~150.2(b)1Fii~~ 180.2(b)2Aivb shall comply with Section ~~150.2(b)1Fiii~~ 180.2(b)2Aivc.

I. Minimum system airflow rate shall comply with the applicable subsection I or II below as confirmed through field verification and diagnostic testing in accordance with the procedures specified in Reference Residential Appendix Section RA3.3 or an approved alternative procedure as specified in Section RA1.;

   A. Small duct high velocity systems shall demonstrate a minimum system airflow rate greater than or equal to 250 cfm per ton of nominal cooling capacity; or

   B. All other air-cooled air conditioner or air-source heat pump systems shall demonstrate a minimum system airflow rate greater than or equal to 300 cfm per ton of nominal cooling capacity; and

II. The installer shall charge the system according to manufacturer's specifications. Refrigerant charge shall be verified according to one of the following options, as applicable.

   A. The installer and rater shall perform the standard charge verification procedure as specified in Reference Residential Appendix Section RA3.2.2, or an approved alternative procedure as specified in Section RA1; or

   B. The system shall be equipped with a fault indicator display (FID) device that meets the specifications of Reference Joint Appendix JA6. The installer shall verify the refrigerant charge and FID device in accordance with the procedures in Reference Residential Appendix Section RA3.4.2. The HERS Rater shall verify FID device in accordance with the procedures in Section RA3.4.2; or

   C. The installer shall perform the weigh-in charging procedure as specified by Reference Residential Appendix Section RA3.2.3.1 provided the system is of a type that can be verified using the RA3.2.2 standard charge verification procedure and RA3.3 airflow rate verification procedure or approved alternatives in RA1. The HERS Rater shall verify the charge using RA3.2.2 and RA3.3 or approved alternatives in RA1

EXCEPTION 1 to Section ~~150.2(b)1Fiia~~180.2(b)2AivbI: Systems unable to comply with the minimum airflow rate requirement shall demonstrate compliance using the procedures in Section RA3.3.3.1.5; and the system's thermostat shall conform to the specifications in Section 110.12.

EXCEPTION 2 to Section ~~150.2(b)1Fiia~~180.2(b)2AivbI: Entirely new or complete replacement space conditioning systems, as specified by Section ~~150.2(b)1C~~180.2(b)2Ai, without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in TABLE ~~150.0-B~~160.3-A or ~~150.0-C~~160.3-B as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Section RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section ~~150.0(m)12~~160.2(a)1C for the system air filter device(s) shall conform to the requirements given in TABLE ~~150.0-B~~160.3-A and ~~150.0-C~~160.3-B.

EXCEPTION 1 to Section ~~150.2(b)1Fiib~~180.2(b)2AivbII: When the outdoor temperature is less than 55 degrees F and the installer utilizes the weigh-in charging procedure in Reference Residential Appendix Section RA3.2.3.1to demonstrate compliance, the installer may elect to utilize the HERS Rater verification procedure in Reference Residential Appendix Section RA3.2.3.2. If the HERS Rater verification procedure in Section RA3.2.3.2 is used for compliance, the system's thermostat shall conform to the specifications in Section 110.12. Ducted systems shall comply with the minimum system airflow rate requirements in Section ~~150.2(b)1Fiia~~180.2(b)2AivbI.

EXCEPTION to Section ~~150.2(b)1Fii~~180.2(b)2Aivb: Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall

certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section ~~150.2(b)1Fiia~~ 180.2(b)2AivbI, provided that the system is of a type that can be verified using the procedure specified in RA3.3 or an approved alternative in RA1.

v. **Altered Space-Conditioning System.** Replacement space-conditioning systems shall be limited to natural gas, liquefied petroleum gas, or the existing fuel type.

EXCEPTION to Section ~~150.2(b)1G~~180.2(b)2Av: When the fuel type of the replaced heating system was natural gas or liquefied petroleum gas, the replacement space-conditioning system may be a heat pump

B. **Central Systems Serving Multiple Dwelling Units and Common Area Space Conditioning Systems**

i. New or Replacement Space-Conditioning Systems or Components other than new or replacement space-conditioning system ducts shall meet the requirements of Section ~~140.4~~170.2(c)1, 2, and 4, applicable to the systems or components being altered. For compliance with Section ~~140.4(c)~~1170.2(c)4A, additional fan power adjustment credits are available as specified in TABLE ~~141.0 D~~180.2-C.

TABLE ~~141.0 D~~180.2-C Fan Power Limitation Pressure Drop Adjustment

Device	Adjustment Credits
Particulate Filtration Credit: MERV 9 through 12	0.5 in. of water
Particulate Filtration Credit: MERV 13 through 15	0.9 in. of water

~~**EXCEPTION 1 to Section 141.0(b)2C.** Subsection (b)2C does not apply to replacements of equivalent or lower capacity electric resistance space heaters for high-rise residential apartment units.~~

EXCEPTION ~~2~~1 to Section ~~141.0(b)2C~~180.2(b)2Bi. ~~Subsection (b)2C~~ does not apply to replacement of electric reheat of equivalent or lower capacity electric resistance space heaters, when natural gas is not available.

EXCEPTION ~~3~~2 to Section ~~141.0(b)2C~~180.2(b)2Bi. Section ~~140.4(n)~~170.2(c)4L is not applicable to new or replacement space conditioning systems.

ii. **Altered Duct Systems.** When new or replacement space-conditioning system ducts are installed to serve an existing building, the new ducts shall meet the requirements of Section ~~120.4~~160.3(c)2. If the space conditioning system meets the criteria of Section ~~140.4(l)1~~170.2(c)4Ji, the duct system shall be sealed as confirmed through field verification and diagnostic testing in accordance with the procedures for duct sealing of an existing duct system as specified in Reference Nonresidential Appendix NA2, to meet one of the following requirements:

a. If the new ducts form an entirely new or replacement duct system directly connected to the air handler, the measured duct leakage shall be equal to, or less than 6 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Nonresidential Appendix Section NA2.1.4.2.1.

b. Entirely new or replacement duct systems installed as part of an alteration shall be constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the building's existing duct system, including registers, grilles, boots, air handlers, coils, plenums, and ducts, if the reused parts are accessible and can be sealed to prevent leakage.

c. If the new ducts are an extension of an existing duct system, the combined new and existing duct system shall meet one of the following requirements:

I. The measured duct leakage shall be equal to or less than 15 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Nonresidential Appendix Section NA2.1.4.2.1; or

II. If it is not possible to comply with the duct leakage criterion in Subsection 141.0(b)2Diia, then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test performed by a certified HERS Rater utilizing the methods specified in Reference Nonresidential Appendix NA2.1.4.2.2.

EXCEPTION to Section ~~141.0(b)2Dii~~ 180.2(b)2Biic: Duct Sealing. Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos are exempt from the requirements of subsection ~~141.0(b)2Dii~~180.2(b)2Biic.

iii. **Altered Space-Conditioning Systems.** When a space-conditioning system is altered by the installation or replacement of space-conditioning system equipment (including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, or cooling or heating coil:

a. For all altered units where the existing thermostat does not comply with the requirements for demand responsive controls specified in Section 110.12, the existing thermostat shall be replaced with a demand responsive thermostat that complies with Section 110.12. All newly installed space-conditioning systems requiring a thermostat shall be equipped with a demand responsive thermostat that complies with Section 110.12; and

b. The duct system that is connected to the new or replaced space-conditioning system equipment shall be sealed, if the duct system meets the criteria of Section ~~140.4(l)1~~ 170.2(c)4Ji, as confirmed through field verification and diagnostic testing, in accordance with the applicable procedures for duct sealing of altered existing duct systems as specified in Reference Nonresidential Appendix NA2, and conforming to the applicable leakage compliance criteria in Section ~~141.0(b)2D~~180.2(b)2Bii.

EXCEPTION 1 to Section ~~141.0(b)2Eii~~180.2(b)2Biiib: Duct Sealing. Buildings altered so that the duct system no longer meets the criteria of Section ~~140.4(l)1~~ 170.2(c)4Ji are exempt from the requirements of Subsection ~~141.0(b)2Eii~~180.2(b)2Biiib**.**

EXCEPTION 2 to Section ~~141.0(b)2Eii~~180.2(b)2Biiib: Duct Sealing. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in the Reference Nonresidential Appendix NA2 are exempt from the requirements of Subsection ~~141.0(b)2Eii~~180.2(b)2Biiib.

EXCEPTION 3 to Section ~~141.0(b)2Eii~~180.2(b)2Biiib: Duct Sealing. Existing duct systems constructed, insulated or sealed with asbestos are exempt from the requirements of Subsection ~~141.0(b)2Eii~~180.2(b)2Biiib.

3. **Hot Water Systems**. Altered or replacement service water-heating systems or components shall meet the applicable requirements below:

A. **Pipe Insulation.** For newly installed piping, the insulation requirements of Section ~~150.0(j)2~~160.4(f)2 shall be met. For existing accessible piping the applicable requirements of Section ~~150.0(j)2~~160.4(f)2Ai, iii, and iv shall be met.

B. **Distribution System.** For recirculation distribution system serving individual dwelling units, only Demand Recirculation Systems with manual on/off control as specified in the Reference Appendix RA4.4.9 shall be installed.

C. **Water heating system.** The water heating system shall meet one of the following:

i. A natural gas or propane water-heating system; or

ii. For Climate Zones 1 through 15, a single heat pump water heater. The storage tank shall not be located outdoors and be placed on an incompressible, rigid insulated surface with a minimum thermal resistance of R-10. The water heater shall be installed with a communication interface that meets either the requirements of 110.12(a); or

iii. For Climate Zones 1 through 15, a single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher. The storage tank shall not be located outdoors; or

iv. If no natural gas is connected to the existing water heater location, a consumer electric water heater.; or

v. A water-heating system determined by the executive director to use no more energy than the one specified in Item a. above; or if no natural gas is connected to the existing water heater location, a water-heating system determined by the executive director to use no more energy than the one specified in Item d. above.

4. **Lighting**.

D. **Dwelling Unit Lighting.** The altered lighting system shall meet the lighting requirements of Section ~~150.0(k)~~160.5(a).The altered luminaires shall meet the luminaire efficacy requirements of Section ~~150.0(k)~~160.5(a).and TABLE ~~150.0-A~~160.3-A. Where existing screw base sockets are present in ceiling-recessed luminaires, removal of these sockets is not required provided that new JA8 compliant trim kits or lamps designed for use with recessed downlights or luminaires are installed.

E. **Common Area Lighting**.

i. Spaces with lighting systems installed for the first time shall meet the requirements of Sections 110.9, ~~130.0~~160.5(b)1, ~~130.1~~ 160.5(b)4, ~~130.2~~160.5(c)2, ~~130.4~~160.5(e), ~~140.3(c)~~170.2(b), ~~140.6~~170.2(e)1, and ~~140.7~~ 170.2(e)2.

ii. When the requirements of Section ~~130.1(d)~~160.5(b)4D 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 Section ~~130.1(d)~~160.5(b)4D.

iii. New internally and externally illuminated signs shall meet the requirements of Sections 110.9, ~~130.3~~160.5(d) and 140.8.

iv. **Altered Indoor Lighting Systems**. Alterations to indoor lighting systems that include 10% or more of the luminaires serving an enclosed space shall meet the requirements of i, ii, or iii below:

a. The alteration shall comply with the indoor lighting power requirements specified in Section ~~140.6~~170.2(e)1 and the lighting control requirements specified in TABLE ~~141.0-F~~ 180.2-D;

b. The alteration shall not exceed 80% of the indoor lighting power requirements specified in Section ~~140.6~~170.2(e)1, and shall comply with the lighting control requirements specified in TABLE ~~141.0-F~~ 180.2-D; or

c. The alteration shall be a one-for-one luminaire alteration within a building or tenant space of 5,000 square feet or less, the total wattage of the altered luminaires shall be at least 40% lower compared to their total pre-alteration wattage, and the alteration shall comply with the lighting control requirements specified in TABLE ~~141.0-F~~ 180.2-D.

Alterations to indoor lighting systems shall not prevent the operation of existing, unaltered controls, and shall not alter controls to remove functions specified in Section ~~130.1~~160.5(b)4.

Alterations to lighting wiring are considered alterations to the lighting system. Alterations to indoor lighting systems are not required to separate existing general, floor, wall, display, or ornamental lighting on shared circuits or controls. New or completely replaced lighting circuits shall comply with the control separation requirements of Section ~~130.1(a)4~~ 160.5(b)4Aiv and ~~130.1(c)1D~~160.5(b)4Cid**.**

EXCEPTION 1 to Section ~~141.0(b)2I~~180.2(b)4Eiv. Alteration of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded as specified in Section 140.6(a)3~~140.6~~170.2(e)1Aiii.

EXCEPTION 2 to Section ~~141.0(b)2I~~180.2(b)4Eiv. Any enclosed space with only one luminaire.

EXCEPTION 3 to Section ~~141.0(b)2I~~180.2(b)4Eiv. Any alteration that would directly cause the disturbance of asbestos, unless the alteration is made in conjunction with asbestos abatement.

EXCEPTION 4 to Section ~~141.0(b)2I~~180.2(b)4Eiv. Acceptance testing requirements of Section ~~130.4~~ 160.5(e) are not required for alterations where lighting controls are added to control 20 or fewer luminaires.

EXCEPTION 5 to Section ~~141.0(b)2I~~180.2(b)4Eiv. Any alteration limited to adding lighting controls or replacing lamps, ballasts, or drivers.

EXCEPTION 6 to Section ~~141.0(b)2I~~180.2(b)4Eiv. One-for-one luminaire alteration of up to 50 luminaires either per complete floor of the building or per complete tenant space, per annum.

v. Alterations to existing outdoor lighting systems in a lighting application listed in TABLE ~~140.7-A~~ 170.2-O or ~~140.7-B~~ 170.2-P shall meet the applicable requirements of Sections ~~130.0~~160.6, ~~130.2(a),~~ ~~130.2(b)~~160.5(c)1, and ~~130.4~~160.5(e), and:

a. In alterations that increase the connected lighting load, the added or altered luminaires shall meet the applicable requirements of Section ~~130.2(c)~~ 160.5(c)2 and the requirements of Section ~~140.7~~170.2(e)2 for general hardscape lighting or for the specific lighting applications containing the alterations; and

b. In alterations that do not increase the connected lighting load, where the greater of 5 luminaires or 10 percent of the existing luminaires are replaced in a general hardscape or a specific lighting application, the alterations shall meet the following requirements:

I. In parking lots and outdoor sales lots where the bottom of the luminaire is mounted 24 feet or less above the ground, the replacement luminaires shall comply with Section ~~130.2(c)1~~160.5(c)2A AND Section ~~130.2(c)3~~160.5(c)2C**;**

II. For all other lighting applications and where the bottom of the luminaire is mounted greater than 24 feet above the ground, the replacement luminaires shall comply with Section ~~130.2(c)1~~160.5(c)2A AND EITHER comply with Section ~~130.2(c)2~~160.5(c)2B or be controlled by lighting control systems, including motion sensors, that automatically reduces lighting power by at least 40 percent in response to the area being vacated of occupants; and

c. In alterations that do not increase the connected lighting load, where the greater of 5 luminaires or 50 percent of the existing luminaires are replaced in general hardscape or a specific application, the replacement luminaires shall meet the requirements of subsection ii above and the requirements of Section ~~140.7~~170.2(e)2 for general hardscape lighting or specific lighting applications containing the alterations.

EXCEPTION to Section ~~141.0(b)2L.iii~~ 180.2(b)4Evc. Alterations where the replacement luminaires have at least 40 percent lower power consumption compared to the original luminaires are not required to comply with the lighting power allowances of Section ~~140.7~~170.2(e)2.

EXCEPTION to Section ~~141.0(b)2L~~180.2(b)4Ev. Acceptance testing requirements of Section ~~130.4~~ 160.5(e) are not required for alterations where controls are added to 20 or fewer luminaires.

vi. Alterations to existing internally and externally illuminated signs that increase the connected lighting load, replace and rewire more than 50 percent of the ballasts, or relocate the sign to a different location on the same site or on a different site shall meet the requirements of Section 140.8.

EXCEPTION to Section ~~141.0(b)2M~~180.2(b)4Evi. Replacement of parts of an existing sign, including replacing lamps, the sign face or ballasts, that do not require rewiring or that are done at a time other than when the sign is relocated, is not an alteration subject to the requirements of Section ~~141.0(b)2M~~180.2(b)4Evi**.**

TABLE ~~141.0-F~~ 180.2-D – Control Requirements for Indoor Lighting System Alterations for Common Use Areas

Control Specifications		**Projects complying with Section ~~141.0(b)2I~~180.2(b)4Eiv**	**Projects complying with Sections ~~141.0(b)2Iii~~ 180.2(b)4Eiv b and ~~141.0(b)2Liii~~ 180.2(b)4Evb**
Manual Area Controls	~~130.1(a)1~~160.5(b)4Ai	Required	Required
	~~130.1(a)2~~160.5(b)4Aii	Required	Required
	~~130.1(a)3~~160.5(b)4Aii	Only required for new or completely replaced circuits	Only required for new or completely replaced circuits
Multi-Level Controls	~~130.1(b)~~ 160.5(b)4B	Required	Not Required
Automatic Shut Off Controls	~~130.1(c)1~~160.5(c)4Ci	Required; ~~130.1(c)1D~~ 160.5(b)4Cid only required for new or completely replaced circuits	Required; ~~130.1(c)1D~~ 160.5(b)4Cid only required for new or completely replaced circuits
	~~130.1(c)2~~160.5(c)4Cii	Required	Required
	~~130.1(c)3~~160.5(c)4Ciii	Required	Required
	~~130.1(c)4~~160.5(c)4Civ	Required	Required
	~~130.1(c)5~~160.5(b)4Cv	Required	Required
	~~130.1(c)6~~160.5(b)4Cvi	Required	Required
	~~130.1(c)7~~160.5(b)4Cvii	Required	Required
	~~130.1(c)8~~160.5(b)4Cviii	Required	Required
Daylighting Controls	~~130.1(d)~~160.5(b)4D	Required	Not Required
Demand Responsive Controls	~~130.1(e)~~ 160.5(b)4E	Required	Not Required

(c) **Performance approach**.

The altered component(s) and any newly installed equipment serving the alteration shall meet the applicable requirements of subsections ~~A, B, and C~~ 1, 2, and 3 below.

1. The altered components shall meet the applicable requirements of Sections 110.0 through 110.9, Section ~~150.0(a)~~ 160.0 through 160.3(b)J, ~~(l); 150.0(m) through 150.0 (m)10~~, ~~Section 150.0(o) through (q)~~ and 160.5. Entirely new or complete replacement space-conditioning systems, and entirely new or complete replacement duct systems, as these terms are used in Sections Section ~~150.2(b)1C~~180.2(b)2Ai, and 150.2(b)1Diia, shall comply with the requirements of Sections ~~150.0(m)12~~160.2(a)1 and ~~150.0(m)13~~160.3(b)5L**.**

2. The standard design for an altered component shall be the higher efficiency of existing conditions or the requirements of Section ~~141.0(b)2~~180.2(b). For components not being altered, the standard design shall be based on the unaltered existing conditions such that the standard and proposed designs for these components are identical. When the third party verification option is specified, all components proposed for alteration, for which the additional credit is taken, must be verified. The Executive Director shall determine the qualifications required by the third party inspector.

3. The proposed design shall be based on the actual values of the altered components.

NOTES TO SECTION ~~150.2(b)2~~ 180.2(c):

A. If an existing component must be replaced with a new component, that component is considered an altered component for the purpose of determining the standard design altered component energy budget and must meet the requirements of Section ~~150.2(b)2B~~180.2(c)2.

B. The standard design shall assume the same geometry and orientation as the proposed design.

C. The "existing efficiency level" modeling rules, including situations where nameplate data is not available, are described in the applicable Residential or Nonresidential ACM Approval Manual.

EXCEPTION 1 to Section ~~150.2(b)~~180.2(c): Any dual-glazed greenhouse or garden window installed as part of an alteration complies with the U-factor requirements in Section ~~150.1(c)3~~170.2.

EXCEPTION 2 to Section ~~150.2(b)~~180.2(c): Where the space in the attic or rafter area is not large enough to accommodate the required R-value, the entire space shall be filled with insulation provided such installation does not violate Section 1203.2 of Title 24, Part 2.

SECTION 180.3 – REPAIRS

Repairs shall not increase the preexisting energy consumption of the repaired component, system, or equipment.

SECTION 180.4 – WHOLE BUILDING

Any addition or alteration may comply with the requirements of Title 24, Part 6 by meeting the requirements for the entire building.