Codes and Standards Enhancement (CASE) Initiative
2022 California Energy Code

Multifamily Restructuring – Results Report

Measure Number: 2022-MF-RESTRUC-F
Multifamily Envelope, HVAC

December 2022

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

This report was prepared by the California Statewide Codes and Standards Enhancement (CASE) Program that is funded, in part, by California utility customers under the auspices of the California Public Utilities Commission.

Pacific Gas and Electric Company
SOUTHERN CALIFORNIA EDISON An EDISON INTERNATIONAL Company
SDGE A Sempra Energy utility
LA DWP Los Angeles Department of Water & Power
SMUD

Document Information

Category:	Codes and Standards
Keywords:	Statewide Codes and Standards Enhancement (CASE) Initiative, Statewide Utility Codes and Standards Team, Codes and Standards Enhancements, 2022 Title 24, Part 6, efficiency, efficiency; multifamily; building envelope; glazing; HVAC; skylight, solar heat gain coefficient; U-factor.
Authors:	Elizabeth McCollum (TRC), Julianna Wei (TRC), Alea German (Frontier Energy),
Acknowledgements	Matthew Christie (TRC), Nehemiah Stone (Stone Energy Associates)
Prime Contractor	TRC
Project Management:	California Utilities Statewide Codes and Standards Team: Pacific Gas and Electric Company, Southern California Edison, San Diego Gas & Electric Company, Los Angeles Department of Water and Power, and Sacramento Municipal Utility District

Table of Contents

List of Tables

1. Introduction

The Codes and Standards Enhancement (CASE) Initiative presents recommendations to support the California Energy Commission's (Energy Commission) efforts to update the California Energy Code (Title 24, Part 6) to include new requirements or to upgrade existing requirements for various technologies. Three California Investor Owned Utilities (IOUs), Pacific Gas and Electric Company, San Diego Gas and Electric, and Southern California Edison, and two Publicly Owned Utilities, Los Angeles Department of Water and Power and Sacramento Municipal Utility District, (herein referred to as the Statewide CASE Team when including the CASE Author) sponsored this effort. The program goal is to prepare and submit proposals that will result in cost-effective enhancements to improve energy efficiency and energy performance in California buildings to the Energy Commission, the state agency that has authority to adopt revisions to Title 24, Part 6. The Energy Commission evaluates proposals submitted by the Statewide CASE Team and other stakeholders and may revise or reject proposals.

In November 2020, the Statewide CASE Team submitted the CASE Report that is presented in Attachment 2 to recommend code changes related to multifamily restructuring. This document explains the revisions that occurred to the proposed code changes between the submittal of the Final CASE Report to the Energy Commission and the Energy Commission's adoption of the 2022 Title 24, Part 6 Standards on August 11, 2021. The document begins with a concise description of the adopted code language, followed by the estimated energy savings of the adopted requirements, with the remainder of the document outlining the evolution of the code changes and the final adopted language.

2. Measure Description

2.1 Summary of Adopted Requirements

Table 1 identifies sections of the standards and Reference Appendices that were modified as a result of advocacy activities. A single CBECC interface will integrate requirements for all multifamily buildings. All prescriptive submeasures included in Table 1 will influence changes to the compliance software.

Table 1: Scope of Adopted Code Change

Measure Name	Type of Requirement	Modified Section(s) of Title 24, Part 6	Modified Title 24, Part 6 Appendices	Will Compliance Software Be Modified
Roof Assemblies	Mandatory	New Section 160.1(a). Modified language from Sections 150.0(a) and 120.7(a).	N/A	No
Roof Assemblies (Option D)	Prescriptive	New Section 170.2(a)1 and Table 170.2-A. Modified language from Sections 150.1 and 140.3(a)1 and Tables 150.1-B and 140.3-C	N/A	Yes
Wall U-Factor	Mandatory	New Section 160.1(b). Modified language from Sections 150.0(b) and 120.7(b).	N/A	No
Wall U-Factor	Prescriptive	New Section 170.2(a)2 and Table 170.2-A. Modified content from 150.1(c)1B and Tables 150.1-B and 140.3-C.	N/A	Yes
Fenestration Properties	Mandatory	New Section 160.1(e). Modified language from Section 150.0(q).	N/A	No
Fenestration Properties	Prescriptive	New Section 170.2(a)3Aii and Table 170.2-A. Modified content from Sections 150.1(c)3 and 140.3(a)5 and Tables 150.1-B and 140.3-C.	N/A	Yes
Fenestration Area	Prescriptive	New Section 170.2(a)3Ai and Table 170.2-A. Modified content from 150.1(c)3B and 140.3(a)5A and Tables 150.1-B and 140.3-C.	N/A	Yes
Duct Insulation	Mandatory	New Section 160.3(b)5Aii. Modified language from Sections 150.0(m)1B and 120.4(a).		Yes
Duct Insulation	Prescriptive	New Table 170.2-K. Modified from Table 150.1-B.		Yes

Measure Name	Type of Requirement	Modified Section(s) of Title 24, Part 6	Modified Title 24, Part 6 Appendices	Will Compliance Software Be Modified
Duct Sealing and Testing	Mandatory	New Section 160.3(b)5K. Modified language from Sections 150.0(m)11C, 120.4(a), and 140.4(l).		Yes
Airflow and Fan Watt Draw	Mandatory	New Section 160.3(b)5L. Modified language from Sections 150.0(m)13B&C and 140.4.		Yes
Refrigerant Charge Verification	Prescriptive	New Section 170.2(c)3Bi. Modified language from Sections 150.1(c)7A and 140.4.		Yes

2.1.1 Submeasure A Envelope: Roof Assemblies

This submeasure was adopted as proposed by the Statewide CASE Team. The roof assemblies submeasure applies 2019 mandatory low-rise residential maximum U-factor of 0.043 for the ceiling or rafter roof to multifamily buildings with attics and 2019 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 less than four habitable stories.

The submeasure applies prescriptive low-rise residential requirements from Table 150.1-B to multifamily buildings with attics, including Option B (below deck insulation high-performance attic) and Option C (ducts in conditioned space). The submeasure adds a prescriptive non-attic roof option (Option D) for all multifamily buildings. Option D applies 2019 high-rise residential prescriptive U-factor requirements using the metal building and wood-framed or other roof categories. The aged solar reflectance (ASR) and thermal emittance for the non-attic option match 2019 requirements for high-rise residential roofing products for steep-slope roofs. The new Option D requires 0.63 ASR and 0.75 thermal emittance in Climate Zones 9-11 and 13-15 for low-sloped roofs.

This submeasure also applies the 2019 high-rise residential requirements for cool roof products on low-sloped roof alterations, with an increase in stringency to 0.63 minimum ASR. This submeasure applies only to Climate Zones 10, 11, 13, 14, and 15. The *Residential Energy Savings and Process Improvements for Additions and Alterations CASE Report* influenced expansion of the adopted multifamily requirement to include 0.63 ASR in Climate Zones 2, 4, 6-9, and 12 (Statewide CASE Team 2020).

2.1.2 Submeasure B: Envelope – Wall U-Factor

This submeasure was adopted as proposed by the Statewide CASE Team. The wall U-factor submeasure combines 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. New fire rating references allow for high fire rating wall types that have constructability limitations to adhere to less stringent U-factor requirements than walls with lower fire-ratings. Table 2 below includes the wall assembly types, with varied mandatory and prescriptive requirements by climate zone.

The submeasure covers new construction buildings and additions but not alterations. Extension of existing wood framing is exempted for additions.

Table 2: Proposed Wall U-factors by Wall Assembly Type and Climate Zone

Wall Type	Climate Zones	Mandatory Assembly U-factor	Prescriptive Assembly U-factor
Metal Buildings	CZ 1-10	Metal Buildings = 0.113 Spandrel Panels and Curtain Walls = 0.280	0.061
	CZ 11-16		0.057
Framed (wood or metal), high fire rating (2- or 3-hours)	CZ 1-5,8-10, 12 & 13	2x4 framing = 0.102 2x6 framing = 0.071 non-framed = 0.102	0.059
	CZ 6 & 7		0.065
	CZ 11 & 14-16		0.051
Framed (wood or metal), low fire rating (0- or 1-hours), and other wall types	CZ 1-5, 8-16		0.051
	CZ 6 & 7		0.065
Heavy mass (>15 Btu/ft^2-F)	CZ 1-3, 16	0.690	0.160
	CZ 4, 11, 14 & 15		0.184
	CZ 5, 13		0.211
	CZ 6-10		0.690
	CZ 12		0.253
Light mass (7-15 Btu/ft^2-F)	CZ 1-15	0.440	0.077
	CZ 16		0.059

2.1.3 Submeasure C: Envelope – Quality Insulation Installation (QII)

This submeasure was not accepted. See Section 2.2.1 for information about the proposed submeasure.

2.1.4 Submeasure D: Envelope – Fenestration Properties

The fenestration properties submeasure was adopted for new construction, additions, and alterations, with minor adjustments. The measure applies the 2019 low-rise residential mandatory weighted average maximum U-factor requirement to multifamily

buildings greater than three habitable stories that use non-curtain wall fenestration types. There are no 2019 mandatory requirements for U-factor and solar heat gain coefficient (SHGC) in multifamily buildings four stories and greater.

2.1.4.1 New Construction

For new construction buildings, this submeasure creates a single set of fenestration U-factor and relative solar heat gain coefficient (RSGHC) requirements that apply across all multifamily buildings, dependent on the window type. The 2019 nonresidential code table includes four window categories (fixed, operable, curtainwall/storefront, and glazed doors) while the 2019 residential code is a single area-weighted average requirement (with some SHGC variation by climate zone). The adopted requirement includes three window categories, without distinction between fixed and operable, and variable requirements by climate zone, as shown in Table 3.

Table 3: Proposed Fenestration Thermal Properties by Type and Climate Zone; New Construction

Window Type	Climate Zones	U-Factor (maximum)	SHGC (maximum)	VT (minimum)
Curtainwall/ Storefront	CZ 1	0.38	0.35	0.46
	CZ 2-15	0.41	0.26	0.46
	CZ 16	0.38	0.25	0.46
Class AW	CZ 1	0.38	0.35	0.37
	CZ 2-15	0.40	0.24	0.37
	CZ 16	0.38	0.24	0.37
All Other	CZ 1	0.30	0.35	No requirement
	CZ 2-5, 8-16	0.30	0.23	No requirement
	CZ 6, 7	0.34	0.23	No requirement

For multifamily buildings with three habitable stories and fewer, buildings in Climate Zones 1, 3, 5, and 16 remain exempted from the relative solar heat gain coefficient (RSHGC) requirements.

2.1.4.2 Alterations and Additions

For window alterations, the fenestration properties submeasure has different requirements by window type: curtainwall/storefront/glazed doors, Class AW fixed, Class AW operable, and all others.

The requirements increase stringency for buildings four habitable stories and greater and reduced stringency for buildings three habitable stories and fewer in Climate Zone 7. For window additions into new floor space, the proposed code requirements are based on an area-weighted average of thermal properties for all fenestration following new construction requirements. For both alterations and additions, there are less

restrictive requirements when a small volume of fenestration, <150 ft^2, is being added or altered. Window additions in new floor space follow new-construction requirements. Window additions in existing floor space follow the requirements in Table 4

Table 4: Fenestration Thermal Properties by Type and Climate Zone; Alterations and Additions

Window Type	Climate Zones	U-Factor (maximum)	SHGC (maximum)	VT (minimum)
Curtain wall / Storefront/ Glazed Doors	CZ 1	0.38	0.35	0.46
	CZ 2-15	0.41	0.26	0.46
	CZ 16	0.38	0.25	0.46
Class AW Fixed Windows	CZ 1	0.38	0.35	0.37
	CZ 2-5, 10-16	0.38	0.25	0.37
	CZ 6,7	0.47	0.31	0.37
	CZ 8, 9	0.41	0.26	0.37
Class AW Operable Windows	CZ 1	0.43	0.35	0.37
	CZ 2-5, 8-16	0.43	0.24	0.37
	CZ 6, 7	0.47	0.31	0.37
All-others	CZ 1	0.30	0.23	NR
	CZ 2-6, 8-16	0.30	0.23	NR
	CZ 7	0.34	0.23	NR
Alterations or Additions <150 ft^2	CZ 1	0.47	0.35	NR
	CZ 2-16	0.47	0.31	NR

Window alterations and additions in multifamily buildings up to three habitable stories in Climate Zones 1, 3, 5, and 16 are exempted from SHGC requirements.

2.1.5 Submeasure E: Envelope - Fenestration Area

The fenestration area submeasure was adopted as proposed. This submeasure applies the prescriptive low-rise residential 20 percent window-to-floor area maximum (inclusive of skylights) to high-rise buildings and the prescriptive high-rise residential 40 percent window-to-wall area maximum and 5 percent skylight-to-roof ratio to low-rise buildings. To comply prescriptively, the fenestration area must comply with each of three limits simultaneously.

The submeasure removes the west-facing glazing area restrictions for all multifamily buildings.

The submeasure covers new construction buildings, additions with greater than 700 ft^2 of conditioned floor area and alterations that add greater than 150 ft^2 of window area.

2.1.6 Submeasure F: Space Conditioning – Duct Insulation

2.1.6.1 Ducts in Unconditioned Space

The ducts in conditioned space submeasure was adopted as proposed in four of the proposed climate zones. This submeasure changes the mandatory and prescriptive duct insulation requirements for ducts in unconditioned spaces. The 2019 low-rise residential requirements of R-6 mandatory duct insulation and R-8 prescriptive duct insulation in Climate Zones 1–2, 4, and 8–16 now applies to all multifamily buildings with systems serving individual dwelling units. These proposed changes apply to new construction and new or replacement ducts in alterations. This submeasure results in reduced stringency in the following situation:

- R-8 to R-6 duct insulation for multifamily buildings four habitable stories and greater with ducts in unconditioned space in Climate Zones 3, 5, 6, and 7 for both new construction and new or replacement ducts in existing buildings.

Market data indicates that multifamily buildings four stories and greater do not have individual duct systems serving dwelling unit in unconditioned space; therefore, there is no statewide impact for this change.

2.1.7 Submeasure G: Space Conditioning – Duct Leakage Testing

The new construction duct leakage testing submeasure was adopted in 14 climate zones. This submeasure applies mandatory duct sealing and leakage testing to multifamily buildings four habitable stories and greater with ducted systems serving individual dwelling units in Climate Zones 2, 4, 6, and 8–16. Duct systems, regardless of location, must be tested to meet no greater than 12 percent total leakage or no greater than 6 percent leakage to outside. Diagnostic field verification and test protocols are described in Residential Reference Appendix RA3.1. Neither third-party verification by a HERS Rater nor registration with a HERS Registry is required for multifamily buildings four habitable stories and greater at this time. For these projects, compliance is demonstrated by the installing contractor and certified on the certificate of installation. The existing HERS verification requirement for multifamily buildings three habitable stories and fewer remains. These requirements apply to new construction and entirely new or complete replacement duct systems in alterations and additions.

For alterations, the duct leakage testing submeasure was adopted as proposed and expanded to include additional climate zones. Prescriptive duct leakage requirements are applied for altered duct systems and space-conditioning systems to multifamily buildings four habitable stories and greater with ducted systems serving individual dwelling units in all climate zones. This requires duct sealing and testing to meet no greater than 15 percent total leakage or no greater than 10 percent leakage to the outside, regardless of duct system location. As with new construction testing,

compliance is demonstrated by the installing contractor and certified on the certificate of installation. HERS Rater verification is not required.

2.1.8 Submeasure H: Space Conditioning – Space Cooling Airflow Rate and Fan Efficacy

The space cooling airflow rate and fan efficacy submeasure was adopted as proposed. This submeasure applies mandatory system airflow and fan power testing to multifamily buildings four habitable stories and greater with ducted cooling systems serving individual dwelling units in Climate Zones 2–16. Systems must meet 350 cubic feet per minute (cfm) per nominal ton of cooling or greater and either 0.45-Watt per cfm for gas furnaces or 0.58-Watt per cfm for all other air handlers. Diagnostic field verification and test protocols are described in Residential Reference Appendix RA3.3. Neither third-party verification by a HERS Rater nor registration with a HERS Registry is required for multifamily buildings four habitable stories and greater. For these projects, compliance is demonstrated by the installing contractor and certified on the certificate of installation. The existing HERS verification requirement for multifamily buildings three habitable stories and fewer remains. These requirements apply to new construction and entirely new or complete replacement space-conditioning systems in alterations and additions.

There is no requirement for fan efficacy testing for altered space-conditioning systems. Airflow testing is required as part of the prescriptive refrigerant charge verification requirements for altered space-conditioning systems with mechanical cooling in alterations and additions in select climate zones. This change is evaluated as part of the refrigerant charge verification submeasure.

2.1.9 Submeasure I: Space Conditioning – Refrigerant Charge Verification

The refrigerant charge verification submeasure was adopted as proposed. This submeasure applies prescriptive verification of refrigerant charge to multifamily buildings four habitable stories and greater with cooling systems serving individual dwelling units. The prescriptive requirement applies to Climate Zones 2 and 8–15. Diagnostic field verification and test protocols are described in Residential Reference Appendix RA3.2. Neither third-party verification by a HERS Rater nor registration with a HERS Registry is required for multifamily buildings four habitable stories and greater. Compliance is demonstrated by the installing contractor and certified on the Certificate of Installation. The existing HERS verification requirement for multifamily buildings three habitable stories and fewer remains. These requirements apply to new construction and entirely new or complete replacement space-conditioning systems with mechanical cooling in alterations and additions.

For alterations, this submeasure applies the prescriptive refrigerant charge verification and airflow testing for altered space-conditioning systems with mechanical cooling to

multifamily buildings four habitable stories and greater in Climate Zones 2 and 8–15. The refrigerant charge verification requirements are the same as with new construction. Additionally, cooling coil airflow testing must meet 300 cfm per ton of nominal cooling capacity or greater. As with new construction, testing compliance shall be demonstrated by the installing contractor and certified on the Certificate of Installation. HERS Rater verification is not required.

2.2 Summary of Proposed Requirements That Were Not Adopted

Submeasures and submeasure components proposed in the Final Multifamily Restructuring CASE Report not adopted are described below.

2.2.1 Submeasure C: Envelope – Quality Insulation Installation (QII)

This submeasure was not adopted because the CEC decided to not adopt any code changes involving HERS verification. The QII submeasure would have applied the prescriptive requirements of QII to all multifamily buildings of up to 40,000 ft^2 of total conditioned floor area. QII is currently a prescriptive requirement for multifamily buildings with three or fewer habitable stories in all climate zones, except Climate Zone 7. The proposed change would have applied to additions greater than 700 ft^2 CFA and would not have applied to alterations or to buildings using curtainwall assembly types.

2.2.2 Submeasure D: Envelope – Fenestration Properties

Portions of the fenestration properties submeasure were not adopted. The Statewide CASE Team proposed application of visual transmittance (VT) requirements to all multifamily buildings with curtainwall or performance class AW fenestration. The adopted requirements include an exemption from VT requirements for multifamily buildings up to three habitable stories.

For fenestration alterations, there were specific instances where proposed U-factor and RSHGC requirements were not adopted, due to marginal cost effectiveness. The final adopted requirements resulted in reduced submeasure savings compared to the CASE Report and include:

- Fixed performance class AW windows in Climate Zones 6, 7, and 9. For Climate Zones 6 and 7, 0.41 U-factor and 0.26 RSHGC were proposed. These remain at 0.47 U-factor and 0.31 RSHGC. In Climate Zone 9, 0.38 U-factor and 0.25 SHGC were proposed. The adopted requirements for Climate Zone 9 remain at 0.41 U-factor and 0.26 RHGC.
- Operable performance class AW windows in Climate Zones 6 and 7. The Statewide Case Team proposed 0.43 U-factor and 0.24 RSHGC. Adopted requirements remain at 0.47 U-factor and 0.31 RSHGC.

- All other fenestration in Climate Zone 6. The Statewide CASE Team proposed 0.34 U-factor. The adopted U-factor is 0.30.

2.2.3 Submeasure F: Space Conditioning – Duct Insulation

2.2.3.1 Ducts in Conditioned Space

To unify the requirements across all multifamily buildings, the Statewide CASE Team recommended that the existing high-rise mandatory requirements for R-4.2 duct insulation on supply ducts in conditioned space (regardless of whether they are verified low leakage ducts or not) apply to all multifamily buildings. This would have reduced stringency in the following situation:

- R-6 to R-4.2 mandatory duct insulation for multifamily buildings three habitable stories and fewer with ducts in conditioned space that are not verified low leakage ducts or directly exposed to conditioned space.

The Energy Commission did not include this recommended change in the 45-Day Language and kept the mandatory duct insulation at R-6, unless the ducts are verified low-leakage ducts or within conditioned space. In the 15-Day Language and the adopted code this language was revised, and insulation levels were reduced for ducts in conditioned space to R-0 when certain conditions are met. This change was made for both single family and multifamily buildings based on field testing of uninsulated ducts in conditioned spaces within houses (Modera, Najib and Harington 2021).

2.2.3.2 Ducts in Unconditioned Space

For new or replacement ducts in unconditioned space in existing multifamily buildings, the Statewide CASE Team recommended in the Final CASE Report to reduce the prescriptive insulation requirement from R-8 to R-6 for multifamily buildings four habitable stories and greater in Climate Zones 1–10, 12, and 13, based on the existing low-rise residential prescriptive insulation requirements. The Energy Commission adopted this requirement for Climate Zones 3 and 5–7 and adopted the proposal from the Residential Energy Savings and Process Improvements for Additions and Alterations CASE Report (Statewide CASE Team 2020) increasing the prescriptive insulation to R-8 in the remaining climate zones.

The Statewide CASE Team marked-up the 15-Day Language in a docketed comment to the Energy Commission, which provided language clarifications in Sections 170.2(c)3Bii related to this submeasure (Statewide CASE Team 2021). The marked-up language was not adopted.

2.2.4 Submeasure G: Space Conditioning – Duct Leakage Testing

The Statewide CASE Team proposed in the Final CASE Report that the prescriptive duct sealing requirements for alterations apply in all climate zones except Climate Zone 1, 5, and 7. This was based on analysis using CBECC-Com software and the embedded nonresidential TDV multipliers that have traditionally been used for evaluation of multifamily buildings four habitable stories and greater. After the CASE Report was finalized, the Statewide CASE Team and the Energy Commission discussed which TDV multipliers to use for multifamily buildings given the unification of all multifamily buildings. The Statewide CASE Team and the Energy Commission decided that the residential TDV are most appropriate. The Statewide CASE Team conducted analysis using the residential TDV (Statewide CASE Team 2020) and found the measure to be cost effective in all climate zones. Based on these results, the adopted language removed the climate zone exceptions and applied the requirement to all climate zones.

The Statewide CASE Team proposed in the Final CASE Report that the mandatory duct sealing requirements for new construction buildings apply in all climate zones except Climate Zone 1. This was based on cost effectiveness results for a verification package, which combined the three HVAC verification measures (duct sealing, airflow rate and fan efficacy, and refrigerant charge). The Statewide CASE Team justified this since many projects will be required to meet all these verification requirements. However, the Energy Commission wanted to base the requirements on cost effectiveness results for the duct leakage measure alone. Based on the analysis conducted by the Statewide CASE Team using the residential TDV (Statewide CASE Team 2020), the new construction duct leakage measure alone is cost effective everywhere except Climate Zones 1, 3, 5, and 7. Therefore, the adopted language includes an exception for Climate Zones 3, 5, and 7 in addition to Climate Zone 1.

The Statewide CASE Team marked-up the 15-day language in a docketed comment to the Energy Commission, which provided language clarification and corrected typographical errors and mis-references in Section 180.2(b)2A related to this submeasure (Statewide CASE Team 2020). These were not adopted.

3. Statewide Energy Impacts of Adopted Requirements

Table 5 shows the estimated energy savings of the adopted requirements over the first twelve months they are in effect. The first-year savings have changed since submitting the Final CASE Report. An explanation of changes by submeasure follows Table 5.

Table 5: Estimated Statewide First Year[a] Energy and Water Savings

Measure	First Year Electricity Savings (GWh/yr)	First Year Peak Electrical Demand Reduction (MW)	First Year Water Savings (million gallons/yr)	First Year Natural Gas Savings (million therms/yr)
Roof Assemblies (Total)	**2.54**	**0.39**	**0**	**0.01**
New Construction & Additions	0.39	0.15	0	(0.02)
Alterations	2.15	0.24	0	0.03
Wall U-Factor (Total)	**0.04**	**(0.02)**	**0**	**0.00**
New Construction & Additions	0.04	(0.02)	0	0.00
Alterations	N/A	N/A	N/A	N/A
Fenestration Properties (Total)	**4.74**	**1.22**	**0**	**0.23**
New Construction & Additions	(0.29)	0.01	0	0.00
Alterations	5.03	1.21	0	0.23
Duct Sealing and Testing (Total)	**0.91**	**0.25**	**0**	**0.01**
New Construction & Additions	0.37	0.11	0	0.00
Alterations	0.54	0.14	0	0.01
Airflow and Fan Watt Draw (Total)	**5.24**	**1.62**	**0**	**(0.01)**
New Construction & Additions	1.59	0.50	0	(0.00)
Alterations	3.65	1.12	0	(0.01)
Refrigerant Charge Verification (Total)	**4.13**	**1.42**	**0**	**0.00**
New Construction & Additions	0.96	0.32	0	0.00
Alterations	3.17	1.10	0	0.00

a. First year savings from all buildings completed statewide in 2023.

3.1 Submeasure A Envelope: Roof Assemblies

The first-year savings of the roof assemblies submeasure for multifamily new construction buildings has not changed since submitting the Final CASE Report.

The Final Multifamily Restructuring CASE Report did not include energy and cost-effectiveness analysis for the alteration requirements of this submeasure, because it was a no-cost improvement and a late addition to the proposal. However, the alterations

requirements of this submeasure as adopted increased the applicable climate zones. Table 5, Table 6, and Table 7 in this Results Report show the savings from the adopted requirements for multifamily buildings with four or more stories. The Residential Energy Savings and Process Improvements for Additions and Alterations Results Report shows the savings for multifamily buildings with three or less stories.

Table 6 shows the per dwelling unit first-year energy impacts of the roof assembly alterations submeasure. Table 7 shows the statewide energy impacts from the roof assembly alterations submeasure. The Statewide CASE Team's analysis assumed that 93 percent and 100 percent of the 5-story and 10-story prototypes have a low-slope roof respectively, and 4 percent of multifamily buildings undergo roof alterations each year.

Table 6: First-Year Energy Impacts Per Dwelling Unit – Low-Slope Alterations 0.63 ASR, 0.75 Thermal Emittance – 10-Story Prototype Building

Climate Zone	Electricity Savings (kWh/yr)	Peak Electricity Demand Reductions (kW)	Natural Gas Savings (therms/yr)	TDV Energy Savings (TDV kBtu/yr)
1	N/A	N/A	N/A	N/A
2	33.47	0.01	(0.85)	518
3	N/A	N/A	N/A	N/A
4	36.33	0.00	(0.57)	673
5	N/A	N/A	N/A	N/A
6	38.20	0.00	(0.27)	733
7	38.22	0.00	(0.22)	715
8	52.31	0.01	(0.28)	1,183
9	48.27	0.00	(0.37)	1,012
10	8.21	0.00	(0.09)	(2,809)
11	4.95	0.00	8.34	92
12	30.32	0.01	(0.45)	578
13	6.32	0.00	8.32	3,067
14	5.07	0.00	8.31	3,047
15	8.10	0.00	8.37	3,127
16	N/A	N/A	N/A	N/A

Table 7: Statewide Energy and Energy Cost Impacts – Roof Assemblies – Multifamily Alterations with Four or More Stories

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2023 (dwelling units)	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (MMTherms)	30-Year Present Valued Energy Cost Savings (million 2023 PV$)
1	N/A	N/A	N/A	N/A	N/A
2	1,644	0.06	0.01	(0.00)	$0.15
3	N/A	N/A	N/A	N/A	N/A
4	4,502	0.16	0.02	(0.00)	$0.52
5	N/A	N/A	N/A	N/A	N/A
6	5,104	0.19	0.02	(0.00)	$0.65
7	4,716	0.18	0.02	(0.00)	$0.58
8	7,909	0.41	0.04	(0.00)	$1.62
9	17,563	0.85	0.09	(0.01)	$3.07
10	5,113	0.04	0.00	(0.00)	($2.48)
11	1,322	0.01	0.00	0.01	$0.02
12	7,358	0.22	0.04	(0.00)	$0.74
13	2,490	0.02	0.00	0.02	$1.32
14	1,279	0.01	0.00	0.01	$0.67
15	647	0.01	0.00	0.01	$0.35
16	N/A	N/A	N/A	N/A	N/A
TOTAL	**59,647**	**2.15**	**0.24**	**0.03**	**$7.21**

3.2 Submeasure B: Envelope – Wall U-Factor

The first-year savings for the wall U-factor submeasure, shown in Table 5 above, have not changed since submitting the Final CASE Report. For savings by prototype and climate zone, see Section 6.1.1.2 of the Final CASE Report.

3.3 Submeasure D: Envelope – Fenestration Properties

The first-year savings of the fenestration properties submeasure for multifamily new construction buildings has not changed since submitting the Final CASE Report.

However, the first-year savings for altered multifamily buildings has changed since submitting the Final CASE Report, because the submeasure was adopted with modifications. The Energy Commission made the following changes, which affect savings:

- Requirements for fixed class AW windows were not adopted in Climate Zone 6, 7 and 9.
- Requirements for operable class AW windows were not adopted in Climate Zone 6 and 7.
- Requirements for all-other windows in Climate Zone 6 for multifamily buildings with three or less stories were not adopted.
- For all-other windows in Climate Zone 6 for multifamily buildings with four or more stories, the required U-factor of 0.30 was adopted instead of the proposed 0.34.

Table 8 shows the updated first-year energy impacts for all-other windows with U-factor 0.30 in Climate Zone 6. Table 9 shows the updated statewide energy and energy cost impacts.

Table 8: First-Year Energy Impacts Per Dwelling Unit – All-Others Climate Zone 6 – 10-Story Prototype Building

Climate Zone	Electricity Savings (kWh/yr)	Peak Electricity Demand Reductions (kW)	Natural Gas Savings (therms/yr)	TDV Energy Savings (TDV kBtu/yr)
6	34.54	0.00	3.27	2,486

Table 9: Statewide Energy and Energy Cost Impacts – Fenestration Properties – Alterations

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2023 (dwelling units)	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (MMTherms)	30-Year Present Valued Energy Cost Savings (million 2023 PV$)
1	225	0.02	0.00	0.00	$0.21
2	1,337	0.06	0.01	0.01	$1.21
3	6,965	1.87	0.27	0.05	$11.83
4	3,660	0.18	0.05	0.02	$2.44
5	589	0.18	0.02	0.00	$0.96
6	3,405	0.13	0.02	0.01	$1.21
7	8,788	0.18	0.06	0.00	$0.93
8	6,430	0.35	0.09	0.01	$3.25
9	12,742	0.83	0.25	0.04	$7.94
10	4,157	0.32	0.10	0.01	$2.83
11	1,075	0.09	0.04	0.01	$1.25
12	5,982	0.33	0.14	0.04	$5.41
13	2,024	0.17	0.08	0.01	$2.06

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2023 (dwelling units)	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (MMTherms)	30-Year Present Valued Energy Cost Savings (million 2023 PV$)
14	1,040	0.10	0.03	0.01	$1.21
15	526	0.09	0.03	0.00	$0.55
16	361	0.12	0.02	0.00	$0.59
TOTAL	**59,306**	**5.03**	**1.21**	**0.23**	**$43.87**

3.4 Submeasure E: Envelope - Fenestration Area

This submeasure was adopted as proposed, but there were no energy savings claimed for this submeasure.

3.5 Submeasure F: Space Conditioning – Duct Insulation

The Final CASE report estimated energy savings for the mandatory requirements proposed in this submeasure. However, the mandatory requirements were not adopted. Table 5 therefore shows no savings for this measure.

3.6 Submeasure G: Space Conditioning – Duct Leakage Testing

The adopted requirements added an exception to the duct leakage testing submeasure in Climate Zone 3, 5, and 7 for multifamily new construction buildings with four or more stories. Additionally, the adopted requirements removed the exception to the duct leakage testing submeasure in Climate Zone 1, 5, and 7 for altered multifamily buildings. The statewide savings for the adopted applicable climate zones are shown in Table 10 and

Table 11.

Table 10: Statewide Energy and Energy Cost Impacts – Duct Leakage – New Construction

Climate Zone	Statewide New Construction Impacted by Proposed Change in 2023 (dwelling units)	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (MMTherms)	30-Year Present Valued Energy Cost Savings (million 2023 PV$)
1	N/A	N/A	N/A	N/A	N/A
2	368	0.01	0.00	0.00	$0.06
3	N/A	N/A	N/A	N/A	N/A
4	930	0.03	0.01	0.00	$0.17

Climate Zone	Statewide New Construction Impacted by Proposed Change in 2023 (dwelling units)	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (MMTherms)	30-Year Present Valued Energy Cost Savings (million 2023 PV$)
5	N/A	N/A	N/A	N/A	N/A
6	789	0.03	0.01	0.00	$0.12
7	N/A	N/A	N/A	N/A	N/A
8	1,109	0.05	0.01	0.00	$0.22
9	2,604	0.11	0.03	0.00	$0.54
10	920	0.04	0.01	0.00	$0.20
11	263	0.01	0.00	0.00	$0.07
12	1,483	0.05	0.02	0.00	$0.33
13	433	0.02	0.01	0.00	$0.13
14	197	0.01	0.00	0.00	$0.05
15	128	0.01	0.00	0.00	$0.05
16	79	0.00	0.00	0.00	$0.01
TOTAL	**9,303**	**0.37**	**0.11**	**0.00**	**$1.96**

Table 11: Statewide Energy and Energy Cost Impacts – Duct Leakage – Alterations

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2023 (dwelling units)	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (MMTherms)	30-Year Present Valued Energy Cost Savings (million 2023 PV$)
1	55	0.00	0.00	0.00	$0.01
2	328	0.01	0.00	0.00	$0.08
3	1,710	0.04	0.01	0.00	$0.29
4	899	0.03	0.01	0.00	$0.22
5	145	0.00	0.00	0.00	$0.02
6	1,019	0.03	0.01	0.00	$0.18
7	941	0.03	0.01	0.00	$0.13
8	1,579	0.07	0.02	0.00	$0.39
9	3,506	0.15	0.04	0.00	$0.91
10	1,021	0.05	0.01	0.00	$0.29
11	264	0.01	0.00	0.00	$0.10
12	1,469	0.06	0.02	0.00	$0.45

Climate Zone	Statewide Alterations Impacted by Proposed Change in 2023 (dwelling units)	First-Year[a] Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (MMTherms)	30-Year Present Valued Energy Cost Savings (million 2023 PV$)
13	497	0.03	0.01	0.00	$0.19
14	255	0.01	0.00	0.00	$0.09
15	129	0.01	0.00	0.00	$0.06
16	89	0.00	0.00	0.00	$0.03
TOTAL	**13,905**	**0.54**	**0.14**	**0.01**	**$3.44**

3.7 Submeasure H: Space Conditioning – Space Cooling Airflow Rate and Fan Efficacy

The first-year savings for the space cooling airflow rate and fan efficacy submeasure, shown in Table 5 above, have not changed since submitting the CASE Report. For results by climate zone, see Section 6.2.1.3 of the Final CASE Report.

3.8 Submeasure I: Space Conditioning – Refrigerant Charge Verification

The first-year savings for the refrigerant charge verification submeasure have not changed since submitting the CASE Report.

4. Compliance and Enforcement

There were no changes to the compliance or enforcement recommendations between the time the Statewide CASE Team submitted the Final CASE Report and the CEC adopted requirements, except for the following submeasures outlined in Section 4.1 and 4.2 below. For all other submeasures, compliance and enforcement is discussed in Sections 2.5 and Appendix E of the Final CASE Report, which is provided in Attachment 2: Final CASE Report.

4.1 Submeasure C: Envelope – Quality Insulation Installation (QII)

This measure was not adopted, so there are no changes to compliance and enforcement.

4.2 Submeasure F: Space Conditioning – Duct Insulation

Changes proposed by the Statewide CASE Team specifically for duct insulation for ducts in conditioned space were not adopted, so there are no changes that will affect those that apply the code in practice.

5. Interactions with Existing Regulations

Section 2.4 of the Final CASE Report describes how the proposed code changes interact with existing regulations. Since CEC adopted most of the requirements as proposed with only minor revisions, the information in the Final CASE Report remains an accurate description of how the adopted requirements interact with existing regulations except for the following submeasures outlined in Section 5.1 and 5.2 below.

5.1 Submeasure C: Envelope – QII

This submeasure was not adopted.

5.2 Submeasure F: Space Conditioning – Duct Insulation

Changes proposed by the Statewide CASE Team specifically for duct insulation for ducts in conditioned space were not adopted.

6. Evolution of Code Requirements

The Statewide CASE Team submitted the Final CASE Report to the Energy Commission during November 2020. The Final CASE Report addresses input that was received during utility-sponsored stakeholder meetings held on August 22, 2019, March 25, 2020, and May 7, 2020 and during the Energy Commission's pre-rulemaking workshop that was held on December 2, 2020. This section describes how the code change proposal evolved between the time Final CASE Report was submitted to the Energy Commission and the time the standards were adopted.

6.1 Common Use Area Definitions and Application

The Statewide CASE Team's Multifamily Restructuring proposal included new subsections in Title 24, Part 6, which applied the 2019 residential requirements to multifamily dwelling units and 2019 nonresidential requirements to multifamily common use areas. The Statewide CASE Team did not propose changes to the Title 24, Part 6 definition of dwelling unit and proposed adding the definition for common use area from Title 24, Part 2 to Part 6.

The February Express Terms and May 45-Day Express Terms introduced new terms and definitions for *common living area* and *common services area*, each a subcategory within common use area. The new terms, as applied in the 45-Day Express Terms, allowed indoor air quality (IAQ), space conditioning, and lighting requirements to differ between common living areas and common services areas, rather than apply to all common use areas.

The Statewide CASE Team docketed a comment, included in Attachment 1, that suggested that introducing *common living area* and *common services area* terms will cause confusion and question the established and well-understood definitions of dwelling unit and common use area. The Statewide CASE Team also spoke with Energy Commission staff about our concerns and possible solutions. Consequently, these definitions and terms were stricken in the 15-Day Language and are not included in the adopted 2022 language.

6.2 Submeasure A Envelope: Roof Assemblies

The Statewide CASE Team's proposal included a more stringent cool roof requirement in climate zones that had a cool roof requirement for multifamily buildings four or more habitable stories in the 2019 standards (10, 11, and 13-15). The Statewide CASE Team proposed a separate residential additions and alterations submeasure for cool roofs in residential buildings up to three habitable stories with low-sloped roofs. The residential proposal included climate zones beyond those included in the multifamily restructuring proposal (2, 4, 6-9, and 12). Due to restructuring of the multifamily requirements, the adopted standard includes the combined climate zones from these proposals (2, 4, and 6-15) for all multifamily buildings.

6.3 Submeasure B: Envelope – Wall U-Factor

In February Express Terms, the Energy Commission corrected an error in Table 170.2-A, as submitted in the CASE Report, switching the headings for low- and high- fire-rated framed walls, so that the more stringent requirements apply to walls with lower fire rating requirements.

The Statewide CASE Team marked-up the 15-Day Language in a docketed comment to the Energy Commission, which provided an update to the definitions of heavy and light mass walls in Table 170.2-A. This change was not adopted.

6.4 Submeasure D: Envelope – Fenestration Properties

In the February Express Terms language, to capture exceptions for RSHGC and VT exceptions for multifamily buildings up to three habitable stories, the Energy Commission added separate rows to Table 170.2-A for RSHGC and VT for buildings up

to three habitable stories and for buildings four or more habitable stories. After the February Express Terms were released, the Statewide CASE Team worked with the Energy Commission to simplify the table and negotiated removal of rows that had “NR” listed across all 16 climate zones. These rows were excluded in the adopted code language.

6.5 Submeasure G: Space Conditioning – Refrigerant Charge Verification

The Statewide CASE Team marked-up the 15-Day language in a docketed comment to the Energy Commission, which provided language clarification and corrected mis-references in Sections 170.2(c)3Bi and 180.2(b)2Aivb related to this submeasure (Statewide CASE Team 2020). These were not adopted.

7. Adopted Code Language

The adopted code language for the standards and Reference Appendices are presented in the following sections. Additions to the 2019 Title 24, Part 6 code language are underlined and deletions are ~~struck~~. The multifamily chapters appear below as all new language.

7.1 California Energy Commission

The multifamily requirements, which originated in other subchapters as illustrated by Table 1 in Section 2.1, are included three new subchapters of Title 24, Part 6. These chapters are included below and underlined to show that the language is new. Requirements influenced by the submeasures described in this report are highlighted in yellow.

7.1.1 Section 100.0 – Scope

(a) **Buildings Covered.** The provisions of Part 6 apply to all buildings:

1. That are of Occupancy Group A210/240, B, E, F, H, I, M, R, S, or U; and

2. For which an application for a building permit or renewal of an existing permit is filed (or is required by law to be filed) on or after the effective date of the provisions, or which are constructed by a governmental agency; and

3. That are:

   A. Unconditioned; or

   B. Indirectly or directly conditioned, or process spaces.

EXCEPTION 1 to Section 100.0(a): Qualified historic buildings, as regulated by the California Historic Building Code (Title 24, Part 8). Lighting in qualified historic buildings shall comply with the applicable requirements in Section 140.6(a)3Q.

EXCEPTION 2 to Section 100.0(a): Building departments, at their discretion, may exempt temporary buildings, temporary outdoor lighting or temporary lighting in an unconditioned building, or structures erected in response to a natural disaster. Temporary buildings or structures shall be completely removed upon the expiration of the time limit stated in the permit.

EXCEPTION 3 to Section 100.0(a): Buildings in Occupancy Group I-3 and I-4.

(b) **Parts of Buildings Regulated.** The provisions of Part 6 apply to the building envelope, space-conditioning systems, water-heating systems, pool and spas, solar ready buildings, indoor lighting systems of buildings, outdoor lighting systems, electrical power distribution systems, and signs located either indoors or outdoors, in buildings that are:

1. Covered by Section 100.0(a); and
2. Set forth in TABLE 100.0-A.

(c) **Habitable Stories.**

1. All conditioned space in a story shall comply with Part 6 whether or not the story is a habitable space.

2. All unconditioned space in a story shall comply with the lighting requirements of Part 6 whether or not the story is a habitable space.

(d) **Outdoor Lighting and Indoor and Outdoor Signs.** The provisions of Part 6 apply to outdoor lighting systems and to signs located either indoors or outdoors as set forth in TABLE 100.0-A.

(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 110.12 apply 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 110.12 apply 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. ~~**Low-rise residential**~~**Single-family buildings.**

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

ii. Compliance approaches. In order to comply with Part 6 newly constructed single-family~~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: Sections 150.1(a) and (b); or

(ii) Prescriptive approach: Sections 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. **Multifamily Buildings.**

i. Sections applicable. 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

b. Either:

(i) Performance approach: Section 170.1; or

(ii) Prescriptive approach: Section 170.2(a) through (f).

F~~E~~. **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. **~~Low-rise residential~~Single-family buildings.** Section 150.2 applies to new construction in existing ~~low- rise residential~~single-family 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 specifies~~y~~ 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.

C. **Multifamily buildings.** Section 180.0 applies to new construction in existing multifamily buildings. New construction in existing buildings includes additions, alterations and repairs. Section 180.0 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 180.0 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 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), or 160.5 and 170.2(e) are met for each occupancy and space, and mandatory measures in Sections 110.0 through 130.5, and 150.0, and 160.0 through 160.9 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 1601-1609.

TABLE 100.0-A APPLICATION OF STANDARDS (This TABLE will be updated for the 15-Day language)

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

Occupancies	Application	Mandatory	Prescriptive	Performance	Additions/Alterations
	parking garages)				
Nonresidential, ~~High-Rise Residential, And~~ Hotels/Motels	Outdoor Lighting	110.9, 130.0, 130.2, 130.4	140.7	N.A.	141.0
Nonresidential, ~~High-Rise Residential, And~~ Hotels/Motels	Electrical Power Distribution	110.11, 130.5	N.A.	N.A.	141.0
Nonresidential, ~~High-Rise Residential, And~~ Hotels/Motels	Pool and Spa Systems	110.4, 110.5, 150.0(p)	N. A.	N.A.	141.0
Nonresidential, ~~High-Rise Residential, And~~ Hotels/Motels	Solar Ready Buildings	110.10	N.A.	N.A.	141.0(a)
Nonresidential, ~~High-Rise Residential, And~~ Hotels/Motels	Solar PV and Battery Storage Systems	N.A.	141.10	140.0, 140.1	N.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
~~Low-Rise Residential~~ Single-Family	General	150.0	150.1(a, c)	150.1(a), 150.1(b)	150.2(a), 150.2(b)
~~Low-Rise Residential~~Single-Family	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)	150.1(a, c)	150.1(a), 150.1(b)	150.2(a), 150.2(b)

7.1.2 Section 100.1 – Definitions and Rules of Construction

Multifamily Building is any of the following:

A building of Occupancy Group R-2, other than a hotel/motel building or timeshare property,

A building of Occupancy Group R-3 that is a nontransient congregate residence, other than boarding houses of more than 6 guests and alcohol or drug abuse recovery homes of more than 6 guests, or

A building of Occupancy Group R-4.

SINGLE- FAMILY ~~RESIDENCE~~ BUILDING is any of the following:

A residential building of Occupancy Group R-3 with two or less dwelling units,

A building ~~that is~~ of Occupancy Group R-3, other than a multifamily building or hotel/motel building, A townhouse,

A building of Occupancy Group R-3.1, or

A building of Occupancy Group U when located on a residential site.

7.1.3 Subchapter 10: Multifamily Buildings- Mandatory Requirements

SECTION 160.0 – GENERAL

Multifamily buildings shall comply with the applicable requirements of Sections 160.1 through 160.98. Sections 160.1 through 160.8 apply to dwelling units and common use areas in multifamily buildings. Nonresidential occupancies in a mixed occupancy building shall comply with nonresidential requirements in Sections 120.0 through 141.1.

NOTE: The requirements of Sections 160.1 through 160.8 9 apply to newly constructed buildings. Sections 180.1 through 180.4 specify which requirements of Sections 160.1 through 160.8 9 apply to additions or alterations.

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 160.1 – MANDATORY REQUIREMENTS FOR BUILDING ENVELOPES

(a) **Ceiling and Roof Insulation.** The opaque portions of ceilings and roofs separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Item1 or 2, and 3 below:

1. Attic Roof. Roofs with an attic space shall meet the requirements of A through C below:

A. Shall be insulated to achieve an area-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;

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. Roofs without attic spaces shall meet the applicable requirements of A through C below:

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

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

C. Insulation Placement- When insulation is installed at the roof, 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.

Exception to Section 160.1(a)2C: 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 160.1(a)2C.

3. Insulation shall be installed in direct contact with a 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 a drywall ceiling.

(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 area-weighted average U-factor of the wall assembly shall not exceed 0.113.

2. Metal Framed- The area-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 an area-weighted average U-factor of the wall assembly not exceeding 0.102.

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

C. Other wall assemblies shall have an area-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 area-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 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 area- 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 area-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 160.1(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 Table170.2-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 160.1(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.

EXCEPTION 1 to Section 160.1(e)1: Up to 0.5 percent of the Conditioned Floor Area is exempt from the maximum U- factor requirement.

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

2. The area-weighted average U-factor of all fenestration, including skylight products, shall not exceed 0.58.

(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 160.1(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 160.1(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.

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 160.2 – MANDATORY REQUIREMENTS FOR VENTILATION AND INDOOR AIR QUALITY

(a) **General Requirements.**

1. Attached dwellings units in multifamily buildings shall comply with the applicable requirements of subsection 160.2(b) below. Occupiable spaces in multifamily buildings other than attached dwelling units shall comply with the applicable requirements of section 160.2(c). When HERS field verification and diagnostic testing of attached dwelling units is required by Section 160.2, buildings with three habitable stories or less shall use the applicable procedures in the Residential Appendices, and buildings with four or more habitable stories shall use the applicable procedures in Nonresidential Appendices NA1 and NA2.

NOTE: Section 160.2 is not applicable to townhouses or dwellings that contain two dwelling units.

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

(b) Attached **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 160.2(b)1B, 160.2(b)1C, and 160.2(b)1D.

System types specified in subsection i shall also comply with Section 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 and makeup air 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. **System Design and Installation.**

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

EXCEPTION to 160.2(b)1Bi: For heat recovery ventilators and energy recovery ventilators the location of the filters required by Section 160.2(b)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 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 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 160.2(b)1Dii.

Aface = Qfilter / Vface (Equation 160.2-A)

Where:

Aface = air filter face area, the product of air filter nominal length x nominal width, ft2 Qfilter = design airflow rate for the air filter, ft3/min

Vface = 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.

v. Filter racks or grilles shall use gaskets, sealing or other to close gaps around inserted filters and to prevent air from bypassing the filter.

C. **Air Filter Efficiency.** The system shall be provided with air filters 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 filters 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 rates for the system air filters.

i. The maximum allowable clean-filter pressure drop shall be determined by the system design for the nominal two-inch minimum depth air filter required by Section 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 160.2(b)1Biib, or

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

iv. If EXCEPTION 1 to Section 160.3(b)5Lii or iv 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 160.3-A or 160.3-B.

E. **Air Filter Product Labeling.** Systems described in 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 160.2(b)1C and 160.2(b)1D.

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

2. **Ventilation and Indoor Air Quality for Attached Dwelling Units.** All attached 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 160.2(b)2A below. All dwelling units shall comply with Section 160.2(b)2B below.

Exception to Section 160.2(b)2 The following sections of ASHRAE 62.2 shall not be required for compliance: Section 4.1.1, Section 4.1.2; Section 4.1.4; Section 4.3; Section 4.6, Section 5, Section 6.1.1, Section 6.5.2, and Normative Appendix A.

A. Amendments to ASHRAE 62.2 Requirements.

i. **Window Operation.** Window operation is not a permissible method of providing the dwelling unit ventilation airflow specified in subsections iv or v below.

ii. **Central Fan Integrated (CFI) Ventilation Systems.**

a. **Continuous Operation Prohibition.** Continuous operation of a dwelling unit's central forced air system air handlers used in CFI ventilation systems is not a permissible method of providing the whole-dwelling unit ventilation airflow required by Section 160.2(b)2Aiv.

EXCEPTION to Section 160.2(b)2Aii: The Energy Commission may approve continuous operation of central fan integrated ventilation systems pursuant to Section 10-109(h).

b. Outdoor Air Damper(s). A motorized damper(s) shall be installed on the connected ventilation duct(s) of CFI systems that prevents all airflow into or out of the space conditioning duct system when the damper(s) is closed.

c. Damper Control. The required motorized damper(s) shall be controlled to be in an opened position when outdoor air ventilation is required for compliance, and shall be in the closed position when ventilation air is not required. The damper(s) shall be closed whenever the space conditioning system air handling unit is not operating. If the outdoor airflow for the CFI ventilation system is fan-powered, then the outdoor air fan shall not operate when the required motorized damper(s) on the outdoor air ventilation duct(s) is closed.

d. Variable Ventilation. CFI ventilation systems shall incorporate controls that track outdoor air ventilation run time, and either open or close the required motorized damper(s) depending on whether or not outdoor air ventilation is required for compliance with sections 160.2(b)2Aiv. During periods when comfort conditioning is not called for by the space conditioning thermostat, the CFI ventilation system controls shall operate the space conditioning system central fan and outdoor air damper(s) when necessary to ensure compliance with the minimum outdoor air ventilation required by sections 160.2(b)2Aiv in accordance with applicable variable mechanical ventilation methods specified in ASHRAE 62.2 section 4.5.

iii. **Air Filtration.** Air filtration shall conform to the specifications in 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.

iv. **Whole-Dwelling Unit Mechanical Ventilation.** Multifamily attached dwelling units shall comply with subsections a and b below.

a. Mechanical ventilation airflow shall be provided at rates greater than or equal to the value determined in accordance with Equation 160.2-B.

Total Required Ventilation Rate [ASHRAE 62.2:4.1.1].

Qtot = 0.03Afloor + 7.5(Nbr + 1) (Equation 160.2-B)

WHERE:

Qtot = total required ventilation rate, cfm Afloor = dwelling-unit floor area, ft2

Nbr = number of bedrooms (not to be less than 1)

b. All dwelling units in a multifamily building shall use the same whole-dwelling unit ventilation system type. The system type installed throughout the building shall be only one of the following three types: supply, exhaust, or balanced. The dwelling unit shall comply with one of the following subsections 1 or 2 below.

1. **Balanced Ventilation.** A balanced ventilation system shall provide the required whole-dwelling- unit ventilation airflow. Systems with heat recovery or energy recovery that serve a single dwelling unit shall have a fan efficacy of ≤1.0 W/cfm; or

2. **Supply or Exhaust Ventilation with Compartmentalization Testing.** Continuously operating supply ventilation systems, or

continuously operating exhaust ventilation systems shall be allowed to be used to provide the required whole-dwelling unit ventilation airflow only 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 ft2 of dwelling unit envelope surface area as confirmed by HERS field verification and diagnostic testing in accordance with the procedures specified in Reference Appendix RA3.8 or NA2.3 as applicable.

v. **Multifamily Building** Central **Ventilation System Airflow Rate Tolerance.** Multifamily building central ventilation systems that serve multiple dwelling units shall have airflow rates in each dwelling unit served that meet or exceed a design ventilation airflow rate specification.

a. Designers shall specify a design ventilation airflow rate for each dwelling unit that is equal to or greater than the rate specified by Equation 160.2-B.

b. The design ventilation airflow rate for each dwelling unit shall be stated on the building design plans approved by the enforcement agency.

c. Airflow in each dwelling unit shall be no more than twenty percent greater than the specified design ventilation airflow rate. Ventilation systems shall utilize mechanical or software airflow control means to ensure each of the dwelling-unit airflows can be maintained at the design ventilation airflow within this tolerance at all times. System airflow control-means may include but are not limited to: constant air regulation devices, orifice plates, and variable speed central fans.

vi. **Local Mechanical Exhaust.** A local mechanical exhaust system shall be installed in each kitchen and bathroom. Systems shall be rated for airflow in accordance with ASHRAE 62.2 section 7.1.

a. Nonenclosed kitchens shall have a demand-controlled mechanical exhaust system meeting the requirements of Section 160.2(b)2Avic.

b Enclosed kitchens and all bathrooms shall have either one of the following alternatives 1 or 2:

1. A demand-controlled mechanical exhaust system meeting the requirements of Section 160.2(b)2Avic; or

2. A continuous mechanical exhaust system meeting the requirements of Section 160.2(b)2Avid.

c Demand-Controlled Mechanical Exhaust. A local mechanical exhaust system shall be designed to be operated as needed.

1. **Control and Operation.** Demand-controlled mechanical exhaust systems shall be provided with at least one of the following controls:

A. A readily accessible occupant-controlled ON-OFF control.

B. An automatic control that does not impede occupant ON control.

2. **Ventilation Rate and Capture Efficiency**. The system shall meet or exceed either the minimum airflow in accordance with Table 160.2-E or the minimum capture efficiency in accordance with Table 160.2-E, and Table 160.2-G. Capture efficiency ratings shall be **determined** in accordance with ASTM E3087, and listed in a product directory approved by the Energy Commission.

d. **Continuous Mechanical Exhaust.** A mechanical exhaust system shall be installed to operate continuously. The system may be part of a balanced mechanical ventilation system.

1. **Control and Operation.** A manual ON-OFF control shall be provided for each continuous mechanical exhaust system. The system shall be designed to operate during all **occupiable** hours. For multifamily dwelling units, the manual ON-OFF control may be accessible to the dwelling unit occupant, however the manual ON-OFF control shall not be required to be accessible to the dwelling unit occupant.

2. **Ventilation Rate.** The **minimum** delivered ventilation shall be at least the amount indicated in Table 160.2-F during each hour of operation.

e. **Airflow Measurement of Local Mechanical Exhaust by the System Installer.** The airflow required by section 160.2(b)2Avi is the quantity of indoor air exhausted by the ventilation system as installed in the dwelling unit. When a vented range hood utilizes a capture efficiency rating to demonstrate compliance with 160.2(b)2Avic2, the airflow listed in the approved directory corresponding to the compliant capture efficiency rating point shall be met by the installed system. The as-installed airflow shall be verified by the system installer to ensure compliance by use of either subsection 1 or 2 below:

1. The system installer shall measure the airflow by using a flow hood, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals/grilles or outlet terminals/grilles in accordance with the procedures in Reference Appendix RA3.7 or NA2.2 as applicable.

2. As an alternative to performing an airflow measurement of the system as installed in the dwelling unit, compliance may be demonstrated by installing an exhaust fan and duct system that conforms to the specifications of Table 160.2-H. Visual inspection shall verify the installed system conforms to the requirements of Table 160.2-H.

When using Table 160.2-H for demonstrating compliance, the airflow rating shall be greater than or equal to the value required by Section 160.2(b)2Avi at a static pressure greater than or equal to 0.25 in. of water (62.5 Pa). When a vented range hood utilizes a capture efficiency rating to demonstrate compliance with 160.2(b)2Avic2, a static pressure greater than or equal to 0.25 in. of water at the rating point shall not be required, and the airflow listed in the approved directory corresponding to the compliant capture efficiency rating point shall be applied to Table 160.2-H for determining compliance.

Use of Table 160.2-H is limited to ventilation systems that conform to all of the following three specifications:

A. total duct length is less than or equal to 25 ft (8 m),

B. duct system has no more than three (3) elbows, and

C. duct system has exterior termination fitting with a hydraulic diameter greater than or equal to the minimum duct diameter and not less than the hydraulic diameter of the fan outlet.

f. **Sound Ratings for Local Mechanical Exhaust.** Local mechanical exhaust systems shall be rated for sound in accordance with Section 7.2 of ASHRAE 62.2 at no less than the minimum airflow rate required by Section 160.2(b)2Avi.

EXCEPTION to Section 160.2(b)2Avif: Kitchen range hoods may be rated for sound at a static pressure determined at working speed as specified in HVI 916 Section 7.2.

vii. **Airflow Measurement of Whole-Dwelling Unit Ventilation.** The airflow required by Sections 160.2(b)2Aiv or 160.2(b)2Av is the quantity of outdoor

ventilation air supplied or indoor air exhausted by the mechanical ventilation system as installed and shall be measured by using a flow hood, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals/grilles or outlet terminals/grilles in accordance with the procedures in Reference Appendix Section RA3.7.4.1.1 or NA2.2.4.1.1 as applicable for supply and exhaust systems or RA3.7.4.1.2 or NA2.2.4.1.2 as applicable for balanced systems. Balanced mechanical ventilation system airflow shall be the average of the supply fan and exhaust fan flows.

viii. **Sound Ratings for Whole-Dwelling Unit Ventilation Systems.** Whole-Dwelling unit ventilation systems shall be rated for sound in accordance with Section 7.2 of ASHRAE 62.2 at no less than the minimum airflow rate required by 160.2(b)2Aiv or 160.2(b)2Av as applicable.

ix. **Label for Whole-Dwelling Unit Ventilation System On-Off Control.** Compliance with ASHRAE 62.2 Section 4.4 (Control and Operation) shall require manual ON-OFF control switches associated with whole- 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 switch in the "on" position at all times unless the outdoor air quality is very poor."

x. **Combustion Air and** Compensating **Outdoor Air or Makeup Air**

a. All dwelling units shall conform to the applicable requirements specified in California Mechanical Code Chapter 7, Combustion Air.

b. All dwelling units shall conform to the requirements in ASHRAE 62.2 Section 6.4, Combustion and Solid-Fuel-Burning Appliances.

B. **Dwelling Unit HERS Field Verification and Diagnostic Testing.**

i. **Whole-Dwelling Unit Ventilation Airflow Performance.** The whole-dwelling unit ventilation airflow required by Section 160.2(b)2Aiv or 160.2(b)2Av shall be confirmed through HERS field verification and diagnostic testing in accordance with Reference Appendix RA3.7.4.1.1 or NA2.2.4.1.1 as applicable for supply and exhaust systems or RA3.7.4.1.2 or NA2.2.4.1.2 as applicable for balanced systems. Balanced mechanical ventilation system airflow shall be the average of the supply fan and exhaust fan flows. Ventilation airflow of systems with multiple operating modes shall be tested in all modes designed to comply with the required ventilation airflows.

ii. **Kitchen Local Mechanical Exhaust - Vented Range Hoods.** Vented range hoods installed to comply with local mechanical exhaust requirements specified in section 160.2(b)2Avi shall be HERS field verified in accordance with

Reference Appendix RA3.7.4.3 or NA2.2.4.1.4 as applicable to confirm the model is rated by HVI or AHAM to comply with the following requirements:

a. The minimum ventilation airflow rate as specified by Section 160.2(b)2Avi, or alternatively the minimum capture efficiency as specified by Section 160.2(b)2Avi; and

b. The maximum sound rating as specified in Section 160.2(b)2Avif.

iii. **Heat Recovery Ventilation (HRV) and Energy Recovery Ventilation (ERV) System Fan Efficacy**. At a minimum, systems with heat or energy recovery serving a single dwelling unit shall have a fan efficacy of ≤1.0 W/cfm as confirmed by HERS field verification in accordance with Reference Appendix RA3.7.4.4 or NA2.2.4.1.5 as applicable. If Section 170.2(c)3Bva requirements are applicable to the dwelling unit, then HERS field verification shall instead confirm compliance with the maximum fan efficacy and minimum sensible recovery efficiency specified in Section 170.2(c)3Bva in accordance with the procedures specified in Reference Appendix RA3.7.4.4 or NA2.2.4.1.5 as applicable.

C. **Multifamily Building Central Ventilation System Field Verification**

i. Central Ventilation System Duct Sealing. Ventilation ducts that conform to subsections a and b below shall meet the duct sealing requirements in the California Mechanical Code Section 603.10 and have leakage that is no greater than six percent of the rooftop fan or central fan design airflow rate as confirmed by field verification in accordance with the procedures in Reference Appendix NA7.18.3. The leakage test shall be conducted using a test pressure of 25 Pa (0.1 inches) for ducts serving six or fewer dwelling units and 50 Pa (0.2 inches) for ducts serving more than six dwelling units, and shall measure the leakage of all ductwork between the central fan and the connection point to the in-unit grille or fan.

a. The ventilation ducts serve multiple dwelling units.

b. The ventilation ducts provide continuous airflows or airflows to provide balanced ventilation to meet the requirements specified in Sections 160.2(b)2Aiv or 160.2(b)2Av as applicable.

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

1. **Air Filtration**

A. Mechanical system types specified in subsections i, ii, and iii below shall be designed to ensure that all recirculated air and all outdoor air supplied to the occupiable space is filtered before passing through any system's thermal conditioning components. Air Filters shall conform to the requirements of Sections 160.2(c)1B, 160.2(c)1C and 160.2(c)1D.

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 and makeup air 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 to Section 160.2(c)1A: For heat recovery ventilators and energy recovery ventilators the location of the filters required by Section 160.2(c)1A may be downstream of a system's thermal conditioning component, provided the system is equipped with ancillary filtration upstream of the system's thermal conditioning component.

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 160.2-A, based on a maximum face velocity of 150 ft per minute.

D. Filter racks or grilles shall be gasketed or sealed to eliminate any gaps around the filter to prevent air from bypassing the filter.

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

EXCEPTION 1 to 160.2(c)2: The mechanical ventilation system shall not be required where natural ventilation openings complying with 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 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 160.2(c)2Ai through 160.2 (c)2Aiii shall be the minimum ceiling height in the space.

EXCEPTION to Section 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 (Vz) to the zone no less than the larger of A or B as described below:

A. The outdoor airflow rate to the zone (Vz) shall be determined in accordance with Equation 160.2-G; or Vz = Ra x Az (Equation 160.2-G)

Where:

Ra = Outdoor airflow rate required per unit area as determined from Table 160.2-B. Az = 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, the outdoor airflow rate to the zone (Vz) shall be determined in accordance with Equation 160.2-H;

Vz = Rp x Pz (Equation 160.2-H)

Where:

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

Pz = 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 160.2(c)3: Transfer air. The rate of outdoor air required by Section 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 160.2(c)8; and

ii. The outdoor air that is supplied to all spaces combined, is sufficient to meet the requirements of Section 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 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 160.2(c) shall be supplied to each space at all times when the space is usually occupied.

EXCEPTION 1 to Section 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 160.2(c)5D or by an occupant sensor ventilation control device complying with Section 160.2(c)5E.

EXCEPTION 2 to Section 160.2(c)5A: Temporary reduction. The rate of outdoor air provided to a space may be reduced below the level required by Section 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 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 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 160.2(c)5C: Where space exhaust is greater than the design ventilation rate specified in Section 160.2(c)3 minus 0.2 cfm per ft² of conditioned area.

EXCEPTION 2 to Section 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 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 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 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 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 160.2(c)3 regardless of CO2 concentration.

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

a. CO2 concentration shall be assumed to be 400 ppm without any direct measurement; or

b. CO2 concentration shall be dynamically measured using a CO2 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 160.2-B for DCV, times the conditioned floor area for spaces with CO2 sensors, plus the rate required by Section 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 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 digital direct controls (DDC) to the zone level.

E. **Occupant Sensor Ventilation Control Devices.** Occupant sensing ventilation controls are required for space conditioning zones that are both permitted to have their ventilation air reduced to zero while in occupied standby mode per Table 160.2-B and required to install occupant sensors to comply with Section 160.5(b)4Cv, vi and vii. Occupant sensor ventilation control devices shall be used to reduce the rate of outdoor air flow when occupants are not present shall comply 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.

ii. When occupant sensors controlling lighting are also used for ventilation, the ventilation signal shall be independent of daylighting, manual lighting overrides or manual control of lighting.

iii. 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 shall not be considered vacant until all rooms in the zone are vacant.

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

v. When the zone is scheduled to be occupied and occupant sensing controls in all rooms and areas served by the zone indicate the spaces are unoccupied, the zone shall be placed in occupied standby mode.

vi. In 5 minutes or less after entering occupied-standby mode, mechanical ventilation to the zone shall be shut off until the space becomes occupied or until ventilation is needed to provide space heating or conditioning. When mechanical ventilation is shut off to the zone, the ventilation system serving the zone shall reduce the system outside air rate by the amount of outside air required for the zone.

vii. Where the system providing space conditioning also provides ventilation to the zone, in 5 minutes or less after entering occupied-standby mode, space conditioning zone setpoints shall be reset in accordance with Section 120.2(e)3.

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 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 minimum levels specified in Section 160.2(c)3 or 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 160.2-B or Table 160.2-D, in accordance with the following:

A. Class 1 Air is air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor. Recirculation or transfer of Class 1 air to any space shall be permitted; [ASHRAE 62.1:5.16.3.1]

B. Class 2 Air is air with moderate contaminant concentration, mild sensory-irritation intensity, or mildly offensive odors (Class 2 air also includes air that is not necessarily harmful or objectionable but that is inappropriate for transfer or recirculation to spaces used for different purposes). Recirculation or transfer of Class 2 air shall be permitted in accordance with 160.2(c)8Bi through 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 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 is air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor. Recirculation or transfer of Class 3 air shall be permitted in accordance with 160.2(c)8Ci and 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 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 is air with highly objectionable fumes or gases or with potentially dangerous particles, bioaerosols, or gases at concentrations high enough to be considered as harmful. 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 Class 2 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 160.2-B, 160.2-C or 160.2-D. Air leaving spaces or locations that are not listed in Tables 160.2-B, 160.2-C or 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 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
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 160.2-B – Minimum Ventilation Rates for Multifamily Common Use Areas

Occupancy Category3	**Area Outdoor Air Rate1 Ra cfm/ft2**	**Min Air Rate for DC cfm/ft2V2**	**Air Class**	**Notes**
Daycare (through age 4)	0.21	0.15	2	
Multiuse assembly	0.50	0.15	1	F
Dining rooms	0.50	0.15	2	
Bars, cocktail lounges	0.50	0.20	2	
Kitchen (cooking)	0.15		2	
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
Laundry rooms, central	0.15		2	
Lobbies/pre-function	0.50	0.15	1	F
Breakrooms	0.50	0.15		
Occupiable storage rooms for dry materials	0.15			
Office space	0.15		1	
Reception areas	0.15		1	F
Telephone/data entry	0.15		1	F

Computer (not printing)	0.15			
Freezer and refrigerated spaces (<50oF)	-		1	F
Shipping/receiving	0.15			
All others	0.15			
Gym, sports arena (play area)	0.50	0.15	2	E
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	
Game arcades	0.68	0.15	1	

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/ft2 then it shall be used to comply with Section160.2(c)5E.

3 For spaces not included in this table, the spaces in Table 120.1-A shall apply.

Specific Notes:

A – RESERVED

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 – RESREVED.

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 160.2-C – Minimum Exhaust Rates [ASHRAE 62.1: TABLE 6.5]

Occupancy Category3	**Exhaust Rete, cfm/unit**	**Exhaust Rate,**	**Air Class**	**Notes**

		cfm/ft2		
Copy, printing rooms	-	0.50	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
Parking garages	-	0.75	2	C
Pet shops (animal areas)	-	0.90	2	
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

General:

[3]For spaces not included in this table, the spaces in Table 120.1-B shall apply. Notes:

A –Reserved

B –Reserved

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 160.2-D – Airstreams or Sources [ASHRAE 62.1:Table 5.16.1]

Description	Air Class
Commercial kitchen grease hoods	4
Commercial kitchen hoods other than grease	3

Hydraulic elevator machine room	2

Table 160.2-E: Demand-Controlled Local Ventilation Exhaust Airflow Rates and Capture Efficiency

Application	Compliance Criteria
Enclosed Kitchen or Nonenclosed Kitchen	Vented range hood, including appliance-range hood combinations shall meet either the capture efficiency (CE) or the airflow rate specified in Table 160.2-G as applicable.
Enclosed Kitchen	Other kitchen exhaust fans, including downdraft: 300 cfm (150 L/s) or a capacity of 5 ACH
Nonenclosed Kitchen	Other kitchen exhaust fans, including downdraft: 300 cfm (150 L/s)
Bathroom	50 cfm (25 L/s)

Table 160.2-F: Continuous Local Ventilation Exhaust Airflow Rates

Application	Airflow
Enclosed kitchen	5 ach, based on kitchen volume
Bathroom	20 cfm (10 L/s)

Table 160.2-G: Kitchen Range Hood Airflow Rates (cfm) and ASTM E3087 Capture Efficiency (CE) Ratings According to Dwelling Unit Floor Area and Kitchen Range Fuel Type

Dwelling **Unit Floor Area (ft^2)**	Hood Over Electric Range	Hood Over Natural Gas Range
>1500	50% CE or 110 cfm	70% CE or 180 cfm
>1000 - 1500	50% CE or 110 cfm	80% CE or 250 cfm
750 - 1000	55% CE or 130 cfm	85% CE or 280 cfm
<750	65% CE or 160 cfm	85% CE or 280 cfm

Table 160.2-H: Prescriptive Ventilation System Duct Sizing [ASHRAE 62.2:Table 5-3]

Fan Airflow Rating, cfm at minimum static pressure[f] 0.25 in. water (L/s at minimum 62.5 Pa)	≤ 50 (25)	≤ 80 (40)	≤100 (50)	≤125 (60)	≤150 (70)	≤175 (85)	≤200 (95)	≤250 (120)	≤350 (165)	≤400 (190)	≤450 (210)	≤700 (330)	≤800 (380)
Minimum Duct Diameter, in. (mm) [a,b] For Rigid duct	4 e (100)	5 (125)	5 (125)	6 (150)	6 (150)	7 (180)	7 (180)	8 (205)	9 (230)	10 (255)	10 (255)	12 (305)	12 d (305)
Minimum Duct Diameter, in. (mm) [a,b] For Flex duct [c]	4 (100)	5 (125)	6 (150)	6 (150)	7 (150)	7 (180)	8 (205)	8 (205)	9 (230)	10 (255)	NP	NP	NP

Footnotes for Table 150.0-H:

a. For noncircular ducts, calculate the diameter as four times the cross-sectional area divided by the perimeter. b. NP = application of the prescriptive table is not permitted for this scenario.

c. Use of this table for verification of flex duct systems requires flex duct to be fully extended and any flex duct elbows to have a minimum bend radius to duct diameter ratio of 1.0.

d. For this scenario, use of elbows is not permitted.

e. For this scenario, 4 in. (100 mm) oval duct shall be permitted, provided the minor axis of the oval is greater than or equal to 3 in. (75 mm)

f. When a vented range hood utilizes a capture efficiency rating to demonstrate compliance with 160.2(b)2Avic2, a static pressure greater than or equal to 0.25 in. of water at the rating point shall not be required, and the airflow listed in the approved directory corresponding to the compliant capture efficiency rating point shall be applied to Table 160.2-H for determining compliance.

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 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 and common living area 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 Services Use Area Controls. Heating or cooling systems serving common services use areas of multifamily buildings shall comply with application requirements of Sections 160.3(a)2A through 160.3(a)2J.

EXCEPTION to Section 160.3(a)2: Heating or cooling systems exclusively serving dwelling units and common use areas providing shared provisions for living, eating, cooking, or sanitation to dwelling units that would otherwise lack these provisions may instead comply with Section 160.3(a)1.

A. **Thermostatic Controls for Each Zone.** The supply of heating and cooling energy to each space-conditioning zone shall be controlled by an individual thermostatic control that responds to temperature within the zone and that meets the applicable requirements of Section 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 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 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 i and 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 to Section 160.3(a)2Biii: Systems with thermostats that require manual changeover between heating and cooling modes.

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 Section 160.3(a)2Biv: Package terminal air conditioners, package terminal heat pumps, room air conditioners, and room air-conditioner heat pumps.

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.

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

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

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

iii. **Occupant Sensing Zone Controls.** Where the system providing space conditioning also provides the ventilation required by Section 160.2(c)3 and includes occupant sensor ventilation control as specified in Section 160.2(c)5E, the occupant sensing zone controls shall additionally comply with the following:

a. Occupancy sensing zone controls shall comply with the Occupant Sensor Ventilation Control Device requirements of Section 160.3(c)5E and allow preoccupancy ventilation requirements of Section 160.3(c)5B; and

b. In 5 minutes or less after entering occupied-standby mode as described in Section 160.2(c)5:

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. In 5 minutes or less after entering occupied-standby mode, mechanical ventilation to the zone shall remain off whenever the space temperature is between the active heating and cooling setpoints.

EXCEPTION to Section 160.3(a)2Diii: Zones which are only ventilated by a natural ventilation system in accordance with Section 120.1(c)2.

EXCEPTION 1 to Sections 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 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.

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 160.3(a)2E: Equipment that serves an area that must operate continuously.

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

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

EXCEPTION 4 to Section 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 160.3(a)2Di.

EXCEPTION to Section 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 over33,000 Btu/hr and an

installed air economizer shall include a stand-alone or integrated Fault Detection and Diagnostics (FDD) system in accordance with Subsections 160.3(a)2Hi through 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

e. Excess outdoor air.

viii. The FDD System shall be certified by the Energy Commission as meeting requirements of Sections 160.3(a)2Hi through160.3(a)2Hvii in accordance with Section 110.0 and JA6.3.

EXCEPTION to Section 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 160.3- C.

i. The provided DDC system shall meet the control logic requirements of Sections 160.3(a)2E and 160.3(a)2G, and be capable of the following:

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

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

iv. 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;

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

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

vii. 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 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 160.3(a)2J: Systems that must operate continuously.

(b) **Dwelling Unit Space Conditioning and Air Distribution Systems.**

1. **Building Cooling and Heating Loads.** Building heating and cooling loads shall be determined using a method based on any one of the following, using cooling and heating loads as two of the criteria for equipment sizing and selection:

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.

NOTE: Heating systems are required to have a minimum heating capacity adequate to meet the minimum requirements of the CBC.

2. **Design conditions.** Design conditions shall be determined in accordance with the following:

A. 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.

B. Outdoor design conditions shall be selected from Reference Joint Appendix JA2, which is based on data from the ASHRAE Climatic Data for Region X.

C. The outdoor design temperatures for heating shall be no lower than the Heating Winter Median of Extremes values.

D. 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 be insulated in accordance with either subsection a or b below:

a. Ducts shall have a minimum installed level of R-6.0

EXCEPTION to 160.3(b)5Aiia: Portions of the duct system located in conditioned space and below the ceiling separating the occupiable space from the attic are not required to be insulated if all of the following conditions are met:

i. The non-insulated portion of the duct system is located entirely inside the building's thermal envelope as confirmed by visual inspection.

ii. At all locations where non-insulated portions of the duct system penetrates into unconditioned space, the penetration shall be draft stopped compliant with CFC sections 703.1 and 704.1 and air-sealed to the construction materials that are penetrated, using materials compliant with CMC section E502.4.2 to prevent air infiltration into the cavity. All connections in unconditioned space are insulated to a minimum of R-6.0 as confirmed by visual

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.

b. Ducts do not require insulation a minimum installed level of R-4.2 when the duct system is located entirely in conditioned space. For buildings with three or fewer habitable stories, duct systems located entirely in conditioned space shall be confirmed through field verification and diagnostic testing in accordance with the requirements of Reference Residential Appendix RA3.1.4.3.8.

EXCEPTION to Section 160.3(b)5A: 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 160.3(b)5D and the installed thickness determined by Section 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 individual dwelling unit, 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. Air handler airflow for calculation of duct leakage rate compliance targets shall be determined according to methods specified in Reference Residential Appendix RA3.1.4.2.

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 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 air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4.

EXCEPTION 1 to Section 160.3(b)5K: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four habitable stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

EXCEPTION 2 to Section 160.3(b)5K: Multifamily dwelling units in buildings four habitable stories and greater in Climate Zone 1, 3, 5, and 7.

L. **System Airflow Rate and Fan Efficacy.** Space conditioning systems that utilize forced air ducts to supply cooling to an individual dwelling unit 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 Section 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 a or 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.

EXCEPTION 1 to Section 160.3(b)5Lii: Standard ducted systems without zoning dampers may comply by meeting the applicable requirements in TABLE 160.3-A or 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 160.2(b)1Div for the system air filter(s) shall conform to the requirements given in TABLE 160.3-A or 160.3-B.

EXCEPTION 2 to Section 160.3(b)5Lii: 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 Section 160.3(b)5Lii: 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.

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 a or 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 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 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 160.3(b)5Liii: 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 160.3(b)5Liv: Standard ducted systems without zoning dampers may comply by meeting the applicable requirements in TABLE 160.3-A or 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 160.2(b)1Div for the system air filter(s) shall conform to the requirements given in TABLE 160.3-A or 160.3-B.

EXCEPTION 2 Section to 160.3(b)5Liv: 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 1 to Section 160.3(b)5L: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four habitable stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

EXCEPTION 2 to Section 160.3(b)5L: Multifamily dwelling units in buildings four habitable stories and greater in Climate Zone 1.

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 160.3(c)1.

(c) **Fluid Distribution Systems; Common Services Use Area Space-Conditioning Systems.** Multifamily buildings shall comply with the applicable requirements of Section 160.3(a)1. Multifamily common services use areas shall comply with the applicable requirements of Sections 160.3(a)2A through160.3(a)2J.

1. **Pipe Insulation.** Multifamily buildings shall comply with the applicable requirements of Sections 160.3(c)1A through 160.3(c)1D.

A. **General Requirements.** The piping conditions listed below for space-conditioning systems with fluid normal operating temperatures listed in 160.3-D, shall have at least the amount of insulation specified in 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.

B. 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.

C. **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.

D. **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 Equation 160.3-A:

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

(Equation 160.3-A)

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

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

EXCEPTION 3 to Section 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 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.** Multifamily common use areas shall comply with the applicable requirements of Sections 160.3(c)2A through 160.3(c)2F.

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:

i. Outdoors; or

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

iii. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces; or iv. In an unconditioned crawlspace; or

v. 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. Ductwork and plenums with pressure class ratings shall be constructed to Seal Class A. 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.

EXCEPTION to Section 160.3(c)2Cid: Ductwork located in occupied space and exposed to view.

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. Ductwork and plenums with pressure class ratings shall be constructed to Seal Class A. 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 Section160.3(c)2D and the installed thickness determined by Section 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.

H. Duct systems shall be tested in accordance with i or ii below

i. New duct systems that meet the criteria in Subsections a, b and c below or ductwork that is part of a system that meets the criteria of Section 180.2(b)2B 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;

a. The duct system provides conditioned air to an occupiable space for a constant volume, single zone, space-conditioning system

b. The space conditioning system serves less than 5,000 square feet of conditioned floor area

c. 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:

I. Outdoors; or

II. In a space directly under a roof that has a U-factor greater than the U-factor of the ceiling, or if the roof does not meet the requirements of Section 170.2(a)1; or

III. In a space directly under a roof that has fixed vents or openings to the outside or unconditioned spaces; or

IV. In an unconditioned crawlspace; or V. In other unconditioned spaces.

ii. All duct systems that do not meet the criteria in Section 160.3(c)2H shall meet the duct leakage testing requirements of CMC Section 603.10.1.

(d) **Mechanical Acceptance Testing.**

1.A. Common Areas. Before an occupancy permit is granted, the following systems and equipment serving multifamily common areas shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. These systems and equipment shall also comply with the applicable requirements of Section 160.3(d)3. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements:

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

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

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

a. They are new duct systems; or

b. They are part of an altered system.

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

EXCEPTION to Section160.3(cd)1D3Aiv: 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.

E. Demand control ventilation systems required by Section 160.2(c)3 shall be tested in accordance with NA7.5.5 Fvi. Supply fan variable flow controls shall be tested in accordance with NA7.5.6

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

H. Boiler or chillers that require isolation controls as specified by Section 170.2(c)4Iii or 170.2(c)4Iiii shall be tested in accordance with NA7.5.7

I. Hydronic systems with supply water temperature reset controls shall be tested in accordance with NA7.5.8 Jx. Automatic demand shed controls shall be tested in accordance with NA7.5.10.

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

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

M. Distributed Energy Storage DX AC Systems shall be tested in accordance with NA7.5.13. Nxiv. Thermal Energy Storage (TES) Systems shall be tested in accordance with NA7.5.14.

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

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

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

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

2. Multifamily Dwelling Units. Before an occupancy permit is granted, the following systems and equipment serving multifamily dwelling units shall be certified as meeting the Acceptance Requirements for Code compliance, as specified by the Reference Nonresidential Appendix NA7. These systems and equipment shall also comply with the appliable requirements of Section 160.3(d)3. A certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements:

A. In multifamily buildings with four or more habitable stories, dwelling unit ventilation systems shall be tested in accordance with NA7.18.1.

B. In multifamily buildings with four or more habitable stories, dwelling unit enclosure leakage shall be tested in accordance with NA7.18.2 when exhaust or supply ventilation systems are used for compliance with whole-dwelling unit ventilation requirements as specified in 160.2(b)2Aivb2.

C. Multifamily building central ventilation ducts in multifamily buildings with four or more habitable stories shall be leak tested in accordance with NA7.18.3.

D. Multifamily building central ventilation system heat recovery or energy recovery systems in multifamily buildings with four or more habitable stories shall be tested in accordance with NA7.18.4.

3. When certification is required by Title 24, Part 1, Section 10-103.2, the acceptance testing specified by Section 160.3(cd)3A 1 and 2 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 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 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 (inch2)**
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 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 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**	**Return Duct 2 Minimum Nominal Diameter**	**Minimum Total Return Filter Grille Nominal Area ($inch^2$)**

	(inch)	**(inch)**	
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 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 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 (Steam, Steam Condensate, Refrigerant, Space Heating)				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
Fluid Operating Temperature	Insulation Conductivity			Nominal Pipe Diameter (in inches)				
	Conductivity (in	Mean Rating Temperature		< 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	0.75	0.75	1.0	1.0	1.0
			R-value	R 6	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 160.3-D:

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

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 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:

A. 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:

B. Both ends of the unused conductor shall be labeled with the word “spare” and be electrically isolated

C. 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

D. 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

3. 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)4.

(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)6.7

(e) **Commercial Boilers**

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).

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.

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 160.4(e)3: Boilers with steady state full-load thermal combustion efficiency 90 percent or higher.

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

1. Piping for multifamily domestic hot water systems, shall be insulated to meet the requirements of Table 160.4-A.

EXCEPTION 1 to Section 160.4(f)12: Factory-installed piping within space-conditioning equipment certified under Section 110.1 or 110.2.

EXCEPTION 2 to Section 160.4(f)12: 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 160.4(f)12: 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 160.4(f)12: 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.

TABLE 160.4-A PIPE INSULATION THICKNESS – Multifamily Domestic Hot Water

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
Multifamily Domestic Hot Water Systems				Minimum Pipe Insulation Required (Thickness in inches or R-value)				
105-1402	0.22-0.28	100	Inches	1.0	1.5	2.0	2.0	2.0
			R-value	R 7.7	R 12.5	R 16	R 12.5	R 11

Footnote to TABLE 160.4-A:

1. Multifamily and hotel/motel domestic hot water systems with water temperature above 140°F shall use the row in table 120.3-A for the applicable water temperature.

2. 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.

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 160.5 – MANDATORY LIGHTING REQUIREMENTS FOR INDOOR AND OUTDOOR SPACES

The design and installation of all lighting systems and equipment in multifamily buildings within the scope of Section 100.0(a) shall comply with the applicable provisions of Section 160.5. All functional areas except dwelling units and common living areas shall comply with the applicable requirements of Section 160.5(b) through 160.5(e).

(a) Dwelling Unit and Common Living Area Lighting.

The design and installation of all lighting systems and equipment in multifamily dwelling units and common living areas shall comply with Section 160.5(a). Multifamily dwelling units include dormitory and senior housing dwelling accommodations. Outdoor lighting attached to multifamily buildings and controlled from the inside of a dwelling unit shall comply with the lighting requirements of Section 160.5(a).

1. Luminaire Requirements.

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

EXCEPTION 1 to Section 160.5(a)1A: Integrated device lighting: Lighting integral to exhaust fans, kitchen range hoods, bath vanity mirrors, and garage door openers, and non-removable lighting attached to ceiling fans.

EXCEPTION 2 to Section 160.5(a)1A: Navigation Lighting: Night lights, step lights, path lights less than 5 watts.

EXCEPTION 3 to Section 160.5(a)1A: Cabinet Lighting: Lighting internal to drawers, cabinetry, and linen closets with an efficacy of 45 lumens per watt or greater.

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

C. Recessed Downlight Luminaires In addition to complying with Section 160.5(a)1A, luminaires recessed into ceilings shall meet all of the following requirements:

i. Shall not contain screw base lamp sockets; 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 with integral light 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, or be installed per manufacturer's instructions to maintain airtightness between the luminaire housing and ceiling; and

iv. Meet the clearance and installation requirements of California Electrical Code Section 410.116 for recessed luminaires.

EXCEPTION to Section 160.5(a)1Cii and Iii: Recessed luminaires marked for use in fire-rated installations, and recessed luminaires installed in non-insulated ceilings.

D. 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.

E. 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, low voltage wiring or fan speed control.

2. Indoor Lighting Controls.

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

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

B. No controls shall bypass a dimmer, occupant sensor or vacancy sensor function where that dimmer or sensor has been installed to comply with Section160.5(a)2.

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

D. An Energy Management Control System (EMCS) or a multiscene programmable controller may be used to comply with dimming, occupancy, and lighting control requirements in Section 160.5(a)2 if it provides the functionality of the specified controls in accordance with Section 110.9, and the physical controls specified in in Section 160.5(a)2A.

E. Automatic Off Controls.

i. In bathrooms, garages, laundry rooms, utility rooms, and walk-in closets, at least one installed luminaire shall be controlled by an occupantcy 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 160.5(a)2A.

ii. For lighting internal to drawers and cabinetry with opaque fronts or doors, controls that turn light off when the drawer or door is closed shall be provided.

F. Dimming Controls. Lighting in habitable spaces, including but not limited to living rooms, dining rooms, kitchens, and bedrooms, shall have readily accessible wall-mounted dimming controls that allow the lighting to be manually adjusted up and down. Forward phase cut dimmers controlling LED light sources shall comply with NEMA SSL 7A.

EXCEPTION 1 to Section 160.5(a)2F: Ceiling fans may provide control of integrated lighting via a remote control.

EXCEPTION 2 to Section 160.5(a)2F: Luminaires controlled by an occupancy or vacancy sensor providing automatic-off functionality.

EXCEPTION 3 to Section 160.5(a)2F: Navigation lighting such as night lights, step lights, and path lights less than 5 watts. Lighting internal to drawers and cabinetry with opaque fronts or doors or with automatic off controls.

G. Independent controls. Integrated lighting of exhaust fans shall be controlled independently from the fans. The following shall be controlled separately from ceiling-installed lighting such that one can be turned on without turning on the other:

i. Undercabinet lighting

ii. Undershelf lighting

iii. Interior lighting of display cabinets

iv. Switched outlets

3. Outdoor Lighting Controls. In addition to meeting the requirements of Section 160.5(a)1, luminaires providing residential outdoor lighting shall meet the following requirements, as applicable:

A. Outdoor lighting attached to a building and separately controlled from the inside of a dwelling unit, shall meet the requirement in item i and the requirements in either item ii or item iii:

i. Controlled by a manual ON and OFF control switch that permits the automatic actions of items ii or iii below; and

ii. Controlled by a photocell and either a motion sensor or an automatic time switch control; or

iii. Controlled by an astronomical time clock control

Controls that override to ON shall not be allowed unless the override automatically returns the automatic control to its normal operation within 6 hours. An energy management control system that provides the specified lighting control functionality and complies with all requirements applicable to the specified controls may be used to meet these requirements.

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

Light sources in this column other than those installed in ceiling recessed downlight luminaires are classified as high luminous efficacy and are not required to comply with Reference Joint Appendix JA8	**Light sources in this column are required to comply with Reference Joint Appendix JA8 and shall be certified and marked as required by JA8.**
1. LED light sources installed outdoors. 2. Inseparable Solid State Lighting (SSL) luminaires containing colored light sources that are installed to provide decorative lighting. 3. Pin-based linear fluorescent or compact fluorescent light sources using electronic ballasts. 4. High intensity discharge (HID) light sources including pulse start metal halide and high pressure sodium light sources. 5. Luminaires with hardwired high frequency generator and induction lamp. 6. Ceiling Fan Light subject to federal appliance regulations.	107. All light sources installed in ceiling recessed downlight luminaires. Note that ceiling recessed downlight luminaires shall not have screw base sockets regardless of lamp type as specified in Section 150.0(k)1C. 118.Any light source not otherwise listed in this table.

(b) Common Services Area Lighting. Lighting systems and equipment in multifamily common services areas shall comply with the applicable provisions of Sections 160.5(b)1 through 160.5(b)4.

EXCEPTION to Section 160.5(b): Lighting systems in common use areas providing shared provisions for living, eating, cooking, or sanitation to dwelling units that would otherwise lack these provisions may instead comply with Section 160.5(a).

NOTE: The requirements of Section160.5(b) applies to newly constructed buildings. Sections 180.1 and 180.2 specify which requirements of Sections 160.5(b)1 through 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. 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

ii. 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 160.3(b)1Aii: Luminaires with a single lamp and an integrated ballast or transformer may use a peel-down label provided that they are layered such that the rated wattage reduces as successive layers are removed.

a. Low-voltage luminaires (except low voltage track systems), ≤ 24 volts, with a maximum relamping

rated wattage of 50 watts.

b. Compact fluorescent luminaires, having an integral electronic ballast, with a maximum relamping rated wattage of 42 watts.

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

B. For luminaires with line voltage lamps not served by drivers, ballasts, or transformers, the wattage of such luminaires shall be determined as the maximum rated wattage as labeled in accordance with Section 160.5(b)1A.

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 160.5(b)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:

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

b. the rated wattage of all of the luminaires included in the system, where the luminaire wattage is determined as specified in Section 160.5(b)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; or

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.

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 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 160.5(b)1B through 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 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, 160.5(b) and 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, 160.5(b) and 160.5(c); and

B. Complies with all applicable Lighting Control Installation Requirements in accordance with Section 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. Multifamily common use areas shall comply with the applicable requirements of Sections 160.5(b)4A through 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 160.5(b)4Ai: Restrooms having two or more stalls, parking areas, stairwells, corridors, and areas of the building intended for access or use by the public 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 to Section 160.5(b)4Aii: For 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 showing the current state of the controlled lighting.

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. Scene controllers may comply with this requirement provided that at least one scene turns

on general lighting only, and the control provides a means to manually turn off all lighting.

EXCEPTION to Section 160.5(b)4A: Up to 0.1 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:

i. Provide the number of control steps specified in TABLE 160.5-B; and

ii. Meet the uniformity requirements specified in TABLE 160.5-B.

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

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

C. Automatic 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 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.

i. In addition to lighting controls installed to comply with Sections 160.5(b)4A and 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 1 to Section 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 160.5(b)4Ci: Lighting complying with Section 160.5(b)4Cv or vii.

EXCEPTION 3 to Section 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.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.

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

EXCEPTION 5 to Section 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 160.5(b)4Ci only in closets less than 70 square feet. The maximum timer setting shall be 10 minutes for closets.

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

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

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

iv. If an automatic time-switch control, other than an occupant sensing control, is installed to comply with Section 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.

v. Occupant Sensing Controls are required for specified offices, multipurpose rooms, conference rooms and restrooms. Lighting installed inIn offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet,

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 within in 20 minutes or less after of the control zone being is unoccupied.

In areas required by Section 160.5(b)4B to have multi-level lighting controls, the occupant sensing controls shall function either as:

a. a partial-ON occupant sensing control capable of automatically activating between 50-70 percent of controlled lighting power, or

b. a vacancy sensing control, where all lighting responds to a manual ON input only.

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

a. an occupant sensing control; or

b. a partial-ON occupant sensing control, or

c. a vacancy sensing control, 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 160.5(b)4A regardless of the sensor status.

vi. Full or Partial OFF occupant sensing controls are required for corridors and stairwells, and offices greater than 250 square feet. Lighting installed in the following areas shall meet the following requirements below in addition to complying with Section 160.5(b)4Ci.

a. In corridors and stairwells, lighting 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.

b. In office spaces greater than 250 square feet, general lighting shall be controlled by occupancy sensing controls that meet all of the following:

I. The occupancy sensing controls shall be configured so that lighting shall be controlled separately in control zones not greater than 600 square feet. For luminaires with an embedded occupancy sensor that are capable of reducing power independently from other luminaires, each luminaire can be considered its own control zone; and

II. In 20 minutes or less after the control zone being is unoccupied, the occupancy sensing controls shall uniformly reduce lighting power in the control zone to by at least 80 percent of full power. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement; and

III. In 20 minutes or less after the entire office space being is unoccupied, the occupancy sensing controls shall automatically turn off lighting in all control zones in the space; and

IV. In each control zone, lighting shall be allowed to automatically turn on to any level up to full power upon occupancy within the control zone. When occupancy is detected in any control zone in the space, the lighting in other control zones that are unoccupied shall operate at no more than 20 percent of full power.

EXCEPTION to Section 160.5(b)4Cvi: Under-shelf or furniture-mounted task lighting controlled by a local switch and either a time switch or an occupancy sensor.

vii. Partial OFF occupant sensing controls are required for parking garages, parking areas, and loading and unloading areas. Lighting installed in the following areas shall meet the following requirements below instead of complying with Section 160.5(b)4Ci.

a. (reserved)

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 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 160.5(b)4Cviib. Parking areas on the roof of a parking structure are classified as outdoor hardscape and shall comply with the (applicable provisions in Section 160.5(c).

EXCEPTION to Section 160.5(b)4Cviib: 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.

D. Automatic Daylighting Controls. The general lighting in skylit daylit zones, primary sidelit daylit zones, and secondary sidelit daylit zones, as well as the general lighting in the combined primary and secondary sidelit daylit zones in parking garages, shall be provided with controls that automatically adjust the power of the installed general lighting up and down to keep the total light level stable as the amount of incoming daylight changes. For skylights located in an atrium, the skylit daylit zones 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, secondary 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 general lighting in each type of daylit zone. General Lighting in overlapping skylit daylit zone and sidelit daylit zone shall be controlled as part of the Sskylit Ddaylit Zzone. General lighting in overlapping primary and secondary sidelit daylit zone shall be controlled as part of the primary sidelit daylit zone. Linear LED luminaires and other solid state lighting (SSL) light sources in linear form may be treated as linear lamps in increments of 4 feet segment or smaller, and each segment is separately controlled based on the type of the daylit zone the segment is primarily located.

iii. The automatic daylighting controls shall:

a. For spaces required to install multilevel controls under Section 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 illuminance provided by the controlled lighting system when no daylight is available, the controlled lighting power in that daylight zone shall be reduced by a minimum of 90 percent; and

d. For parking garages, ensure that when daylight 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 in the combined primary and secondary sidelit daylight zones shall be reduced by 100 percent.

iv. 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 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 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 160.5(b)4D: Rooms where the combined total installed wattage of the general lighting in the skylit and primary sidelit zones is less than 120 watts are not required to have daylighting controls for those zones. Rooms where the total installed wattage of the general lighting in the secondary sidelit zones is less than 120 watts are not required to have daylighting controls for that zone.

EXCEPTION 4 to Section 160.5(b)4D: Parking garage areas where the total installed wattage of the general lighting in the primary and the secondary sidelit daylit zones is less than 60 watts do not require automatic daylighting controls in the daylit zones.

EXCEPTION 5 to Section 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 6 to Section 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 7 to Section 160.5(b)4D: 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 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 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 Section160.5(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.

viii. (RESERVED)

ix. For space conditioning system zones serving only spaces that are required to have occupancy sensing controls as specified in Section 160.5(b)4Cv, vi, and vii, and where Table 120.1-A allows the ventilation air to be reduced to zero when the space is in occupied-standby mode, the space conditioning system shall be controlled by occupancy sensing controls as specified in Section 160.3(a)2Dii.

TABLE 160.5-B MULTI-LEVEL LIGHTING CONTROLS AND UNIFORMITY REQUIREMENTS

Luminaire Type	Minimum Required Control Steps (percent of full rated power1)	Uniform level of illuminance shall be achieved by:
LED luminaires and LED light source systems	Continuous dimming 10-100 percent	Continuous dimming 10-100 percent
Line-voltage sockets except GU-24	Continuous dimming 10-100 percent	Continuous dimming 10-100 percent
Low-voltage incandescent systems	Continuous dimming 10-100 percent	Continuous dimming 10-100 percent
Fluorescent luminaires	Continuous dimming 20-100 percent	Continuous dimming 20-100 percent
GU-24 sockets rated for fluorescent ≤ 20 watts; Pin-based compact fluorescent ≤ 20 watts2 Linear fluorescent and U-bent fluorescent ≤ 13 watts	Minimum one step between 30-70 percent	Continuous dimming; or Stepped dimming; or Switching alternate lamps in a luminaire, or Separately switching circuits in multi-circuit track with a minimum of two circuits.
Track Lighting	Minimum one step between 30-70 percent	Continuous dimming; or Stepped dimming; or Switching alternate lamps in a luminaire, or Separately switching circuits in multi-circuit track with a minimum of two circuits.
Linear fluorescent and U-bent fluorescent > 13 watts	Minimum one step in each range: 20-40 % 50-70 % 75-85 % 100 %	Stepped dimming; or Continuous dimming; or Switching alternate lamps in each luminaire, having a minimum of 4 lamps per luminaire illuminating the same

Luminaire Type	Minimum Required Control Steps (percent of full rated power1)	Uniform level of illuminance shall be achieved by:
		area and in the same manner
Other light sources, including HID and induction	Minimum one step between 50 - 70 percent	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.

1. Full rated input power of driver, ballast and lamp, corresponding to maximum ballast factor

2. Includes only pin based lamps: twin tube, multiple twin tube, and spiral lamps

(c) Outdoor Lighting and Controls Equipment. Multifamily buildings shall comply with the applicable requirements of Sections 160.5(c)1 through 160.5(c)2.

1. **Luminaire Shielding Requirements.** All outdoor luminaires of 6,200 initial luminaire lumens or greater, shall comply with Backlight, Uplight, and Glare (BUG) (in accordance with ANSI/IES TM-15-20, Annex A) requirements in accordance with Title 24, Part 11, Section 5.106.8.

EXCEPTION 1 to Section 160.5(c)1: Signs.

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

EXCEPTION 3 to Section 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 160.5(c)1: Temporary outdoor lighting.

EXCEPTION 5 to Section 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 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 160.5(c)1: Luminaires that illuminate the public right of way including publicly-maintained or utility-maintained roadways, sidewalks, and bikeways.

EXCEPTION 7 to Section 160.5(c)1: Outdoor lighting attached to a multifamily building and separately controlled from the inside of a dwelling unit.

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

ii. Automatic scheduling controls shall be capable of reducing the outdoor lighting power by at least 60 50 percent and no more than 90 percent, and separately capable of turning the lighting OFF, during scheduled unoccupied periods.

iii. 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.

C. Motion Sensing Controls.

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

a. Outdoor luminaires other than those providing Building Façade, Ornamental Hardscape, or Outdoor Dining, where the bottom of luminaire is mounted 24 feet or less above grade or lower; and,

b. Outdoor wall mounted luminaires installed for General Hardscape parking lot lighting, located within 1 mounting height of a parking space, mounted 24 feet or less above grade or lower.

ii. Motion sensing controls shall be capable of reducing the outdoor lighting power of each controlled luminaire by at least 60 50 percent and no more than 90 percent, and separately capable of turning the luminaire OFF, during unoccupied periods.

iii. 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.

iv. No more than 1,500 watts of lighting power shall be controlled by a single sensor or as a single zone.

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

EXCEPTION 2 to Section 160.5(c)2C: Applications listed as Exceptions to Section 170.2(e)2A are not required to have motion sensing controls.

EXCEPTION 3 to Section 160.5(c)2C: 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 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 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. Multifamily common use areas shall comply with the applicable requirements of Sections 160.5(e)1 through 160.5(e)3.

1. Lighting Control Acceptance Requirements. Before an occupancy permit is granted, indoor and outdoor lighting controls serving the building, area, or site and installed to comply with Section 160.5(b)4D, 160.5(b)4C, 160.5(b)4E, 160.5(c)2, or 170.2(e)1Aiij shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7.6 and NA7.8. A Certificate of Acceptance shall be submitted to the enforcement agency under Section 10-103(a) of Part 1, that the equipment and systems meet the acceptance requirements:

A. RESERVED;

B. RESERVED;

C. Automatic daylight controls shall be tested in accordance with Reference Nonresidential Appendix NA7.6.1;

D. Lighting shut-OFF controls shall be tested in accordance with Reference Nonresidential Appendix NA7.6.2; E. Demand responsive lighting controls shall be tested in accordance with Reference Nonresidential Appendix

NA7.6.3; and

F. Outdoor lighting controls shall be tested in accordance with Reference Nonresidential Appendix NA7.8; and

G. Lighting systems receiving the Institutional Tuning Power Adjustment Factor shall be tested in accordance with Reference Nonresidential Appendix NA 7.6.4.

H. Demand responsive controls required to control controlled receptacles shall be tested in accordance with Reference Nonresidential Appendix NA7.6.5.

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, 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, 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 170.2(e)1A2A; and comply with Reference Nonresidential Appendix NA7.7.4.

D. Certification that lighting controls installed to earn a lighting Power Adjustment Factor (PAF) comply with Section 170.2(e)1B2B; and comply with Reference Nonresidential Appendix NA7.7.5.

E. Certification that additional lighting wattage installed for a videoconference studio complies with Section 170.2(e)1CifVI; and complies with Reference Nonresidential Appendix NA7.7.6RESERVED.

3. When certification is required by Title 24, Part 1, Section 10-103.1, the acceptance testing specified by Section 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.

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 160.6 – MANDATORY REQUIREMENTS FOR ELECTRIC POWER DISTRIBUTION SYSTEMS

Multifamily buildings shall comply with the applicable requirements of 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 160.6-A.

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

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

Metering Functionality	**Electrical Services1 rated 50 kVA or less**	**Electrical Services1 rated more than 50kVA and less than or equal to 250 kVA**	**Electrical Services1 rated more than 250 kVA and less than or equal to 1000kVA**	**Electrical Services1 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 building service-entrance rating or to the submetering service. For a building with submetering, this applies to the submetering service size to the common use areas.

(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 160.6-B.

EXCEPTION 1 to 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 160.6(b): Submetered electrical power distribution systems that provide power to dwelling units.

TABLE 160.6-B MINIMUM REQUIREMENTS FOR SEPARATION OF ELECTRICAL LOAD

Electrical Load Type	Electrical Services1 rated 50 kVA or less	Electrical Services1 rated more than 50kVA and less than or equal to 250 kVA	Electrical Services1 rated more than 250 kVA and less than or equal to 1000kVA	Electrical Services1 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
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 building service-entrance rating or to the submetering service. For a building with submetering, this applies to the submetering service size to the common use area.

(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 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 common services coareas, both controlled and uncontrolled 120 volt receptacles shall be provided in office areas, lobbies, conference rooms, kitchen areas in office spaces, and copy rooms. 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

NOTE: A hardwired power strip controlled by an occupant sensing control may be used to comply with 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 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 160.6(d): Receptacles in common use areas providing shared provisions for living, eating, cooking, or sanitation to dwelling units that would otherwise lack these provisions.

(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 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.

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 160.7 – MANDATORY REQUIREMENTS FOR COVERED PROCESSES

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

(b) Pool and spa systems. Pool and spa systems available to multiple tenants or to the public shall comply with the applicable requirements of Section 110.4. Pool and spa systems installed for exclusive use by a single tenant shall comply with the applicable requirements of 150.0(p).

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 160.8 – MANDATORY REQUIREMENTS FOR SOLAR READY BUILDINGS

(a) Solar Ready Buildings. Newly constructed multifamily buildings shall meet the requirements of Section 110.10 applicable to the building project.

SECTION 160.9 – MANDATORY REQUIREMENTS FOR ELECTRIC READY BUILDINGS

(a) Heat Pump Space Heater Ready. Systems using gas or propane furnaces to serve individual dwelling units shall include the following:

1. A dedicated 240 volt branch circuit wiring shall be installed within 3 feet from the furnace and accessible to the furnace with no obstructions. The branch circuit conductors shall be rated at 30 amps minimum. The blank cover shall be identified as “240V ready”. All electrical components shall be installed in accordance with the California Electrical Code.

2. The main electrical service panel shall have a reserved space to allow for the installation of a double pole circuit breaker for a future heat pump space heater installation. The reserved space shall be permanently marked as “For Future 240V use”.

(b) Electric Cooktop Ready. Systems using gas or propane cooktops to serve individual dwelling units shall include the following:

1. A dedicated 240 volt branch circuit wiring shall be installed within 3 feet from the cooktop and accessible to the cooktop with no obstructions. The branch circuit conductors shall be rated at 50 amps minimum. The blank cover shall be identified as “240V ready”. All electrical components shall be installed in accordance with the California Electrical Code.

2. The main electrical service panel shall have a reserved space to allow for the installation of a double pole circuit breaker for a future electric cooktop installation. The reserved space shall be permanently marked as “For Future 240V use”.

(c) Electric Clothes Dryer Ready. Systems using gas or propane cClothes dryers locations with gas or propane plumbing shall include the following:

1. Systems serving individual dwelling units shall include:

   A. A dedicated 240 volt branch circuit wiring shall be installed within 3 feet from the clothes dryer location and accessible to the clothes dryer location with no obstructions. The branch circuit conductors shall be rated at 30 amps minimum. The blank cover shall be identified as “240V ready”. All electrical components shall be installed in accordance with the California Electrical Code.

   B. The main electrical service panel shall have a reserved space to allow for the installation of a double pole circuit breaker for a future electric clothes dryer installation. The reserved space shall be permanently marked as “For Future 240V use”.

2. Systems in common use areas shall include:

   A. Conductors or raceway shall be installed with termination points at the main electrical panel, via subpanels panels if applicable, to a location no more than 3 feet from each gas outlet or a designated location of future electric replacement

equipment. Both ends of the conductors or raceway shall be labelled “Future 240V Use.” The conductors or raceway and any intervening subpanels, panelboards, switchboards, and busbars shall be sized to meet the future electric power requirements, at the service voltage to the point at which the conductors serving the building connect to the utility distribution system, as specified below. The capacity requirements may be adjusted for demand factors in accordance with the California Electric Code. Gas flow rates shall be determined in accordance with the California Plumbing Code. Capacity shall be one of the following:

i. 24 amps at 208/240 volts per clothes dryer;

ii. 2.6 kVA for each 10,000 Btu per hour of rated gas input or gas pipe capacity; or

iii. The electrical power required to provide equivalent functionality of the gas-powered equipment as calculated and documented by the responsible person associated with the project.

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.

7.1.4 Subchapter 11: Multifamily Buildings – Performance and Prescriptive Compliance Options

Multifamily buildings shall comply with the applicable requirements of Sections 170.0 through 170.2. Sections 170.0 through 170.2 apply to 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) 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 160.0 (mandatory features).
3. Either the performance Standards (170.1) or the prescriptive Standards (170.2) set forth in this Subchapter 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 170.0 (a)3: If a single 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 170.1(a) through 170.2(e) apply to newly constructed buildings and Sections 180.1 and 180.2 specify changes to the requirements of Sections 170.1(a) through 170.2(e) that apply to additions or alterations.

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 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 expressed in terms of source energy and time-dependent valuation (TDV) energy, and they are determined by applying the mandatory and prescriptive requirements to the Proposed Design Building. The source energy budget and the TDV energy budget is the sum of the TDV energy for

space-conditioning, indoor lighting, mechanical ventilation, photovoltaic (PV) and battery storage system, service water heating, and covered process loads.

(b) Energy Budget for the Proposed Design Building. The energy budget for a Proposed Design Building is expressed in terms of source energy and time-dependent valuation (TDV) energy, and they are determined by calculating the source energy and TDV energy for the Proposed Design Building. The source energy budget are the TDV energy budget is the sum of the TDV energy for space-conditioning, indoor lighting, mechanical ventilation, photovoltaic (PV) and battery storage system, and service water heating and covered process loads. The Proposed Building shall separately comply with the source energy budget and the TDV energy budget.

EXCEPTION to Section 170.1(b). A community shared solar electric generation system, or other renewable electric generation system, and/or community shared battery storage system, which provides dedicated power, utility energy reduction credits, or payments for energy bill reductions, to the permitted building and is approved by the Energy Commission as specified in Title 24, Part 1, Section 10-115, may offset part or all of the solar electric generation system or battery storage system TDV energy required to comply with the Standards, as calculated according to methods established by the Commission in the Nonresidential ACM Reference Manual.

(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 source energy budget and TDV energy budget do not exceed the Standard Design for the applicable climate zone.

2. Field Verification of Individual Dwelling Unit Systems. When performance of installed features, materials, components, manufactured devices or systems above the minimum specified in Section 170.2 is necessary for the building to comply with Section 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. EER/EER2/SEER/SEER2/CEER/HSPF/HSPF2 Rating. When performance compliance requires installation of a space conditioning system with a rating that is greater than the minimum rating required by TABLE 170.2-K or specified for the standard design, the installed system shall be field verified in accordance with the procedures specified in the applicable sections of Reference Residential Appendix RA3.4.4.1.

B. Variable Capacity Heat Pump (VCHP) Compliance Option. When performance compliance requires installation of a heat pump system that meets all the requirements of the VCHP compliance option specified in the ACM Reference Manual, the system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.4.4.3.

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. RESERVED.

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. Dwelling Unit 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.

J. Pre-Cooling. When performance compliance requires field verification of the installation and programming of a Pre-Cooling Thermostat, it shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.4.5.

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 170.2 – PRESCRIPTIVE APPROACH

Multifamily 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 170.2-A. In TABLE 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 minimum aged solar reflectance and thermal emittance requirements of Table 170.2-A.

EXCEPTION 1 to Section 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 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 170.2-A, meeting option i, ii, iii, or iv below. Where required by Section 110.8 and 160.1(a), insulation shall be placed in direct contact with a continuous roof or drywall ceiling.

i. Option A: RESERVED

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 170.2(c)3Biia; or

iii. Option C: A minimum R-value of ceiling insulation located between the attic and the conditioned space when meeting Section 170.2(c)3Biib.

iv. Option D: A minimum U-factor for roof assemblies above conditioned space without attic space.

C. Radiant Barrier. A radiant barrier required in TABLE 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 170.2-A.

B. Demising walls shall meet the requirements of 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 TABLE 170.2-A.

3. Fenestration.

A. Vertical fenestration and glazed doors in exterior walls shall comply with subsections i, ii, and iii:

i. Percent fenestration area shall be limited in accordance with the applicable requirements of a and b below:

a. A total fenestration area no greater than 20 percent of the conditioned floor area; and

b. A total fenestration area no greater than 40 percent of the gross exterior wall area.

NOTE: Demising walls are not exterior walls, and therefore demising wall area is not part of the gross exterior wall area, and fenestration in demising walls are not part of the fenestration area limitation.

ii. Fenestration Properties. Installed fenestration products, including glazed doors, shall have an area- weighted average U-factor, Relative Solar Heat Gain Coefficient (RSHGC), and Visual Transmittance (VT) meeting the applicable fenestration values in TABLE 170.2-A and shall be determined in accordance with Sections 110.6(a)2 and 110.6(a)3.

Vertical fenestration in demising walls between conditioned and unconditioned spaces are only required to comply with the area-weighted average U-factor requirement in TABLE 170.2-A.

EXCEPTION 1 to Section 170.2(a)3Aii: For each dwelling unit, up to 3 square feet of new glazing area installed in doors shall not be required to meet the U-factor and RSHGC requirements of TABLE 170.2-A.

EXCEPTION 2 to Section 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 3to Section 170.2(a)3Aii: 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.

EXCEPTION 4 to Section 170.2(a)3ii: Fenestration in dwelling units of buildings that are three habitable stories or fewer in climate zones 1, 3, 5, and 16, are not required to comply with the RSHGC requirements.

EXCEPTION 5 to Section 170.2(a)3ii: Fenestration in dwelling units of buildings that are three habitable stories or fewer are not required to comply with the VT requirements.

iii. Shading. Where Table 170.2-A requires a maximum RSHGC, the requirements shall be met with an area- weighted average RSHGC excluding the effects of interior shading, no greater than the applicable value in Table 170.2-A.

For the purposes of this paragraph, the RSHGC of a vertical window is:

a. The Solar Heat Gain Coefficient of the window; or

b. Relative Solar Heat Gain Coefficient is calculated using EQUATION 170.2-A, if the window has an overhang that extends beyond each side of the window jamb by a distance equal to the overhang's horizontal projection.

EXCEPTION 1 to Section 170.2(a)3Aiiib: An area-weighted average Relative Solar Heat Gain Coefficient of 0.56 or less shall be used for windows:

I. That are in the first story of exterior walls that form a display perimeter; and

II. For which codes restrict the use of overhangs to shade the windows.

EXCEPTION 2 to Section 170.2(a)3Aiiib: For vertical glazing containing chromogenic type glazing:

I. the lower-rate labeled RSHGC 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

II. chromogenic glazing shall be considered separately from other glazing; and

III. area-weighted averaging with other glazing that is not chromogenic shall not be permitted.

NOTE: Demising walls are not exterior walls, and therefore fenestration in demising walls are not subject to SHGC requirements.

RSHGC = SHGC × [1 + a × (2.72-PF – 1) × (sin(b × Az) – c)] (Equation 170.2-A)

WHERE:

Azimuth of the vertical fenestration in degrees. Projection factor as calculated by Equation 140.3-D.

WHERE:

	a	b	c
Overhang	0.150	0.130	5.67
Exterior Horizontal Slat	0.144	0.133	5.13

RSHGC = Relative Solar Heat Gain Coefficient.

SHGC = Solar Heat Gain Coefficient of the vertical fenestration.

Az = Azimuth of the vertical fenestration in degrees.

PF = Projection factor as calculated by Equation 140.3-D.

iv. Vertical fenestration shall have an area-weighted average Visible Transmittance (VT) no less than the applicable value in TABLE 170.2-A, or EQUATION 170.2-B, as applicable.

EXCEPTION 1 to Section 170.2(a)3Aiv: When the window's primary and secondary sidelit daylit zones are completely overlapped by one or more skylit daylit zones, then the window need not comply with Section 170.2(a)3Aivw.

EXCEPTION 2 to Section 170.2(a)3Aiv: If the window's VT is not within the scope of NFRC 200, or ASTM E972, then the VT shall be calculated according to Reference Nonresidential Appendix NA6.

EXCEPTION 3 to Section 170.2(a)3Aiv: For vertical windows 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;

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 4 to Section 170.2(a)3iv: Fenestration in dwelling units of buildings that are three habitable stories or fewer are not required to comply with the VT requirements.

NOTE: Demising walls are not exterior walls, and therefore windows in demising walls are not subject to VT requirements.

$VT \geq 0.11 / WWR$ (Equation 170.2-B)

WHERE:

WWR = Window Wall Ratio, the ratio of (i) the total window area of the entire building to (ii) the total gross exterior wall area of the entire building. If the WWR is greater than 0.40, then 0.40 shall be used as the value for WWR in EQUATION 170.2-B.

VT = Visible Transmittance of framed window.

B. Skylights shall:

i. Have an area no greater than 5 percent of the gross exterior roof area Skylight Roof Ratio (SRR); and

EXCEPTION 1 to Section 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 170.2-A.

EXCEPTION 2 to Section 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 170.2-A.

EXCEPTION to Section 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. 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 170.2(a)3Biv: 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, excluding glazed 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 170.2-A. Glazed doors must comply with the requirements of Section 170.2(a)3A.

EXCEPTION to Section 170.2(a)4: Swinging doors that are required to have fire protection are not required to meet the applicable door value in TABLE 170.2-A.

5. Floors shall meet the following requirements:

A. Raised-floors shall be insulated such that the floor assembly has an assembly U-factor equal to or less than shown in TABLE 170.2-A, or shall be

insulated between wood framing with insulation having an R-value equal to or greater than shown in TABLE 170.2-A.

B. All buildings with three habitable stories or fewer shall have slab floor perimeter insulation installed with a U- factor equal to or less than or R-value equal to or greater than shown in Table 170.2-A. 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 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 170.2-A.

6. All buildings up to three habitable stories shall comply with the Quality Insulation Installation (QII) requirements shown in TABLE 170.2-A. When QII is required, insulation installation shall meet the criteria specified in Reference Appendix RA3.5.

EXCEPTION to Section 170.2(a): The insulation requirements of TABLE 170.2-A and TABLE 170.2-B may 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.

TABLE 170.2-A ENVELOPE COMPONENT PACKAGE – Multifamily Standard Building Design

Quality Insulation Installation (QII) for buildings up to three habitable stories			Yes	Yes	Yes	Yes	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fenestration	Curtain Wall/ Storefront	Maximum U-factor	0.38	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	0.38
		Maximum RSHGC, three or fewer habitable stories	NR	0.26	NR	0.26	NR	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.26	NR
		Maximum RSHGC, four or more habitable stories	0.35	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.26	0.25
		Minimum VT, four or more habitable stories	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
	NAFS 2017 Performance Class AW[5]	Maximum U-factor	0.38	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.38
		Maximum RSHGC, three or less habitable stories	NR	0.24	NR	0.24	NR	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	NR
		Maximum RSHGC, four or more habitable stories	0.35	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
		Minimum VT, four or more habitable stories	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
	All Other Fenestration	Maximum U-factor	0.30	0.30	0.30	0.30	0.30	0.30	0.34	0.34	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
		Maximum RSHGC, three or less habitable stories	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 RSHGC, four or more habitable stories	0.35	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
	Maximum 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		40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
	Maximum Skylight Roof Ratio		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%

Exterior Doors[6]	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 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-ft2.5. Product must be certified to meet the North American Fenestration Standard/Specification for an Architectural Window (AW).

6. Glazed doors must meet the fenestration requirements.

(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 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 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.

EXCEPTION 1 to Section 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 2 to Section 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 3 to Section 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, space cooling, and ventilation equipment shall comply with minimum Appliance Efficiency Regulations as specified in

Sections 110.0 through 110.2 and the applicable requirements of Subsections 1 through 4.

1. Sizing and Equipment Selection – Common Use Areas. Mechanical heating and mechanical cooling equipment serving common use areas of multifamily buildings, 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 2 below.

EXCEPTION 1 to Section 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 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 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 – Common Use Areas. In making equipment sizing calculations under Subsection (c)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 method in the 2017 ASHRAE Handbook, Fundamentals Volume, or as specified in a method approved by the Commission.

B. Indoor design conditions. Indoor design temperature and humidity conditions for comfort applications shall be determined using ASHRAE Standard 55 or the 2017 ASHRAE Handbook, Fundamentals Volume, except that winter humidification and summer dehumidification shall not be required.

C. Outdoor design conditions. Outdoor design conditions shall be in accordance with the design conditions from Reference Joint Appendix JA2, 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.

EXCEPTION to Section 170.2(c)12C: 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 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 Section170.2(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 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 Sections 170.2(c)2A through 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 170.2(c)2K.

3. Dwelling Unit Space Conditioning Systems

A. Heating System Type. Space conditioning systems serving dwelling units shall meet ii. Systems that cannot meet the requirements of i or ii, including multi-zone systems and systems using central boilers or chillers, shall comply with the performance requirements of Section 170.21.

i. Multifamily Buildings three habitable stories or less. For climate zones 1 through 15, the space conditioning system shall be a heat pump. For climate zones 16, the space conditioning system shall be an air conditioner with furnace. Additionally, balanced ventilation systems serving these dwelling units shall meet the applicable requirements of Section 170.2(c)3Biv.c.

ii. Multifamily Buildings four habitable stories or greater. For climate zones 2 through 15, the space conditioning system shall be a heat pump. For climate zones 1 and 16, the space conditioning system shall be a dual-fuel heat pump.

EXCEPTION to Section 170.2(c)3A: 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 kW or 7,000 Btu/hr and is controlled by a time-limiting device not exceeding 30 minutes.

B. Space Conditioning and Ventilation Systems. All space heating and space cooling equipment serving 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 160.3(b) and 170.2(c)2.

i. Refrigerant Charge – Systems Serving Individual Dwelling Units. When refrigerant charge verification or fault indicator display is shown as required by TABLE 170.2-K, the system shall comply with either 170.2(c), 170.2(c)3Bia or 170.2(c)3Bib:

a. 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, shall comply with subsections I, II and III, unless the system is of a type that cannot be verified using the specified procedures:

I. Have measurement access holes (MAH) installed according to the specifications in the Reference Residential Appendix Section RA3.2.2.3; and

II. System airflow rate in accordance with subsection A or B 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

A. For small duct high velocity systems, the system airflow rate shall be greater than or equal to 250 cfm per ton; or

B. 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.

III. 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 procedure as specified by Reference Residential Appendix Section RA3.2.2 or an approved alternative procedure as specified by 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 to Section 170.2(c)3Bial: 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 170.2(c)3BiaII: Standard ducted systems without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in TABLE 160.3-A and TABLE 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 160.2(b)1D for the system air filter device(s) shall conform to the requirements given in TABLE 160.3-A and TABLE 160.3-B.

EXCEPTION to Section 170.2(c)3BiaIII: 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 the minimum system airflow rate requirement in Section 170.2(c)3BiaII.

b. For 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 170.2(c)3Bi:

I. 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

II. Systems that utilize forced air ducts shall comply with the minimum system airflow rate requirement in Section 170.2(c)3BiaII 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 1 to Section 170.2(c)3Bi: 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 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 170.2(c)3Bib, 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.

EXCEPTION 2 to Section 170.2(c)3Bi: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four habitable stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

ii. Space Conditioning Distribution Systems. All space conditioning systems shall meet all applicable requirements of a or b below:

a. 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 170.2-KA.

b. 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.

NOTE: Gas heating appliances installed in conditioned spaces must meet the combustion air requirements of the California Mechanical Code Chapter 7, as applicable.

iii. Central Fan Integrated Ventilation Systems – Systems Serving Individual Dwelling Units. 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 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.

a. 0.45 W/cfm for gas furnace air-handling units; or

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

iv. Balanced Ventilation Systems. When balanced ventilation systems are used to meet Section 160.2(b)2Aivb, they shall meet the applicable requirements of a, b, or c below:

a. In Climate Zones 1, 2, and 11-16, balanced ventilation systems serving individual dwelling units shall:

1. Be an energy recovery ventilator (ERV) or heat recovery ventilator (HRV)

2. Have a minimum sensible recovery efficiency of 67 percent, rated at 32 degrees Fahrenheit (0 degrees Celsius), and

3. Have a fan efficacy less than or equal to 0.6 W per cfm.

These measures shall be confirmed through HERS field verification in accordance with the procedures in RA3.7.4.4 for buildings with three habitable stories or less, or the procedures in NA2.2.4.1.5 for buildings with four or more habitable stories.

b. In Climate Zones 1, 2, and 11-16, balanced ventilation systems serving multiple dwelling units in buildings with four or more habitable stories shall:

1. Be an ERV or HRV

2. Have a minimum sensible recovery efficiency or effectiveness of 67 percent, rated at 32 degrees Fahrenheit (0 degrees Celsius),

3. Meet the fan power requirements of Section 170.2(c)4A, and

4. Have recovery bypass or control to directly economize with ventilation air based on outdoor air temperature limits specified in Table 170.2- G.

These measures shall be filed verified in accordance with NA7.18.4.

c. In buildings with three habitable stories or less in Climate Zones 4-10, when a heat pump space conditioning system is installed to meet the requirements of Section 170.2(c)3Ai, balanced ventilation systems without an ERV or HRV shall have a fan efficacy less than or equal to 0.4 W/cfm.

EXCEPTION to Section 170.2(c)3B: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four habitable stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

C. 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. 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 through M.

A. Fan Systems. Each fan system moving air into, out of, or between spaces or circulating air for the purpose of conditioning air within a space shall meet the requirements of Items i, ii, and iii below.

i. Fan Power Budget. For each fan system that includes at least one fan or fan array with fan electrical input power ≥ 1 kW, fan system electrical input power (Fan kWdesign,system) determined per Section 170.2(c)4Aib at the fan system design airflow determined per section 170.2(c)4Aib shall not exceed Fan kWbudget as calculated per section 170.2(c)4Aia.

a. Calculation of Fan Power Budget (Fan kWbudget). For each fan system:

I. Determine the fan system airflow and choose the appropriate table(s) for fan power allowance.

A. For single-cabinet fan systems, use the fan system airflow and the power allowances in both Tables 170.2-B and Table 170.2-C.

B. For supply-only fan systems, use the fan system airflow and power allowances in Table 170.2- B.

C. For relief fan systems, use the design relief airflow and the power allowances in Table 170.2-C.

D. For exhaust, return, and transfer fan systems, use the fan system airflow and the power allowances in Table 170.2-C.

E. For complex fan systems, separately calculate the fan power allowance for the supply and return/exhaust systems and sum them. For the supply airflow, use supply airflow at the fan system design conditions, and the power allowances in Table 170.2-B. For the return/exhaust airflow, use return/exhaust airflow at the fan system design conditions, and the power allowances in Table 170.2-C.

II. For each fan system determine the components included in the fan system and sum the Fan Power Allowances of those components. All fan systems shall include the System Base Allowance. If, for a given component, only a portion of the fan system airflow passes through the component, calculate the Fan Power Allowance for that component per this equation:

$$FPA_{adj} = \frac{Q_{comp}}{Q_{sys}} X\ FPA_{comp}$$

Where:

FPAadj = The correct/ed fan power allowance for the component in w/cfm

Qcomp = The airflow through component in cfm

Qsys = The fan system airflow in cfm

FPAcomp = The fan power allowance of the component from Table 170.2-B or Table 170.2-C

III. Multiply the fan system airflow by the sum of the fan power allowances for the fan system.

IV. Divide by 1000 to convert to Fan kWbudget.

V. For building sites at elevations greater than 3,000 feet, multiply Fan kWbudget by Correction Factor in Table 170.2-D.

b. Determining Fan System Electrical Input Power (Fan kWdesign,system). Fan kWdesign,system is the sum of Fan kWdesign for each fan or fan array included in the fan system with Fan kWdesign ≥ 1 kW.

If variable speed drives are used their efficiency losses shall be included. Fan input power shall be calculated with two times the clean filter pressure drop, which is the mean of the clean filter pressure drop and design final filter pressure drop. The Fan kWdesign for each fan or fan array shall be determined using one of the following methods. There is no requirement to use the same method for all fans in a fan system:

I. Use the default Fan kWdesign in Table 170.2-E for one or more of the fans. This method cannot be used for complex fan systems.

II. Use the Fan kWdesign at fan system design conditions provided by the manufacturer of the fan, fan array, or equipment that includes the fan or fan array calculated per a test procedure included in USDOE 10 CFR Part 430, USDOE 10 CFR Part 431, ANSI/AMCA Standard 208-2018, ANSI/AMCA Standard 210-2016, AHRI Standard 430-2020, AHRI Standard 440-2019, or ISO 5801-2017.

III. Use the Fan kWdesign provided by the manufacturer, calculated at fan system design conditions per one of the methods listed in section 5.3 of ANSI/AMCA 208-2018.

IV. Determine the Fan kWdesign by using the maximum electrical input power provided on the motor nameplate.

ii. 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 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 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 170.2(c)4Aiii: Motors in space conditioning equipment certified under Section 110.1 or 110.2

EXCEPTION 1 to 170.2(c)4A: fan system power caused solely by process loads.

TABLE 170.2-B: Supply Fan Power Allowances (watts/cfm)

	Multi-Zone VAV Systems ≤5,000 cfm	**Multi-Zone VAV Systems >5,000 and ≤10,000 cfm**	**Multi-Zone VAV Systems >10,000 cfm**	**All Other Fan Systems ≤5,000 cfm**	**All Other Fan Systems >5,000 and ≤10,000 cfm**	**All Other Fan Systems >10,000 cfm**
Supply System Base Allowance for AHU Serving Spaces < 6 Floors Away.	0.395	0.453	0.413	0.232	0.256	0.236
Supply System Base Allowance for AHU Serving Spaces > 6 Floors Away	0.508	0.548	0.501	0.349	0.356	0.325
MERV 13 to MERV 16 Filter Upstream of Thermal Conditioning Equipment (two times the clean filter pressure drop)[2]	0.136	0.114	0.105	0.139	0.120	0.107
MERV 13 to MERV 16 Final Filter Downstream of Thermal Conditioning Equipment. (two times the clean filter pressure drop) [2]	0.225	0.188	0.176	0.231	0.197	0.177
Filtration Allowance for > Merv 16 or HEPA Filter (two times the clean filter pressure drop) [2]	0.335	0.280	0.265	0.342	0.292	0.264
Central Hydronic Heating Coil Allowance	0.046	0.048	0.052	0.046	0.050	0.054
Electric Heat Allowance	0.046	0.038	0.035	0.046	0.040	0.036

	Multi-Zone VAV Systems ≤5,000 cfm	Multi-Zone VAV Systems >5,000 and ≤10,000 cfm	Multi-Zone VAV Systems >10,000 cfm	All Other Fan Systems ≤5,000 cfm	All Other Fan Systems >5,000 and ≤10,000 cfm	All Other Fan Systems >10,000 cfm
Gas Heat Allowance	0.069	0.057	0.070	0.058	0.060	0.072
Hydronic/DX Cooling Coil, or Heat Pump Coil (wet) Allowance	0.135	0.114	0.105	0.139	0.120	0.107
Solid or Liquid Desiccant System Allowance	0.157	0.132	0.123	0.163	0.139	0.124
Reheat Coil for Dehumidification Allowance	0.045	0.038	0.035	0.046	0.040	0.036
Allowance for evaporative humidifier/cooler in series with a cooling coil. Value shown is allowed watts/cfm per 1.0 in. wg. Determine pressure loss (in. wg) at 400 fpm or maximum velocity allowed by the manufacturer, whichever is less. *[Calculation required, see note 4]*	0.224	0.188	0.176	0.231	0.197	0.177
Allowance for 100% outdoor air system meeting the requirements of Note 5.	0.000	0.000	0.000	0.070	0.100	0.107
Energy Recovery Allowance for 0.50 ≤ ERR <0.55 6	*0.135*	*0.114*	*0.105*	0.139	0.120	0.107
Energy Recovery Allowance for 0.55 ≤ ERR <0.60 6	*0.160*	*0.134*	*0.124*	0.165	0.141	0.126
Energy Recovery Allowance for 0.60 ≤ ERR <0.65 6	*0.184*	*0.155*	*0.144*	0.190	0.163	0.146
Energy Recovery Allowance for 0.65 ≤ ERR <0.70 6	*0.208*	*0.175*	*0.163*	0.215	0.184	0.165
Energy Recovery Allowance for 0.70 ≤ ERR <0.75 6	*0.232*	*0.196*	*0.183*	0.240	0.205	0.184

	Multi-Zone VAV Systems ≤5,000 cfm	Multi-Zone VAV Systems >5,000 and ≤10,000 cfm	Multi-Zone VAV Systems >10,000 cfm	All Other Fan Systems ≤5,000 cfm	All Other Fan Systems >5,000 and ≤10,000 cfm	All Other Fan Systems >10,000 cfm
Energy Recovery Allowance for 0.75 ≤ ERR <0.80 6	*0.257*	*0.216*	*0.202*	0.264	0.226	0.203
Energy Recovery Allowance for ERR ≥ 0.80 6	*0.281*	*0.236*	*0.222*	0.289	0.247	0.222
Runaround Loop	*0.135*	*0.114*	*0.105*	0.139	0.120	0.107
Allowance for gas phase filtration required by code or accredited standard. Value shown is allowed w/cfm per 1.0 in. wg air pressure drop. [Calculation required, see note 4]	*0.224*	*0.188*	*0.176*	0.231	0.197	0.177
Economizer Return Damper	*0.045*	*0.038*	*0.035*	0.046	0.040	0.036
Air Blender Allowance	*0.045*	*0.038*	*0.035*	0.046	0.040	0.036
Allowance for sound attenuation section [fans serving spaces with design background noise goals below NC35].	*0.034*	*0.029*	*0.026*	0.035	0.030	0.027
Deduction for systems that feed a terminal unit with a fan with electrical input power < 1kW.	*-0.100*	*-0.100*	*-0.100*	-0.100	-0.100	-0.100
Low-turndown single-zone VAV fan systems meeting the requirements in note 7.	*0.000*	*0.000*	*0.000*	.070	0.100	0.089

1. See FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV) in definition a Multi-Zone VAV System.

2. Filter fan power allowance can only be counted once per fan system.

3. RESERVED.

4. Power allowance requires further calculation by multiplying the actual in. wg. of the device/ component by the watts/ cfm in Table 170.2-B.

5. The 100% outdoor air system must serve 3 or more HVAC zones and airflow during non-economizer operating periods must not exceed 135% of minimum requirements in Section 120.1(c)(3).

6. Energy Recovery Ratio (ERR) calculated per ANSI/ASHRAE 84-2020.

7. A low-turndown single-zone VAV fan system must be capable of and configured to reduce airflow to 50 percent of design airflow and use no more than 30 percent of the design wattage at that airflow. No more than 10 percent of the design load served by the equipment shall have fixed loads.

TABLE 170.2-C: EXHAUST, RETURN, RELIEF, TRANSFER FAN POWER ALLOWANCES (WATT/CFM)

	Multi-Zone VAV Systems ≤5,000 cfm[1]	**Multi-Zone VAV Systems >5,000 and ≤10,000 cfm[1]**	**Multi-Zone VAV Systems >10,000 cfm[1]**	**ll Other Fan Systems ≤5,000 cfm**	**All Other Fan Systems >5,000 and ≤10,000 cfm**	**All Other Fan Systems >10,000 cfm**
Exhaust System Base Allowance	0.221	0.246	0.236	0.186	0.184	0.190
Filter (any MERV value)[2]	0.046	0.041	0.036	0.046	0.041	0.035
Energy Recovery Allowance for 0.50 ≤ ERR <0.55 [3]	0.139	0.120	0.107	0.139	0.123	0.109
Energy Recovery Allowance for 0.55 ≤ ERR <0.60 [3]	0.165	0.142	0.126	0.165	0.144	0.128
Energy Recovery Allowance for 0.60 ≤ ERR <0.65 [3]	0.190	0.163	0.146	0.191	0.166	0.148
Energy Recovery Allowance for 0.65 ≤ ERR <0.70 [3]	0.215	0.184	0.165	0.216	0.188	0.167
Energy Recovery Allowance for 0.70 ≤ ERR <0.75 [3]	0.240	0.206	0.184	0.241	0.209	0.186
Energy Recovery Allowance for 0.75 ≤ ERR <0.80 [3]	0.265	0.227	0.203	0.266	0.231	0.205
Energy Recovery Allowance for ERR ≥ 0.80 [3]	0.289	0.248	0.222	0.291	0.252	0.225

	Multi-Zone VAV Systems ≤5,000 cfm[1]	Multi-Zone VAV Systems >5,000 and ≤10,000 cfm[1]	Multi-Zone VAV Systems >10,000 cfm[1]	ll Other Fan Systems ≤5,000 cfm	All Other Fan Systems >5,000 and ≤10,000 cfm	All Other Fan Systems >10,000 cfm
Runaround Loop	0.139	0.120	0.107	0.139	0.123	0.109
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	0.116	0.100	0.089	0.116	0.102	0.091
Return and/or exhaust airflow control devices required for space pressurization control	0.116	0.100	0.089	0.116	0.102	0.091
Laboratory and vivarium exhaust systems in high- rise buildings for vertical duct exceeding 75 ft. Value shown is allowed w/cfm per 0.25 in. wg for each 100 feet exceeding 75 feet. [Calculation required, see note 4]	0.058	0.051	0.045	0.058	0.052	0.046
Biosafety cabinet. Value shown is allowed w/cfm per 1.0 in. wg air pressure drop. [Calculation required, see note 4]	0.231	0.198	0.177	0.232	0.202	0.179
Exhaust filters, scrubbers, or other exhaust treatment required by code or standard. Value shown is allowed w/cfm per 1.0 in. wg air pressure drop. [Calculation required, see note 4]	0.231	0.198	0.177	0.232	0.202	0.179

	Multi-Zone VAV Systems ≤5,000 cfm[1]	Multi-Zone VAV Systems >5,000 and ≤10,000 cfm[1]	Multi-Zone VAV Systems >10,000 cfm[1]	ll Other Fan Systems ≤5,000 cfm	All Other Fan Systems >5,000 and ≤10,000 cfm	All Other Fan Systems >10,000 cfm
Sound attenuation section [Fans serving spaces with design background noise goals below NC35.]	0.035	0.030	0.027	0.035	0.031	0.028

1. For requirements to be classified as a Multi-Zone VAV System see definition for Multi-Zone Variable Air Volume Fan System.

2. Filter pressure loss can only be counted once per fan system.

3. Energy Recovery Ratio (ERR) calculated per ANSI/ASHRAE 84-2020.

4. Power allowance requires further calculation, multiplying the actual pressure drop (in. wg.) of the device/ component by the watts/cfm in the Table 170.2-C.

TABLE 170.2-D AIR DENSITY CORRECTION FACTORS

Altitude (ft)	*Correction factor*
<3,000	*1.000*
≥~~2:~~3,000 and <4,000	*0.896*
≥~~2:~~4,000 and <5,000	*0.864*
≥~~2:~~5,000 and <6,000	*0.832*
≥~~2:~~6,000	*0.801*

TABLE 170.2-E: Default values for Fan kWdesign Based on Motor Nameplate HP

Motor Nameplate HP	Default Fan kWdesign with variable speed drive (Fan kWdesign)	Default Fan kWdesign without variable speed drive (Fan kWdesign)
<1	0.96	0.89
≥1 and <1.5	1.38	1.29
≥1.5 and <2	1.84	1.72
≥2 and <3	2.73	2.57
≥3 and <5	4.38	4.17
≥5 and <7.5	6.43	6.15

Motor Nameplate HP	Default Fan kWdesign with variable speed drive (Fan kWdesign)	Default Fan kWdesign without variable speed drive (Fan kWdesign)
≥7.5 and <10	8.46	8.13
≥10 and <15	12.47	12.03
≥15 and <20	16.55	16.04
≥20 and <25	20.58	19.92
≥25 and <30	24.59	23.77
≥30 and <40	32.74	31.70
≥40 and <50	40.71	39.46
≥50 and <60	48.50	47.10
≥60 and <75	60.45	58.87
≥75 and ≤100	80.40	78.17

1. This table cannot be used for Motor Nameplate Horsepower values greater than 100.

2. This table is to be used only with motors with a service factor ≤1.15. If the service factor is not provided, this table may not be used.

B. **Space-conditioning Zone Controls.** Each space-conditioning zone shall have controls designed in accordance with 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), the volume of primary air that is reheated, recooled or mixed air supply shall not exceed the larger of:

I. 50 percent of the peak primary airflow; or

II. The design zone outdoor airflow rate as specified by Section 160.2(c)3.

b. The volume of primary air in the deadband shall not exceed the design zone outdoor airflow rate as specified by Section 160.2(c)3.

c. 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.

d. The second stage of heating consists of modulating the airflow rate from the dead band flow rate up to the heating maximum flow rate.

e. 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 160.2(c)3.

EXCEPTION 1 to Section 170.2(c)4B: Zones with special pressurization relationships or cross-contamination control needs.

EXCEPTION 2 to Section 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 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 170.2(c)4B: Zones with a peak supply-air quantity of 300 cfm or less.

C. Economizers

i. Each cooling air handler that has a design total mechanical cooling capacity over 33,000 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 170.2-E, 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 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 170.2(c)4Ci: Where the use of outdoor air for cooling will affect other systems, such as humidification or dehumidification, so as to increase overall building TDV energy use.

EXCEPTION 3 to Section 170.2(c)4Ci: Systems serving dwelling units.

EXCEPTION 4 to Section 170.2(c)4Ci: Where comfort cooling systems have the cooling efficiency that meets or exceeds the cooling efficiency improvement requirements in TABLE 170.2-F.

EXCEPTION 5 to Section 170.2(c)4Ci: Fan systems primarily serving computer rooms. See Section 140.9(a) for computer room economizer requirements.

TABLE 170.2-E CHILLED WATER SYSTEM COOLING CAPACITY

Climate Zones	Total Building Chilled Water System Capacity, Minus Capacity of theCooling units with Air Economizers	
	Building Water-Cooled ChilledWater System	Air-Cooled Chilled Water Systemsor 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 170.2-F ECONOMIZER TRADE-OFF TABLE FOR COOLING SYSTEMS

Climate Zone	**Efficiency Improvement [a]**
1	70%
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%

[a] If a unit is rated with an annualized or part-load metric, then to eliminate the required economizer, only the annualized or part-load minimum cooling efficiency of the unit must be increased by the percentage shown. If the unit is only rated with a full load metric, like EER or COP cooling, then that metric must be increased by the percentage shown. To determine the efficiency required to eliminate economizer, when the unit equipment efficiency is rated with an energy-input divided by work-output metric, the metric shall first be converted to COP prior to multiplying by the efficiency improvement percentage and then converted back to the rated metric.

ii. If an economizer is required by Section 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 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 170.2-G.

TABLE 170.2-G AIR ECONOMIZER HIGH LIMIT SHUT OFF CONTROL REQUIREMENTS

Device Type[a]	**Climate Zones**	**Required High Limit (Economizer Off When):**	**High Limit (Economizer OffWhen):**
		Equation[b]	**Description**

Fixed Dry Bulb	1, 3, 5, 11-16	T_{OA} > 75°F	Outdoor air temperature exceeds 75°F
Fixed Dry Bulb	2, 4, 10	T_{OA} > 73°F	Outdoor air temperature exceeds 73°F
Fixed Dry Bulb	6, 8, 9	T_{OA} > 71°F	Outdoor air temperature exceeds 71°F
Fixed Dry Bulb	7	T_{OA} > 69°F	Outdoor air temperature exceeds 69°F
fferential DryBulb	1, 3, 5, 11-16	T_{OA} > T_{RA}°F	door air temperature exceedsreturn air temperature
fferential DryBulb	2, 4, 10	T_{OA} > T_{RA}-2°F	Outdoor air temperature exceedsreturn air temperature minus 2°F
fferential DryBulb	6, 8, 9	T_{OA} > T_{RA}-4°F	Outdoor air temperature exceedsreturn air temperature minus 4°F
fferential DryBulb	7	T_{OA} > T_{RA}-6°F	Outdoor air temperature exceedsreturn air temperature minus 6°F
Fixed Enthalpy[c] + Fixed Drybulb	All	h_{OA} > 28 Btu/lb[c] or T_{OA} > 75°F	enthalpy exceeds 28 Btu/lbof 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 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.

iii. The air economizer and all air dampers shall have the following features:

a. **Warranty.** 5-year Manufacturer warranty of economizer assembly.

b. **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.

c. **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.

d. **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.

e. **Sensor accuracy.** Outdoor air, return air, mixed air, and supply air sensors shall be calibrated within the following accuracies.

I. Drybulb and wetbulb temperatures accurate to ±2°F over the range of 40°F to 80°F;

II. Enthalpy accurate to ±3 Btu/lb over the range of 20 Btu/lb to 36 Btu/lb;

III. Relative humidity (RH) accurate to ±5 percent over the range of 20 percent to 80 percent RH;

f. **Sensor calibration data.** Data used for control of the economizer shall be plotted on a sensor performance curve.

g. **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.

h. **Relief air system.** Relief air systems shall be capable of providing 100 percent outside air without over- pressurizing the building.

iv. The space conditioning system shall include the following:

a. 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 45oF.

b. 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.

c. DX units not within the scope of Section 170.2(c)4Ciib shall (i) comply with the requirements in TABLE 170.2-H, 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 170.2-H DIRECT EXPANSION (DX) UNIT REQUIREMENTS FOR COOLING STAGES AND COMPRESSOR DISPLACEMENT

Cooling Capacity	Minimum Number of Mechanical Cooling Stages	imum 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

v. Systems that include a water economizer to meet Section 170.2(c)4Ci shall 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 170.2(c)4D: Systems that meet the requirements of Section 170.2(c)3Bi, without using Exception 1 to that section.

EXCEPTION 2 to Section 170.2(c)4D: Where supply-air temperature reset would increase overall building energy use.

EXCEPTION 3 to Section 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.

E. Electric Resistance Heating. Electric resistance heating systems shall not be used for space heating.

EXCEPTION 1 to Section 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 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 170.2(c)1 at the design outdoor temperature specified in Section 170.2(c)2.

EXCEPTION 3 to Section 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 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 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 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-NI.

EXCEPTION 2 to Section 170.2(c)4Fi: Condenser fans serving multiple refrigerant circuits.

EXCEPTION 3 to Section 170.2(c)4Fi: Condenser fans serving flooded condensers.

EXCEPTION 4 to Section 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 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 170.2(c)4Fiii: Cooling towers that meet the energy efficiency requirement for propeller fan towers in Section 110.2, TABLE 110.2-GF.

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 manufacture's 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-GF.

EXCEPTION 1 to Section 170.2(c)4Fv: Replacement of existing cooling towers that are inside an existing building or on an existing roof.

EXCEPTION 2 to Section 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 170.2(c)4G: Chillers with electrical service > 600V.

EXCEPTION 2 to Section 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 170.2(c)4G: Chillers used to charge thermal energy storage systems where the charging temperature is < 40 °F.

EXCEPTION 4 to Section 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 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 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).

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 170.2(c)4I: Systems that include no more than three control valves.

EXCEPTION 2 to Section 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 to Section 170.2(c)4Iiv: Hydronic systems that use variable flow to reduce pumping energy in accordance with Section 170.2(c)4Ii.

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 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 170.2(c)4Ivi: Heating hot water systems.

EXCEPTION 2 to Section 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 170.2(c)4lvii: 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. RESERVED

K. Fan Control. Each cooling system listed in TABLE 170.2-H shall be designed to vary the indoor fan airflow as a function of load and shall comply with the following requirements:

i. 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.

ii. 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.

iii. Systems that include an air side economizer to meet 170.2(c)4Ci shall have a minimum of two speeds of fan control during economizer operation.

EXCEPTION to Section 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.

L. Mechanical System Shut-off. Any directly conditioned common use area 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 170.2(c)4L: Interlocks are not required on doors with automatic closing devices.

EXCEPTION 2 to Section 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).

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 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 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 2 to Section 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.

N. Dedicated Outdoor Air Systems (DOAS). HVAC Systems utilizing a dedicated outdoor air system (DOAS) to condition, temper, or filter 100 percent outdoor air separate from local or central space-conditioning systems serving the same space shall meet the following criteria:

i. Provide each space with one of the following configurations:

a. A DOAS unit and a separate independent space-conditioning system in which the independent space- conditioning system complies with the economizer requirements specified by Section 170.2(c)4Ci and the DOAS unit complies with the exhaust air heat recovery requirements specified in Section 170.2(c)4N.

b. A DOAS unit which meets or exceeds the following criteria and a separate space cooling system:

I. Provides at least the minimum ventilation air flow rate as specified in Section 120.1(c)3 and provides no less than 0.3cfm/ft2 during economizer operation.

II. Ventilation sensible energy recovery ratio of at least 60 percent or enthalpy recovery ratio of at least 50 percent at full flow cooling design conditions and heating design condition.

III. Energy recovery bypass or control to directly economize with ventilation air based on outdoor air temperature limits specified in TABLE 170.2-G.

c. DOAS units with airflow rate > 1,000 cfm must meet demand ventilation control requirements in accordance with Sections 160.2(c)5C, D, and E.

EXCEPTION to Section 170.2(c)4Ni: Systems installed for the sole purpose of providing makeup air for exhausting toxic fumes, flammable materials, paint, corrosive fumes, dust, dryer exhaust, or commercial kitchen hoods used for collecting and removing grease vapors and smoke.

ii. Ventilation fan systems shall be capable of modulating fan speed control.

iii. Heating and cooling equipment fans, heating and cooling circulation pumps, and terminal unit fans shall cycle off, and terminal unit primary cooling air shall be shut off when there is no call for heating or cooling in the zone.

EXCEPTION to Section 170.2(c)4Niii: Fans used for heating and cooling using less than 0.12 watts per cfm may operate when space temperatures are within the thermostat deadband to provide destratification and air mixing in the space.

iv. The DOAS supply air shall be delivered directly to the occupied space or downstream of the terminal heating/or cooling coils.

EXCEPTION 1 to Section 170.2(c)4Niv: Active chilled beam systems.

EXCEPTION 2 to Section 170.2(c)4Niv: Sensible only cooling terminal units with pressure-independent variable-airflow regulating devices limiting the DOAS supply air to the greater of latent load or minimum ventilation requirements.

EXCEPTION 3 to Section 170.2(c)4Niv: Terminal heating or cooling units that comply with the low fan power allowance requirements in Exception to Section 170.2(c)4Oiii.

v. DOAS with mechanical cooling providing ventilation to multiple zones and operating in conjunction with zone heating and cooling systems shall

not use heating or heat recovery to warm supply air above 60°F when representative building loads or outdoor air temperature indicate that the majority of zones require cooling.

vi. DOAS with a total fan system power less than 1 kW shall not exceed a total combined fan power of 1.0 W/cfm. DOAS with fan power greater than or equal to 1 kW shall meet the requirements of Section 170.2(c)4A.

O. Exhaust Air Heat Recovery. Fan systems designed to operate to the criteria listed in either Table 170.2-I or Table 170.2-J shall include an exhaust air heat recovery system which meets the following:

i. A sensible energy recovery ratio of at least 60 percent or an enthalpy recovery ratio of at least 50 percent for both heating and cooling design conditions.

ii. Energy recovery bypass or control to disable energy recovery and to directly economize with ventilation air based on outdoor air temperature limits specified in TABLE 170.2-G. For energy recovery systems where the transfer of energy cannot be stopped, bypass shall prevent the total airflow rate of either outdoor air or exhaust air through the energy recovery exchanger from exceeding 10% of the full design airflow rate.

iii. For a DOAS unit and a separate independent space-conditioning system meeting the requirements of 170.2(c)4Nia, the design supply fan airflow rate shall be the total airflow of only the DOAS unit.

EXCEPTION 1 to Section 170.2(c)4Oii: DOAS units with the capability to shut off when a separate independent space-conditioning system meets the economizer requirements specified by section 170.2(c)4Ci is economizing.

EXCEPTION 2 to Section 170.2(c)4O: Systems meeting Section 140.9(c) Prescriptive Requirements for Laboratory and Factory Exhaust Systems.

EXCEPTION 3 to Section 170.2(c)4O: Systems serving spaces that are not cooled and that are heated to less than 60°F.

EXCEPTION 4 to Section 170.2(c)4O: Where more than 60 percent of the outdoor air heating energy is provided from site-recovered energy in Climate Zone 16.

EXCEPTION 5 to Section 170.2(c)4O: Sensible recovery ratio requirements at heating design conditions are exempted for Climate Zone 15.

EXCEPTION 6 to 170.2(c)4O: Sensible recovery ratio requirements at cooling design conditions are exempted for Climate Zone 01.

EXCEPTION 7 to Section 170.2(c)4O: Where the sum of the airflow rates exhausted and relieved within 20 feet of each other is less than 75 percent of the design outdoor airflow rate, excluding exhaust air that is either:

i. used for another energy recovery system;

ii. not allowed by California Mechanical Code (Title 24, Part 4) for use in energy recovery systems with leakage potential; or

iii. of Class 4 as specified in Section 160.2(c)8.

EXCEPTION 8 to Section 170.2(c)4O: Systems expected to operate less than 20 hours per week.

TABLE 170.2-I: ENERGY RECOVERY REQUIREMENTS BY CLIMATE ZONE AND PERCENT OUTDOOR AIR AT FULL DESIGN AIRFLOW (<8,000 HOURS / YEAR)

% Outdoor Air at Full Design Airflow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
≥10% and <20%	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
≥20% and <30%	≥15,000	≥20,000	NR	NR	NR	NR	NR	NR	NR	NR	≥18,500	≥18,500	≥18,500	≥18,500	≥18,500	≥18,500
≥30% and <40%	≥13,000	≥15,000	NR	NR	NR	NR	NR	NR	NR	NR	≥15,000	≥15,000	≥15,000	≥15,000	≥15,000	≥15,000
≥40% and <50%	≥10,000	≥12,000	NR	NR	NR	NR	NR	NR	NR	≥22,000	≥10,000	≥10,000	≥10,000	≥10,000	≥10,000	≥10,000
≥50% and <60%	≥9,000	≥10,000	NR	≥18,500	NR	NR	NR	NR	NR	≥17,000	≥8,000	≥8,000	≥8,000	≥8,000	≥8,000	≥8,000
≥60% and <70%	≥7,000	≥7,500	NR	≥16,500	NR	NR	NR	NR	≥20,000	≥15,000	≥7,000	≥7,000	≥7,000	≥7,000	≥7,000	≥7,000
≥70% and <80%	≥6,500	≥7,000	NR	≥15,000	NR	NR	NR	NR	≥17,000	≥14,000	≥5,000	≥5,000	≥5,000	≥5,000	≥5,000	≥5,000
≥80%	≥4,500	≥6,500	NR	≥14,000	NR	NR	NR	NR	≥15,000	≥13,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000

TABLE 170.2-J: ENERGY RECOVERY REQUIREMENTS BY CLIMATE ZONE AND PERCENT OUTDOOR AIR AT FULL DESIGN AIRFLOW (≥8,000 HOURS / YEAR)

% Outdoor Air at Full Design Airflow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
≥10% and <20%	≥10,000	≥10,000	NR	NR	NR	NR	NR	NR	NR	≥40,000	≥40,000	≥20,000	≥10,000	≥10,000	≥10,000	≥10,000
≥20% and <30%	≥2,000	≥5,000	≥13,000	≥9,000	≥9,000	NR	NR	NR	NR	≥15,000	≥15,000	≥5,000	≥5,000	≥5,000	≥5,000	≥5,000
≥30% and <40%	≥2,000	≥3,000	≥10,000	≥6,500	≥6,500	NR	NR	NR	≥15,000	≥7,500	≥7,500	≥3,000	≥3,000	≥3,000	≥3,000	≥3,000
≥40% and <50%	≥2,000	≥2,000	≥8,000	≥6,000	≥6,000	NR	NR	NR	≥12,000	≥6,000	≥6,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000
≥50% and <60%	≥2,000	≥2,000	≥7,000	≥6,000	≥6,000	NR	NR	≥20,000	≥10,000	≥5,000	≥5,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000
≥60% and <70%	≥2,000	≥2,000	≥6,000	≥6,000	≥6,000	NR	NR	≥18,000	≥9,000	≥4,000	≥4,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000
≥70% and <80%	≥2,000	≥2,000	≥6,000	≥5,000	≥5,000	NR	NR	≥15,000	≥8,000	≥3,000	≥3,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000
≥80%	≥2,000	≥2,000	≥6,000	≥5,000	≥5,000	NR	NR	≥12,000	≥7,000	≥3,000	≥3,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000

(d) Water Heating Systems. Water-heating systems shall meet the requirements of either 1, 2, 3 or 4.

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. Recirculation system serving multiple dwelling units shall meet the requirements of Sections 110.3(c)2 and 110.3(c)5, and shall be capable of automatically controlling the recirculation pump operation based on measurement of hot water demand and hot water return temperature:

1. For systems serving individual dwelling units, the water heating system shall meet the requirement of either A, B, C, or shall meet the performance compliance requirements of Section 170.1:

   A. A single 240 volt heat pump water heater. In addition, meet the following:

      i. A compact hot water distribution system as specified in the Reference Appendix RA4.4.6. in climate 1 and 16; and

      ii. A drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9 in climate zone 16.

   B. A single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher. In addition, for Climate Zones 16, a drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9.

   C. A gas or propane instantaneous water heater with an input of 200,000 Btu per hour or less and no storage tank.

2. For heat pump water-heating systems serving multiple dwelling units, the water heating system shall be installed according to the manufacturer design and installation guidelines and meet the following requirements:

   A. The hot water return from the recirculation loop shall connect to a recirculation loop tank and shall not directly connect to the primary heat pump water heater inlet or the primary thermal storage tanks.

   B. The fuel source for the recirculation loop tank shall be electricity if auxiliary heating is needed. The recirculation loop heater shall be capable of multi-pass water heating operation.

   C. For systems with single pass primary heat pump water heater, the primary thermal storage tanks shall be piped in series if multiple tanks are used. For systems with multi-pass primary heat pump water heater, the primary thermal storage tanks shall be piped in parallel if multiple tanks are used.

   D. The primary storage tank temperature setpoint shall be at least 135°F.

E. The recirculation loop tank temperature setpoint shall be at least 10°F lower than the primary thermal storage tank temperature setpoint such that hot water from the recirculation loop tank is used for the temperature maintenance load before engaging the recirculation loop tank heater.

F. The minimum heat pump water heater compressor cut-off temperature shall be equal to or lower than 40°F ambient air temperature.

G. A recirculation system.

H. Design documentation shall be provided in accordance with JA14.4.

EXCEPTION to Section 170.2(d)2G: Buildings with eight or fewer dwelling units.

3. For gas or propane systems serving multiple dwelling units, a central water-heating system that includes the following components shall be installed:

A. For Climate Zones 1 through 9, gas service water-heating systems with a total installed gas water-heating input capacity of 1 MMBtu/h or greater shall have gas service water-heating equipment with a minimum thermal efficiency of 90 percent. Multiple units are allowed to meet this requirement with an input capacity- weighted average of at least 90 percent.

EXCEPTION 1 to Section 170.2(d)3A: Individual gas water heaters with input capacity at or below 100,000 Btu/h shall not be included in the calculations of the total system input or total system efficiency.

EXCPTION 2 TO Section 170.2(d)3A: If 25 percent of the annual water-heating requirement is provided by site-solar energy or site-recovered energy.

B. A recirculation system.

EXCEPTION to Section 170.2(d)3B: Buildings with eight or fewer dwelling units.

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 i or ii 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.

4. A water-heating system serving multiple dwelling units determined by the Executive Director to use no more energy than the one specified in subsection 1, 2, or 3 above.

TABLE 170.2-K 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
Unitary (serving one dwelling unit)	If Balanced Ventilation System[1]	HRV or ERV Sensible Recovery Efficiency	0.67	0.67	NR	NR	NR	NR	NR	NR	NR	NR	0.67	0.67	0.67	0.67	0.67	0.67
		HRV or ERV Fan Efficacy (W/cfm)	0.6	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.6	0.6	0.6	0.6	0.6
		Non-HRV or Non-ERV Fan Efficacy (W/cfm)	NR	NR	NR	0.4	0.4	0.4	0.4	0.4	0.4	0.4	NR	NR	NR	NR	NR	NR
	If Heat Pump, HSPF [72]/HSPF2		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
	If Dual-Fuel Heat Pump, AFUE		MIN	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	MIN
	Refrigerant Charge Verification or Fault Indicator Display		NR	REQ	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
	SEER/SEER2		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
Central (serving multiple dwelling units)	If Balanced Ventilation Systems[1]	Sensible Recovery Efficiency or Effectiveness	0.67	0.67	NR	NR	NR	NR	NR	NR	NR	NR	0.67	0.67	0.67	0.67	0.67	0.67
		Bypass Function	REQe	REQe	NR	NR	NR	NR	NR	NR	NR	NR	REQe	REQe	REQe	REQe	REQe	REQe
Central System Air Handlers	ral Fan Integrated Ventilation System Fan Efficacy		REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
Duct Insulation	Ducts in Unconditioned Space		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
Water Heating	All Buildings		System Shall meet Section 170.2(dc)															

Footnote requirements to TABLE 170.2-K:

1. Requirements only apply when using Balanced Ventilation to meet 160.2(b)2Aivb.

2. HSPF means "heating seasonal performance factor."

3. 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.

(e) **Lighting.** Dwelling unit lighting shall meet the applicable mandatory requirements of Section 160.5(a). Common use area lighting shall meet the following requirements:

EXCEPTION to Section 170.2(e): Common use areas providing shared provisions for living, eating, cooking, or sanitation to dwelling units that would otherwise lack these provisions may instead comply with Section 160.5(a).

1. Interior Common Use Area Lighting. A building complies with Section 170.2(e)1 if:

A. The Calculation of Adjusted Indoor Lighting Power of all proposed building areas combined, calculated under Subsection 170.2(e)2 is no greater than the Calculation of Allowed Indoor Lighting Power, Specific Methodologies calculated under Subsection 170.2(e)4; and

B. The Calculation of Allowed Indoor Lighting Power, General Rules comply with Subsection 170.2(e)3;

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.

2. **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 A through D of this subsection.

A. **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:

i. An Installation Certificate detailing compliance with Section 170.2(e)1A is submitted in accordance with Section 10-103 and Section 160.5(e); and

ii. The area or areas served by the interlocking systems is an auditorium, a conference room, a multipurpose room, or a theater; and

iii. 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.

B. 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 170.2-L may be reduced by the product of (i) the number of watts controlled as described in TABLE 170.2-L, times (ii) the applicable Power Adjustment Factor (PAF), if all of the following conditions are met:

i. An Installation Certificate is submitted in accordance with Section 160.5(e)2; and

ii. Luminaires and controls meet the applicable requirements of Section 110.9, and Sections 160.5(b) through 160.6; and

iii. 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:

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

b. The furniture mounted luminaires shall be permanently hardwired; and

c. The furniture mounted lighting system shall be designed to provide indirect general lighting; and

d. Before multiplying the installed watts of the furniture mounted luminaire by the applicable PAF, 0.3 watts per square foot of the area illuminated by the furniture mounted luminaires shall be subtracted from installed watts of the furniture mounted luminaires; and

e. The lighting control for the furniture mounted luminaire complies with all other applicable requirements in Section 170.2(e)1Aii.

iv. At least 50 percent of the light output of the controlled luminaire is within the applicable area listed in Table 170.2-L. Luminaires on lighting tracks shall be within the applicable area in order to qualify for a PAF.

v. Only one PAF from Table 170.2-L may be used for each qualifying luminaire. PAFs shall not be added together unless allowed in Table 170.2-L.

vi. Only lighting wattage directly controlled in accordance with Section 170.2(e)1Aii shall be used to reduce the installed watts as allowed by Section 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 170.2(e)1Aii, then only that portion of controlled wattage may be reduced in calculating Adjusted Indoor Lighting Power.

vii. 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 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.

viii. To qualify for the PAF for daylight continuous dimming plus OFF control, the daylight control and controlled luminaires shall comply with Section 160.5(b)4D, 160.5(e)1C and 160.5(e)1G, and the controls shall be continuous dimming 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 to the luminaires in the primary sidelit daylit zone, secondary sidelit daylit zone, and the skylit daylit zone.

ix. To qualify for the PAF for an occupant sensing control controlling the general lighting in open plan office areas above workstations, in accordance with Table 170.2-L, the following requirements shall be met:u

a. The open plan office area shall be greater than 250 square feet; and

b. This PAF shall be available only in office areas which contain workstations; and

c. Controlled luminaires shall only be those that provide general lighting directly above the controlled area, or furniture mounted luminaires that comply with Section 170.2(e)1Aii and provide general lighting directly above the controlled area; and

d. Qualifying luminaires shall be controlled by occupant sensing controls that meet all of the following requirements, as applicable:

I. Infrared sensors shall be equipped by the manufacturer, 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.

II. Ultrasonic sensors shall be tuned to reduce their sensitivity to prevent them from being triggered by movements outside of the controlled area.

III. All other sensors shall be installed and adjusted as necessary to prevent them from being triggered by movements outside of the controlled area.

x. To qualify for the PAF for an Institutional Tuning in Table 170.2-L, the tuned lighting system shall comply with all of the following requirements:

a. The lighting controls shall limit the maximum output or maximum power draw of the controlled lighting to 85 percent or less of full light output or full power draw; and

b. The means of setting the limit is accessible only to authorized personnel; and

c. The setting of the limit is verified by the acceptance test required by Section 160.5(e)1G; and

d. 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.

xi. To qualify for the PAF for a Demand Responsive Control in Table 170.2-L, the general lighting wattage receiving the PAF shall not be within the scope of Section 110.12(c) and a Demand Responsive Control shall meet all of the following requirements:

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

b. General lighting shall be reduced in a manner consistent with uniform level of illumination requirements in TABLE 160.5-B.

xii. To qualify for the PAFs for clerestory fenestration, horizontal slats, or light shelves in Table 170.2- L, 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 160.5(b)4D) are installed.

C. Lighting wattage excluded. The watts of the following indoor lighting applications may be excluded from Adjusted Indoor Lighting Power:

i. Lighting installed by the manufacturer in walk-in coolers or freezers, vending machines, and food preparation equipment.

ii. Lighting that is required for exit signs subject to the CBC. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.

iii. Exit way or egress illumination that is normally off and that is subject to the CBC. iv. Temporary lighting systems.

v. 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.

vi. Lighting for signs: Lighting for signs shall comply with Section 170.2(e)7.

vii. Lighting in elevators where the lighting meets the requirements in Section 120.6(f).

viii. Lighting connected to a Life Safety Branch or Critical Branch, as specified in Section 517 of the California Electrical Code.

D. **Luminaire Classification and Power Adjustment**

i. Luminaire Classification and Power shall be determined in accordance with Section 160.5(b)1.

ii. 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:

a. Small Aperture. Qualifying luminaires with a luminaire aperture length longer than 18 inches shall have a luminaire aperture no wider than four inches. Qualifying luminaires with a luminaire aperture length of 18 inches or less shall have a luminaire aperture no wider than eight inches.

b. 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.

c. Controls. Qualifying luminaires shall be connected to controls that allows color changing of the luminaires.

iii. Tailored Method Display Lighting Mounting Height Lighting Power Adjustment. For wall display luminaires or floor display luminaires meeting Tailored Method Section 170.2(e)1Ciig and hvi 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 170.2-O. 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.

3. **Calculation of Allowed Indoor Lighting Power: General Rules.**

A. 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.

B. 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.

C. The Allowed Indoor Lighting Power allotment for general lighting shall be calculated as follows:

i. The Area Category Method, as described in Section 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 170.2(e)1Ci. Under the Area Category Method (either by itself or in conjunction with the Tailored Method), as described more fully in Section 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:

a. 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 170.2-M (or TABLE 170.2-N if the Tailored Method is used for that area).

b. 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 170.2-M (or Table 170.2-N 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.

D. The Tailored Method, as described in Section 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 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 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 170.2-N (or Table 170.2-M 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 170.2-L (or TABLE 170.2-M if the Area Category Method is used for that area);

E. 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.

F. 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.

4. Calculation of Allowed Indoor Lighting Power: Specific Methodologies. The allowed indoor Lighting Power for each common use primary function area shall be calculated using only one of the methods in Subsection i, ii, or iii below as applicable.

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

i. The Area Category Method shall be used only for primary function areas, as defined in Section 100.1, that are listed in Table 170.2-M. For primary function areas not listed, selection of a reasonably equivalent type shall be permitted.

ii. For purposes of compliance with Section 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 170.2-M.

iii. 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.

iv. The allowed indoor Lighting Power for each primary function area is the Lighting Power Density value in TABLE 170.2-M 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.

v. In addition to the allowed indoor Lighting Power calculated according to Sections 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 170.2-M under the following conditions:

a. Only primary function areas having a lighting system as specified in the Qualifying Lighting Systems column in TABLE 170.2-M and in accordance with the corresponding footnote of the TABLE shall qualify for the additional lighting power allowances; and

b. 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

c. 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

d. The additional lighting power allowances shall not utilize any type of luminaires that are used for general lighting in the building; and

e. 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

f. The additional lighting power allowed is the smaller of:

I. the lighting power density listed in the “Allowed Additional Lighting LPD” column in TABLE 170.2-M, times the square feet of the primary function, or

II. the Adjusted Indoor Lighting Power of the applicable lighting; and

III. RESERVED

B. Tailored Method. Requirements for using the Tailored Method include all of the following:

i. The Tailored Method shall be used only for primary function areas listed in TABLE 170.2-N as defined in Section 100.1.

ii. Allowed Indoor Lighting Power allotments for general lighting shall be determined according to Section 170.2(e)1Ciif, as applicable.

iii. For compliance with Section 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 170.2-N.

iv. 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.

v. In addition to the allowed indoor Lighting Power allotments for general lighting calculated according to Section 170.2(e)1Ciif, as applicable, the building may add additional lighting power allowances for wall display lighting, task lighting, and decorative/special effects lighting, according to Section 170.20(e)1Ciig through ix.

vi. Determine allowed indoor Lighting Power allotments for general lighting for primary function areas listed in TABLE 170.2-N as follows:

a. Use the General Illumination Level (Lux) listed in Column 2 of TABLE 170.2-N to determine the Allowed General Lighting Power Density allotments for the area.

b. Determine the room cavity ratio (RCR) for the area. The RCR shall be calculated according to the applicable equation in TABLE 170.2-P.

c. Find the allowed General Lighting Power Density allotments in TABLE 170.2-Q that is applicable to the General Illuminance Level (Lux) from Column 2 of TABLE 170.2-N (as described in Item i.) and the RCR determined in accordance with TABLE 170.2-P (as described in Item ii).

d. Determine the square feet of the area in accordance with Section 170.2(e)1Ciie and d.

e. 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.

vii. Determine additional allowed power for wall display lighting according to column 3 of TABLE 170.2-N for each primary function area as follows:

a. Qualifying wall lighting shall:

I. 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.

II. 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.)

b. 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.

c. 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 170.2-O can be used to adjust the installed luminaire wattage as specified in Section 170.2(e)1Aive.

d. The allowed power for wall display lighting shall be the smaller of:

I. the “wall display lighting power density” determined in accordance with TABLE 170.2-N, multiplied by the wall display lengths determined in accordance with Item iii; and

II. The Adjusted Indoor Lighting Power used for the wall display lighting systems.

e. 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 170.2(e)1Ciig. All other lighting internal to display cases are counted as floor display lighting as specified in Section.

viii. Determine additional allowed power allotment for task lighting according to Column 4 of Table 170.2-N for each primary function area as follows:

a. Additional allowed power for task lighting, may be used by qualifying task lighting systems. For floor areas qualifying for 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.

b. 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.

c. The square footage of task areas shall be determined in accordance with Section 170.2(e)1ciic and e, except that any floor area designed to not have tasks, such as floor areas designated as a path of egress, shall not be included for the task lighting allowance.

d. The allowed power for task lighting for each applicable area shall be the smaller of:

I. The allowed task lighting power determined in accordance with Section 170.2(e)1ciih multiplied by the floor square footage determined in accordance with Section 170.2(e)1cihhIII; and

II. The Adjusted Indoor Lighting Power used for the task lighting systems.

ix. Determine additional allowed power for decorative/special effects lighting for each primary function area as follows:

a. Qualifying decorative/special effects 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.

b. Additional lighting power for decorative/special effects lighting shall be used only if allowed by Column 5 of TABLE 170.2-N.

c. Additional lighting power for decorative/special effects lighting shall be used only in areas having decorative/special effects lighting. The square footage of the floor area shall be determined in accordance with Section 170.2(e)1ciic and d, and it shall not include floor areas not having decorative/special effects lighting.

d. The additional allowed power for decorative/special effects lighting for each applicable area shall be the smaller of:

I. The product of the "allowed decorative/special effects lighting power" determined in accordance with Section 170.2(e) 1CiikII, multiplied by the floor square footage determined in accordance with Section 170.2(e)1CiikIII; and

II. The Adjusted Indoor Lighting Power of allowed ornamental/special effects lighting.

TABLE 170.2-L LIGHTING POWER ADJUSTMENT FACTORS (PAF)

a. To qualify for any of the Power Adjustment Factors in this table, the installation shall comply with the applicable requirements in Section 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

TYPE OF CONTROL	TYPE OF AREA	FACTOR
1. Daylight Continuous Dimming plus OFF Control	Luminaires in skylit daylit zone or primary sidelit daylit zone	0.10
2. Occupant Sensing Controls in Office Spaces larger than 250 square feet	In open plan offices > 250 square feet: One sensor controlling an area that is: No larger than 125 square feet	0.30
	In open plan offices > 250 square feet: One sensor controlling an area that is: From 126 to 250 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

TYPE OF CONTROL	TYPE OF AREA	FACTOR
4. Demand Responsive Control	General lighting luminaires not in the scope of Section 110.12(c). 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 170.2-MAREA CATEGORY METHOD - LIGHTING POWER DENSITY VALUES (WATTS/FT²)

Primary Function Area	Allowed Lighting Power Density for General Lighting (W/ft2)	Additional Lighting Power Qualified Lighting Systems	Additional Lighting Power Additional Allowance (W/ft², unless noted otherwise)
Storage	0.45	-	-
Conference, Multipurpose and Meeting Area	0.75	Display/Decorative	0.30
Copy Room	0.50	-	-
Corridor Area	0.40	Decorative/Display	0.25
Dining Area Bar/Lounge and Fine Dining	0.45	Display/Decorative	0.35
Dining Area Cafeteria/Fast Food	0.45	Display/Decorative	0.3525
Dining Area Family and Leisure	0.40	Display/Decorative	0.25
Health Care / Assisted Living Nurse's Station	0.75	Tunable white or dim-to-warm8	0.10
Health Care / Assisted Living Physical Therapy Room	0.85	Tunable white or dim-to-warm8	0.10
Kitchen/Food Preparation Area	0.95	-	-
Electrical, Mechanical, Telephone Rooms	0.40	Detailed Task Work1	0.20
Exercise/Fitness Center and Gymnasium Area	0.50	-	-

Primary Function Area		Allowed Lighting Power Density for General Lighting (W/ft2)	Additional Lighting Power Qualified Lighting Systems	Additional Lighting Power Additional Allowance (W/ft², unless noted otherwise)
Lobby, Main Entry		0.70	Display/Decorative	0.25
Locker Room		0.45	-	-
Lounge, Breakroom, or Waiting Area		0.55	Display/Decorative	0.25
Concourse and Atria Area		0.60	Display/Decorative	0.25
Office Area	> 250 square feet	0.60	Decorative/Display and Portable lighting for office areas5	0.20
Office Area	≤ 250 square feet	0.65	Decorative/Display and Portable lighting for office areas5	0.20
Parking Garage Area	Parking Zone and Ramps	0.10	First ATM or Ticket Machine	100 W
Parking Garage Area	Parking Zone and Ramps	0.10	Additional ATM or Ticket machine	50 W each
Parking Garage Area	Daylight Adaptation Zones3	1.00	-	-
Laundry Area		0.45	-	-
Restrooms		0.65	Decorative/ Display	0.35
Stairwell		0.60	Decorative/ Display	0.35
All other		0.40	-	-
Aging Eye/Low-vision6	Lobby, Main Entry	0.85	Display/Decorative	0.30
Aging Eye/Low-vision6	Lobby, Main Entry	0.85	Transition Lighting OFF at night7	0.95
Aging Eye/Low-vision6	Stairwell	0.80	Display/Decorative	0.30
Aging Eye/Low-vision6	Corridor Area	0.70	Display/Decorative	0.30
Aging Eye/Low-vision6	Lounge/Waiting Area	0.80	Display/Decorative	0.30
Aging Eye/Low-vision6	Multipurpose Room	0.85	Display/Decorative	0.30
Aging Eye/Low-vision6	Dining	0.80	Display/Decorative	0.30
Aging Eye/Low-vision6	Restroom	1.00	Display/Decorative	0.20

Footnotes for this table are listed below.

1. 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.

2. RESERVED

3. Daylight Adaptation Zones shall be no longer than 66 feet from the entrance to the parking garage. 4. RESERVED

5. 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.

6. 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.

7. 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.

8. 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.

TABLE 170.2-N TAILORED METHOD LIGHTING POWER ALLOWANCES

1	2	3		5
Primary Function Area	**General Illumination Level (Lux)**	**Wall Lighting Power Density (W/ft)**	**Task Lighting Power Density (W/ft)**	**Allowed Decorative/ Special Effect Lighting Power Density (W/ft^2)**
Conference, Multipurpose, and Meeting Center Areas	300	2.00	0.25	0.35
Dining Areas	200	1.25	0.25	0.35
Lobby, Main Entry	200	3.50	0.25	0.35

TABLE 170.2-O TAILORED WALL AND FLOOR DISPLAY MOUNTING HEIGHT ADJUSTMENT FACTORSFACTORS

Height in feet above finished floor and bottom of luminaire(s)	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 170.2-P ROOM CAVITY RATIO (RCR) EQUATIONS

Determine the Room Cavity Ratio for Table 170.2-Q using one of the following equations.
Room cavity ratio for rectangular rooms $RRRRRR = \frac{5 \times HH \times (LL + WW)}{LL \times WW}$

Room cavity ratio for irregular-shaped rooms $RRRRRR = \frac{2.5 \times HH \times PP}{AA}$
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 170.2-Q TAILORED METHOD GENERAL LIGHTING POWER ALLOWED – BY ILLUMINANCE AND ROOM CAVITY RATIO

General Lighting Power Density (W/ft²) for the following RCR 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	0.35	0.40	0.50	0.65
200	0.40	0.50	0.65	0.85
300	0.55	0.70	0.85	1.20
400	0.65	0.80	1.05	1.25
500	0.80	0.90	1.25	1.55
600	0.90	1.05	1.40	2.00

[a] Illuminance values from Column 2 of TABLE 170.2-N.

[b] RCR values are calculated using applicable equations in TABLE 170.2-P.

5. RESERVED.

6. Outdoor Lighting.

A. A multifamily or mixed occupancy outdoor lighting installation complies with this section if it meets the requirements in Subsections 170.2(e)6B and C, and the actual outdoor lighting power installed is no greater than the allowed outdoor lighting power calculated under Subsection 170.2(e)6D. The allowed outdoor lighting shall be calculated according to Outdoor Lighting Zone in Title 24, Part 1, Section 10-114.

EXCEPTIONS to Section 170.2(e)6A: 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 170.2(e)6:

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 local municipality or utility.

iv. Lighting for sports and athletic fields, and children's playgrounds.

v. RESERVED.

vi. Lighting of public monuments.

vii. Lighting of signs complying with the requirements of Sections 160.5(d) and 170.2(e)7.

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. RESERVED.

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 170.2(e)6.

B. **Outdoor Lighting Power Trade-offs.** Outdoor lighting power trade-offs shall be determined as follows:

i. Allowed lighting power determined according to Section 170.2(e)6Di for general hardscape lighting allowance may be traded to specific applications in Section 170.2(e)6Dii, provided the hardscape area from which the lighting power is traded continues to be illuminated in accordance with Section 170.2(e)6Dia.

ii. Allowed lighting power determined according to Section 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 170.2(e)6Di.

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 160.5(b)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 170.2(e)2Di, and the sum of the additional lighting power allowance for specific applications determined in accordance with Section 170.2(e)6Dii.

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. Public roadway(s) that are illuminated by a lighting system owned or maintained 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 170.2-R for the appropriate Lighting Zone.

b. Determine the Initial Wattage Allowance (IWA) for general hardscape lighting from TABLE 170.2-R 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 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 TABLE170.2-S for the appropriate lighting zone, or the actual installed lighting power meeting the requirements for the allowance.

TABLE 170.2-R GENERAL HARDSCAPE MULTIFAMILY LIGHTING POWER ALLOWANCE

Type of Power Allowance	Lighting Zone 0[2]	Lighting Zone 1[2]	Lighting Zone 2[2]	Lighting Zone 3[2]	Lighting Zone 4[2]
Area Wattage Allowance (AWA)	No allowance[1]	0.026 W/ft²	0.030 W/ft²	0.038 W/ft²	0.055 W/ft²
Initial Wattage Allowance (IWA)	No allowance[1]	300 W	350 W	400 W	450 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 160.5(c)1.

[2] 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 170.2-S 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 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
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 HARDSCAPE AREA (W/ft²). May be used for any illuminated hardscape area on the site.					

Lighting Application	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Hardscape Ornamental Lighting. Allowance for the total site illuminated hardscape area. Luminaires qualifying for this allowance shall be rated for 50 watts or less as determined in accordance with Section 160.5(b)1 and 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. This allowance calculation shall not include portions of the building facades within 20 feet of residence bedroom windows.	Not applicable	No Allowance	0.100 W/ft²	0.170 W/ft²	0.225 W/ft²
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
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

Lighting Application		Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
	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
	Security Camera. This additional allowance is for the illuminated general hardscape area. This allowance shall apply when a security camera is installed within 2 mounting heights of the general hardscape area and mounted more than 10 feet away from a building.	Not applicable	No Allowance	0.018 W/ft²	0.018 W/ft²	0.018 W/ft²

7. Requirements for Signs. Section 170.2(e)7 applies to all internally illuminated and externally illuminated signs, unfiltered light emitting diodes (LEDs), and unfiltered neon, both indoor and outdoor. Each sign shall comply with either Subsection A or B, as applicable.

A. Maximum Allowed Lighting Power.

i. For internally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 12 watts per square foot. For double-faced signs, only the area of a single face shall be used to determine the allowed lighting power.

ii. For externally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 2.3 watts per square foot. Only areas of an externally lighted sign that are illuminated without obstruction or interference, by one or more luminaires, shall be used.

iii. Lighting for unfiltered light emitting diodes (LEDs) and unfiltered neon shall comply with Section 170.2(e)7B.

B. **Alternate Lighting Sources.** The sign shall be equipped with one or more of the following light sources:

i. High pressure sodium lamps; or

ii. Metal halide lamps that are:

a. Pulse start or ceramic served by a ballast that has a minimum efficiency of 88 percent or greater; or

b. Pulse start that are 320 watts or smaller, are not 250 watt or 175 watt lamps, and are served by a ballast that has a minimum efficiency of 80 percent.

Ballast efficiency is the reference lamp power divided by the ballast input power when tested according to ANSI C82.6-2015.

iii. Neon or cold cathode lamps with transformer or power supply efficiency greater than or equal to following:

a. A minimum efficiency of 75 percent when the transformer or power supply rated output current is less than 50 mA; or

b. A minimum efficiency of 68 percent when the transformer or power supply rated output current is 50 mA or greater.

The ratio of the output wattage to the input wattage is at 100 percent tubing load.

iv. Fluorescent lighting systems meeting one of the following requirements:

a. Use only lamps with a minimum color rendering index (CRI) of 80; or

b. Use only electronic ballasts with a fundamental output frequency not less than 20 kHz.

v. Light emitting diodes (LEDs) with a power supply having an efficiency of 80 percent or greater; or

EXCEPTION to Section 170.2(e)7Bv: Single voltage external power supplies that are designed to convert 120 volt AC input into lower voltage DC or AC output, and have a nameplate output power less than or equal to 250 watts, shall comply with the applicable requirements of the Appliance Efficiency Regulations (Title 20).

vi. Compact fluorescent lamps that do not contain a medium screw base sockets (E24/E26).

EXCEPTION 1 to Section 170.2(e)7: Unfiltered incandescent lamps that are not part of an electronic message center (EMC), an internally illuminated sign, or an externally illuminated sign.

EXCEPTION 2 to Section 170.2(e)7: Exit signs. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.

(f) Photovoltaic Requirements – Three Habitable Stories or Less. All multifamily buildings up to three habitable stories shall have a newly installed photovoltaic (PV) system or newly installed PV modules meeting the minimum qualification requirements

specified in Joint Appendix JA11. The annual electrical output of the PV system shall be no less than the smaller of a PV system size determined using Equation 170.2-C, or the maximum PV system size that can be installed on the building's Solar Access Roof Area (SARA).

A. SARA includes the area of the building's roof space capable of structurally supporting a PV system, and the area of all roof space on covered parking areas, carports, and all other newly constructed structures on the site that are compatible with supporting a PV system per Title 24, Part 2, Section 1511.2.

B. SARA does NOT include:

i. Any roof area that has less than 70 percent annual solar access. Annual solar access is determined by dividing the total annual solar insolation, accounting for shading obstructions, by the total annual solar insolation if the same areas were unshaded by obstructions. For steep slope roofs only shading from existing permanent natural or manmade obstructions that are external to the dwelling, including but not limited to trees, hills, and adjacent structures, shall be considered for annual solar access calculations. For low slope roofs, all obstructions including those that are external to the dwelling unit, and obstructions that are part of the building design and elevation features shall be considered for the annual solar access calculations.

ii. Occupied roof areas as specified by CBC Section 503.1.4.

iii. Roof area that is otherwise not available due to compliance with other building code requirements if confirmed by the Executive Director.

EQUATION 170.2-C ANNUAL PHOTOVOLTAIC ELECTRICAL OUTPUT

kWPV = (CFA × A)/1000 + NDU × B)

WHERE:

kWPV = kWdc size of the PV system CFA = Conditioned floor area NDU = Number of dwelling units

A = CFA adjustment factor from Table 170.2-T

B = Dwelling unit adjustment factor from Table 170.2-T

EXCEPTION 1 to Section 170.2(f): For steep slope roofs, SARA shall not consider roof areas with a northerly azimuth that lies between 300 degrees and 90 degrees from true north. No PV system is required if the SARA is less than 80 contiguous square feet.

EXCEPTION 2 to Section 170.2(f): No PV system is required when the minimum PV system size specified by section 170.2(f) is less than 1.8 kWdc.

EXCEPTION 3 to Section 170.2(f): Buildings with enforcement-authority-approved roof designs, where the enforcement authority determines it is not possible for the PV system, including panels, modules and components and supports and attachments to the roof structure, to meet the requirements of the American Society of Civil Engineers (ASCE), Standard 7-16, Chapter 7, Snow Loads.

EXCEPTION 4 to Section 170.2(f): For buildings that are approved by the local planning department prior to January 1, 2020 with mandatory conditions of approval:

a. Shading from roof designs and configurations for steep slope roofs shall be considered for the annual solar access calculations; and

b. Roof areas that are not allowed to have PVs by the mandatory conditions of approval shall not be considered in determining the SARA.

EXCEPTION 5 to Section 170.2(f): PV system sizes determined using Equation 170.2-C 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 usable capacity of 7.5 kWh.

Table 170.2-T – CFA and Dwelling Unit 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**

(g) Photovoltaic Requirements - More Than Three or More Habitable Stories. All newly constructed building types specified in Table 170.2-U, or mixed occupancy buildings where one or more of these building types constitute at least 80 percent of the floor area of the building, shall have a newly installed photovoltaic (PV) system meeting the minimum qualification requirements of Reference Joint Appendix JA11. The PV size in kWdc shall be not less than the smaller of the PV system size determined by Equation 170.2-D, or the total of all available Solar Access Roof Areas (SARA) multiplied by 14 W/ft².

1. SARA include the area of the building's roof space capable of structurally supporting a PV system, and the area of all roof space on covered parking areas, carports, and all other newly constructed structures on the site that are compatible with supporting a PV system per Title 24, Part 2, Section 1511.2.

2. SARA does not include:

A. Any area that has less than 70 percent annual solar access. Annual solar access is determined by dividing the total annual solar insolation (accounting for shading obstructions) by the total annual solar insolation if the same areas were unshaded by those obstructions. For all roofs, all obstructions including those that are external to the building, and obstructions that are part of the building design and elevation features may be considered for the annual solar access calculations.

B. Occupied roofs as specified by CBC Section 503.1.4.

C. Roof space that is otherwise not available due to compliance with other building code requirements if confirmed by the Executive Director.

EQUATION 170.2-D PHOTOVOLTAIC DIRECT CURRENT SIZE

kWPVdc = (CFA x A)/1000

WHERE:

kWPVdc = Size of the PV system in kW

CFA = Conditioned floor area in square feet

A = PV capacity factor specified in Table 170.2-U for the building type

Where the building includes more than one of the space types listed in Table 170.2-U, the total PV system capacity for the building shall be determined by applying Equation 170.2-D to each of the listed space types and summing the capacities determined for each.

EXCEPTION 1 to Section 170.2(g). No PV system is required where the total of all available SARA is less than three percent of the conditioned floor area.

EXCEPTION 2 to Section 170.2(g). No PV system is required where the required PV system size is less than 4 kWdc.

EXCEPTION 3 to Section 170.2(g). No PV system is required if the SARA contains less than 80 contiguous square feet.

EXCEPTION 4 to Section 170.2(g). Buildings with enforcement-authority-approved roof designs, where the enforcement authority determines it is not possible for the PV system, including panels, modules, components, supports, and attachments to the roof structure, to meet ASCE 7-16, Chapter 7, Snow Loads.

EXCEPTION 5 to Section 170.2(g). Multi-tenant buildings in areas where a load serving entity does not provide either a Virtual Net Metering (VNEM) or community solar program.

Table 170.2-U – PV Capacity Factors

Building Type	Factor A – Minimum PV Capacity (W/ft² of conditioned floor area) Climate Zones 1, 3, 5, 16	Factor A – Minimum PV Capacity (W/ft² of conditioned floor area) Climate Zones 2, 4, 6-14	Factor A – Minimum PV Capacity (W/ft² of conditioned floor area) Climate Zone 15
Grocery	2.62	2.91	3.53
High-Rise Multifamily	1.82	2.21	2.77
Office, Financial Institutions, Unleased Tenant Space	2.59	3.13	3.80
Retail	2.62	2.91	3.53
School	1.27	1.63	2.46
Warehouse	0.39	0.44	0.58
Auditorium, Convention Center, Hotel/Motel, Library, Medical Office Building/Clinic, Restaurant, Theater	0.39	0.44	0.58

(h) Battery Storage System Requirements – More Than Three Habitable Stories. All buildings that are required by Section 170.2(g) to have a PV system shall also have a battery storage system meeting the minimum qualification requirements of Reference Joint Appendix JA12. The rated energy capacity and the rated power capacity shall be not less than the values determined by Equation 170.2-E and Equation 170.2-F. Where the building includes more than one of the space types listed in Table 170.2-V, the total battery system capacity for the building shall be determined by applying Equations

170.2-E and 170.2- F to each of the listed space types and summing the capacities determined for each space type and equation.

EQUATION 170.2-E BATTERY STORAGE RATED ENERGY CAPACITY

kWhbatt = kWPVdc x B / D0.5

WHERE:

kWhbatt = Rated Useable Energy Capacity of the battery storage system in kWh

kWPVdc = PV system capacity required by section 170.2(g) in kWdc

B = Battery energy capacity factor specified in Table 170.2-V for the building type

D = Rated single charge-discharge cycle AC to AC (round-trip) efficiency of the battery storage system

EQUATION 170.2-F BATTERY STORAGE RATED POWER CAPACITY

kWbatt = kWPVdc x C

WHERE:

kWbatt = Power capacity of the battery storage system in kWdc

kWPVdc = PV system capacity required by section 170.2(g) in kWdc

C = Battery power capacity factor specified in Table 170.2-V for the building type

EXCEPTION 1 to Section 170.2(h). No battery storage system is required if the installed PV system size is less than 15 percent of the size determined by Equation 170.2-D.

EXCEPTION 2 to Section 170.2(h). No battery storage system is required in buildings with battery storage system requirements with less than 10 kWh rated capacity.

EXCEPTION 3 to Section 170.2(h). For multi-tenant buildings, the energy capacity and power capacity of the battery storage system shall be based on the tenant spaces with more than 5,000 square feet of conditioned floor area. For single-tenant buildings with less than 5,000 square feet of conditioned floor area, no battery storage system is required.

EXCEPTION 4 to Section 170.2(h). In climate zone 1, no battery storage system is required for offices, schools, and warehouses.

Table 170.2-V – Battery Storage Capacity Factors

	Factor B – Energy Capacity	Factor C – Power Capacity
Storage-to-PV Ratio	Wh/W	W/W
Grocery	1.03	0.26

High-Rise Multifamily	1.03	0.26
Office, Financial Institutions, Unleased Tenant Space	1.68	0.42
Retail	1.03	0.26
School	1.87	0.46
Warehouse	0.93	0.23
Auditorium, Convention Center, Hotel/Motel, Library, Medical Office Building/Clinic, Restaurant, Theater	0.93	0.23

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, 25402.8, and 25943, Public Resources Code.

7.1.5 Subchapter 12: Multifamily Buildings – Additions, Alterations, and Repairs to Existing Buildings

SECTION 180.0 – GENERAL

Additions, alterations, and repairs to existing 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 160.1, and 160.3 through 170.2 that are applicable to the building project, and either the performance compliance approach (energy budgets) in Section 180.1(b) (for additions) or 180.2(c) (for alterations), or the prescriptive compliance approach in Section 180.1(a) (for additions) or 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 multifamily buildings are specified in Section 141.1.

Nonresidential occupancies in mixed occupancy buildings shall comply with nonresidential requirements in Sections 120.0 through 141.1.

NOTE: For alterations that change the occupancy classification of the building, the requirements specified in Section 180.2 apply to the occupancy after the alterations.

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 180.1 – ADDITIONS

Additions to existing multifamily buildings shall meet the applicable requirements of Sections 110.0 through 110.9, Sections 160.0, 160.1, 160.2(c) and (d), 160.3 through 160.7, and either Section 180.1(a) or 180.1(b).

EXCEPTION 1 to Section 180.1: Additions of 300 square feet or less are exempt from the roofing product requirements of Section170.2(a)1A.

EXCEPTION 2 to Section 180.1: Existing inaccessible piping shall not require insulation as defined under Section 160.4(f)2Aiii.

EXCEPTION 3 to Section 180.1: Space-Conditioning System. When heating or cooling will be extended to an addition from the existing system(s), the existing heating and cooling equipment need not comply with Part 6. The heating system capacity must be adequate to meet the minimum requirements of CBC Section 1204.1.

EXCEPTION 4 to Section 180.1: Space-Conditioning System Ducts. When any length of ducts are extended from an existing duct system to serve the addition, the existing duct system and the extended ducts shall meet the applicable requirements specified in Section 180.1(b)2ai and 180.1(b)2aii.

EXCEPTION 5 to Section 150.2(a)180.1: Photovoltaic and battery storage systems, as specified in Section 170.2(f) through 170.2(h), are not required for additions.

EXCEPTION 6 to Section 180.1: Dwelling Unit Space Heating System. New or replacement space heating systems serving an addition may be a heat pump or gas heating system.

(a) Prescriptive approach. The envelope and lighting of the addition; any newly installed space-conditioning or ventilation 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 through 110.12, and 160.0, 160.1, 160.2(c) and (d), 160.3 through 170.2.

1. Envelope

A. Additions that are greater than 700 square feet shall meet the requirements of Section 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.

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 air

sealing part of QII 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 170.2(a), with the following modifications.

i. Roof and Ceiling insulation in a ventilated attic shall meet one of the following requirements:

a. In Climate Zones 1, 2, 4, and 8 through 16, achieve an overall assembly U-factor not exceeding 0.025. In wood framed assemblies, compliance with U-factors may be demonstrated by installing insulation with an R-value of R-38 or greater.

b. In Climate Zones 3, and 5 through 7, achieve an overall assembly U-factor not exceeding 0.031. In wood framed assemblies, compliance with U-factors may be demonstrated by installing insulation with an R-value of R-30 or greater.

ii. Radiant Barrier – For buildings three habitable stories or less, radiant barriers shall be installed in attics with exposed attic deck undersides in climate zones 2-15.

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. Fenestration products must meet the U-factor, RSGHC, and VT requirements of TABLE 180.2-B

v. Quality Insulation Installation (QII) requirements of Section 170.2(a)6 do not apply.

EXCEPTION 1 to Section 180.1(a)1B: Insulation in an enclosed rafter ceiling shall meet the requirements of Section 160.1(a).

EXCEPTION 2 to Section 180.1(a)1B: Additions that increase the area of the roof by 2,000 square feet or less are exempt from the solar ready requirements of Section 160.8.

2. Mechanical Ventilation for Indoor Air Quality. Additions to existing buildings shall comply with Section 160.2 subject to the requirements specified in subsections A and B below. When HERS field verification and diagnostic testing is required by Section 180.1(a)2, buildings with three habitable stories or less shall use the applicable procedures in the Residential Appendices, and buildings with four or more habitable stories shall use the applicable procedures in Nonresidential Appendices NA1 and NA2.

A. Whole-dwelling Unit Mechanical Ventilation.

i. Dwelling units that meet the conditions in subsections a or b below shall not be required to comply with the whole-dwelling unit ventilation airflow specified in Sections 160.2(b)2Aiv or 160.2(b)2Av.

a. Additions to an existing dwelling unit that increase the conditioned floor area of the existing dwelling unit by less than or equal to 1000 square feet.

b. Junior Accessory Dwelling Units (JADU) that are additions to an existing building.

ii. Additions to an existing dwelling unit that increase conditioned floor area by more than 1,000 square feet shall have mechanical ventilation airflow in accordance with Sections 160.2(b)2Aiv or 160.2(b)2Av, as applicable. The 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.

iii. New dwelling units that are additions to an existing building shall have mechanical ventilation airflow provided in accordance with Sections 160.2(b)2Aiv or 160.2(b)2Av as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the new dwelling unit.

B. Local Mechanical Exhaust. Additions to existing buildings shall comply with all applicable requirements specified in 160.2(b)2Avi and 160.2(b)2B.

3. Water Heater. When additional water heating equipment is installed to serve a dwelling unit 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 170.2(d); or

B. A water-heating system determined by the Executive Director to use no more energy than the one specified in Item A above.

(b) Performance approach. Performance calculations shall meet the requirements of Section 170.0 through 170.2(a), pursuant to the applicable requirements in Items 1, 2, and 3 below.

1. For additions alone. The addition complies if the addition alone meets the energy budgets as specified in Section 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 180.2(c); plus the proposed addition's energy use meeting the requirements of Section 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 Section180.1(b)2: Existing structures with a minimum R-11 insulation in framed walls showing compliance with Section 180.1(b) are exempt from showing compliance with Section 160.1(b).

3. Mechanical Ventilation for Indoor Air Quality. Additions to existing buildings shall comply with Section 160.1(b)2 subject to the requirements specified in subsections A and B below. When HERS field verification and diagnostic testing is required by Section 180.1(b)3, buildings with three habitable stories or less shall use the applicable procedures in the Residential Appendices, and buildings with four or more habitable stories shall use the applicable procedures in Nonresidential Appendices NA1 and NA2.

A. **Whole-dwelling Unit Mechanical Ventilation.**

i. Dwelling units that meet the conditions in subsections a or b below shall not be required to comply with the whole-dwelling unit ventilation airflow specified in Sections 160.2(b)2Aiv or 160.2(b)2Av.

a. Additions to an existing dwelling unit that increase the conditioned floor area of the existing dwelling unit by less than or equal to 1000 square feet.

b. Junior Accessory Dwelling Units (JADU) that are additions to an existing building.

ii. Additions to an existing dwelling unit that increase the conditioned floor area of the existing dwelling unit by more than 1,000 square feet shall have mechanical ventilation airflow in accordance with Section 160.2(b)2Aiv or 160.2(b)2Av as applicable. The 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.

iii. New dwelling units that are additions to an existing building shall have mechanical ventilation airflow provided in accordance with Section 160.2(b)2Aiv or 160.2(b)2Av as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the new dwelling unit.

B. Local Mechanical Exhaust. Additions to existing buildings shall comply with all applicable requirements **specified** in 160.2(b)2Avi and 160.2(b)2B.

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 180.2 – ALTERATIONS

Alterations to components of existing multifamily buildings, including alterations made in conjunction with a change in building occupancy to a multifamily occupancy shall meet item (a), and either Item (b) or (c) below:

EXCEPTION 1 to Section 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, 160.0 through 160.7, and Section 170.2(c) or 170.2(d).

EXCEPTION 2 to Section 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, 160.0 through 160.7, and Section 170.2(c) or 170.2(d).

EXCEPTION 3 to Section 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 170.2(b)4E. Additional electric reheat capacity in excess of 20 percent may be added subject to the requirements of the Section 170.2(b)4E.

EXCEPTION 4 to Section 180.2: The requirements of Section 160.3(a)2H shall not apply to alterations of space- conditioning systems or components.

(a) **Mandatory Requirements**. Altered components in a 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 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 A through D below:

A. Metal Building. A minimum of R-13 insulation between framing members, or the area-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 area-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 area- 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 area-weighted average U-factor of the wall assembly shall not exceed U-0.280.

EXCEPTION to Section 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 A through B below:

A. Raised Framed Floors. A minimum of R-11 insulation between framing members, or the area- 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 area-weighted average U-factor of the floor assembly shall not exceed the U-factor of U-0.111.

(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 160.0, 160.1, 160.2(c) and (d), 160.3(a) through 160.3(b)5J, 160.3(b)6, 160.3(c), and 160.5; and

1. Envelope

A. Roof Alterations. Existing roofs being replaced, recovered or recoated, of a 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 2, 4, and 6 through 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.

EXCEPTION to Section 180.2(b)1Ai: The aged solar reflectance requirement can be met by using insulation at the roof deck specified in TABLE 180.2-A.

Table 180.2-A Roof/Ceiling Insulation Tradeoff for Low-Sloped Aged Solar Reflectance

Minimum Aged Solar Reflectance	Roof Deck Continuous Insulation R- value (Climate Zones 6-7)	Roof Deck Continuous Insulation R-value (Climate Zones 2, 4, 8-15)
0.60	2	16
0.55	4	18
0.50	6	20
0.45	8	22
No requirement	10	24

ii. Steep-sloped roofs in Climate Zones 4 and 8 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 180.2(b)1Aii: The following shall be considered equivalent to Subsection ii:

a. Buildings with ceiling assemblies with a U-factor lower than or equal to 0.025 or that are insulated with at least R-38 ceiling insulation in an attic; or

b. Buildings with a radiant barrier in the attic, where the radiant barrier is not installed directly above spaced sheathing, meeting the requirements of Section 150.1(c)2170.2(a)1C; or

c. Buildings that have no ducts in the attic in Climate Zones 2, 4, 9, 10, 12, and 14; or

d. Buildings with R-2 or greater continuous insulation above or below the roof deck.

EXCEPTION 1 to Section 180.2(b)1Ai and ii: 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 SR.

EXCEPTION 2 to Section 180.2(b)1Ai and ii: 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.

iii. For low-sloped roofs, the area of the roof recover or roof replacement shall be insulated to R-14 continuous insulation or a U-factor of 0.039 in Climate Zones 1, 2, 4, and 8 through 16.

EXCEPTION 1 to Section 180.2(b)1Aiii: Roof recovers with new R-10 insulation added above deck do not need to be insulated to meet R-14.

EXCEPTION 2 to Section 180.2(b)1Aiii: When existing mechanical equipment located on the roof will not be disconnected and lifted, insulation

added may be limited to the greater of R-10 or the maximum installed thickness that will allow the distance between the height of the roof membrane surface to the top of the base flashing to remain in accordance with the manufacturer's instructions.

EXCEPTION 3 to Section 180.2(b)1Aiii: At the drains and other low points, tapered insulation with a thermal resistance less than R-14 may be used, provided that insulation thickness is increased at the high points of the roof so that the average thermal resistance equals or exceeds R-14

EXCEPTION 4 to Section 180.2(b)1Aiii: The area of the roof recoat is not required to be insulated

B. **Roof/Ceiling Insulation.**

i. Attic Roof. Vented attics shall meet the following:

a. In Climate Zones 1 through 4 and 8 through 16, insulation shall be installed to achieve a weighted U-factor of 0.020 or insulation installed at the ceiling level shall result in an installed thermal resistance of R-49 or greater for the insulation alone; and

EXCEPTION to Section 180.2(b)1Bia: In Climate Zones 1, 3, 4, and 9, dwelling units with at least R-19 existing insulation installed at the ceiling level.

b. In Climate Zones 2 and 11 through 16, air seal all accessible areas of the ceiling plane between the attic and the conditioned space in accordance with Section 110.7; and

EXCEPTION 1 to Section 180.2(b)1Bib: Dwelling units with at least R-19 existing insulation installed at the ceiling level.

EXCEPTION 2 to Section 180.2(b)1Bib: Dwelling units with atmospherically vented space heating or water heating combustion appliances located inside the pressure boundary of the dwelling unit.

c. In Climate Zones 1 through 4 and 8 through 16, recessed downlight luminaires in the ceiling shall be covered with insulation to the same depth as the rest of the ceiling. Luminaires not rated for insulation contact must be replaced or fitted with a fire-proof cover that allows for insulation to be installed directly over the cover; and

EXCEPTION to Section 180.2(b)1Bic: In Climate Zones 1 through 4 and 8 through 10, dwelling units with at least R-19 existing insulation installed at the ceiling level.

d. Attic ventilation shall comply with California Building Code requirements.

EXCEPTION 1 to Section 180.2(b)1Bi: Dwelling units with at least R-38 existing insulation installed at the ceiling level.

EXCEPTION 2 to Section 180.2(b)1Bi: Dwelling units where the alteration would directly cause the disturbance of asbestos, unless the alteration is made in conjunction with asbestos abatement.

EXCEPTION 3 to Section 180.2(b)1Bi: Dwelling units with knob and tube wiring located in the vented attic.

EXCEPTION 4 to Section 180.2(b)1Bi: Where the accessible space in the attic is not large enough to accommodate the required R-value, the entire accessible space shall be filled with insulation provided such installation does not violate Section 806.3 of Title 24, Part 2.5.

EXCEPTION 5 to Section 180.2(b)1Bi: Where the attic space above the altered dwelling unit is shared with other dwelling units and the requirements of Section 180.2(b)1Bi are not triggered for the other dwelling units.

NOTE: Glass replaced in an existing sash and frame or sashes replaced in an existing frame are considered repairs. In these cases, Section 180.2(b) requires that the replacement be at least equivalent to the original in performance.

i. Fenestration products installed to replace existing fenestration products of the same total area shall meet either a or b:

a. The maximum U-factor, RSHGC, and VT requirements of TABLE 180.2-B, or

b. The area-weighted U-factor and RSHGC of TABLE 170.2-A.

EXCEPTION 1 to Section 180.2(b)1Ci: In an alteration, where 150 square feet or less of the entire building's vertical fenestration is replaced, RSHGC and VT requirements of TABLE 180.2-B shall not apply.

ii. Alterations that add fenestration and skylight area shall meet the total fenestration area requirements of Section 170.2(a) and the U-factor, RSHGC, and VT requirements of TABLE 180.2-B.

EXCEPTION 1 to Section 180.2(b)1Cii: Alterations that add fenestration area of up to 50 square feet shall not be required to meet

the total fenestration area requirements of Sections 170.2(a), nor the U-factor, RSHGC, and VT requirements of TABLE 180.2-B.

EXCEPTION 2 to Section 180.2(b)1Cii: Alterations that add up to 16 square feet of new skylight area per dwelling unit with a maximum U-factor of 0.55 and a maximum RSHGC of 0.30 area shall not be required to meet the total fenestration area requirements of Section 170.2(a)3.

D. Exterior doors. Alterations that add exterior door area shall meet the U-factor requirement of Section 170.2(a)4.

Table 180.2-B Altered Fenestration Maximum U-Factor and Maximum SHGC

Climate Zone		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Curtainwall / Storefront / Window Wall and Glazed Doors1	U-factor	0.38	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	0.38
Curtainwall / Storefront / Window Wall and Glazed Doors1	RSHGC	0.35	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	0.25
Curtainwall / Storefront / Window Wall and Glazed Doors1	VT2	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
NAFS 2017 Performance Class AW Window – Fixed1	U-factor	0.38	0.38	0.38	0.38	0.38	0.47	0.47	0.41	0.41	0.38	0.38	0.38	0.38	0.38	0.38	0.38
NAFS 2017 Performance Class AW Window – Fixed1	RSHGC	0.35	0.25	0.25	0.25	0.25	0.31	0.31	0.26	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25

Climate Zone		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
NAFS 2017 Performance Class AW Window – Fixed1	VT2	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
NAFS 2017 Performance Class AW Window – Operable1	U-factor	0.43	0.43	0.43	0.43	0.43	0.47	0.47	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
NAFS 2017 Performance Class AW Window – Operable1	RSHGC	0.35	0.24	0.24	0.24	0.24	0.31	0.31	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
NAFS 2017 Performance Class AW Window – Operable1	VT2	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
All Other Windows and Glazed Doors1	U-factor	0.30	0.30	0.30	0.30	0.30	0.30	0.34	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
All Other Windows and Glazed Doors1	RSHGC	0.35	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

Climate Zone		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Skylights, 3 habitable stories and fewer	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
Skylights, 3 habitable stories and fewer	RSHGC	NA	0.23	NA	0.23	NA	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	NA

Footnote to Table 180.2-B:

1. For fenestration installed in buildings with three or fewer habitable stories, there is no SHGC requirement in Climate Zones 1, 3, 5, and 16.

2. Minimum VT requirements to not apply to multifamily buildings 3 habitable stories or less.

2. Space Conditioning Systems

A. Space Conditioning Systems Serving 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, cooling or heating coil, and air handler for split systems; or complete replacement of a packaged unit; plus entirely new or replacement duct system (Section 180.2(b)2Aiib). Entirely new or complete replacement space-conditioning systems shall meet the requirements of Sections 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)3Bi, 180.2(b)2Av, and TABLE 180.2-C.

ii. Altered Duct Systems - Duct Sealing: In all Climate Zones, when more than 25 feet of new or replacement space-conditioning system ducts are installed, the ducts shall comply with the applicable requirements of subsections a and b below. New ducts located in unconditioned space shall meet the applicable requirements of Sections 160.3(b)5A through J, and the duct insulation requirements of TABLE 180.2-C, and

a. 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 Reference Residential Appendix RA3.1, utilizing the leakage compliance criteria specified in subsection I or II below.

TABLE 180.2-C DUCT INSULATION R-VALUE

Climate Zone	3, 5 through 7	1, 2, 4, 8 through 16
Duct R-Value	R-6	R-8

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:

A. The total leakage of the duct system shall not exceed 12 percent of the 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 air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4.

Entirely new or complete replacement duct systems installed as part of an alteration are 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.

Entirely new or complete replacement duct systems shall also conform to the requirements of Sections 160.2(a)1 and 160.3(b)5L. If the air handler and ducts are located within a vented attic, the requirements of Section 180.2(b)1Bi shall also be met.

II. Extension of an Existing Duct System. If the new ducts are an extension of an existing duct system serving 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 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 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 180.2(b)2Aiic or BII 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 180.2(b)2AiibII: Duct Sealing. Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos.

EXCEPTION 1 to Section 180.2(b)2Aii: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

iii. Altered Space-Conditioning System – Duct Sealing: In all Climate Zones, when a space-conditioning system serving a 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 subsections a, b, or c below.

a. The measured duct leakage shall be equal to or less than 15 percent of air handler airflow as determined 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 air handler airflow as determined 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 180.2(b)2Aiiia or b, 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 180.2(b)2Aiii: 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 180.2(b)2Aiii: Duct systems with less than 40 linear feet as determined by visual inspection.

EXCEPTION 3 to Section 180.2(b)2Aiii: Existing duct systems constructed, insulated or sealed with asbestos.

EXCEPTION 4 to Section 180.2(b)2Aiii: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

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 I and II, unless the system is of a type that cannot be verified using the specified procedures. Systems that cannot comply with the requirements of Section 180.2(b)2Aivb shall comply with Section 180.2(b)2Aivc.

EXCEPTION to Section 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 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 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.

I. Minimum system airflow rate shall comply with the applicable subsection A or B 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

EXCEPTION 1 to Section 180.2(b)2Aivbl: 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 180.2(b)2Aivbl: Entirely new or complete replacement space conditioning systems, as specified by Section 180.2(b)2Ai, without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in TABLE 160.3-A or 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 Section160.2(a)1C for the system air filter device(s) shall conform to the requirements given in TABLES 160.3-A and 160.3-B.

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 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 180.2(b)2AivbI.

EXCEPTION 2 to Section 180.2(b)2Aivb: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

v. Altered Space-Heating System. Altered or replacement space-heating systems shall not use electric resistance as the primary heat source.

EXCEPTION 1 to Section 180.2(b)2Av: Non-ducted electric resistance space heating systems, if the existing space heating system is electric resistance.

EXCEPTION 2 to Section 180.2(b)2Av: Ducted electric resistance space heating systems, if the existing space heating system is electric resistance and a ducted space cooling system is not being replaced or installed.

EXCEPTION 3 to Section 180.2(b)2Av: Electric resistance space heating systems, if the existing space heating system is electric resistance in Climate Zones 6, 7, 8, or 15.

B. Common Use 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 Sections 170.2(c)1, 2, and 4, applicable to the systems or

components being altered. For compliance with Section 170.2(c)4A, additional fan power adjustment credits are available as specified in TABLE 180.2-D.

TABLE 180.2-D Fan Power Limitation Pressure Drop Adjustment

Airflow	Multi-Zone VAV Systems[1] ≤5,000 cfm	Multi-Zone VAV Systems[1] >5,000 and ≤10,000 cfm	Multi-Zone VAV Systems[1] >10,000 cfm	All Other Fan Systems ≤5,000 cfm	All Other Fan Systems >5,000 and ≤10,000 cfm	All Other Fan Systems >10,000 cfm
Supply Fan System Additional Allowance	0.135	0.114	0.105	0.139	0.12	0.107
Supply Fan System Additional Allowance In Unit with Adapter Curb	0.033	0.033	0.043	0.000	0.000	0.000
Exhaust/ Relief/ Return/ Transfer Fan System Additional Allowance	0.07	0.061	0.054	0.07	0.062	0.055
Exhaust/ Relief/ Return/ Transfer Fan System Additional Allowance In Unit with Adapter Curb	0.016	0.017	0.022	0.000	0.000	0.000

Footnotes to Table 141.0-D:

1. See FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV) for the definition of a Multi-Zone VAV System.

EXCEPTION 1 to Section 180.2(b)2Bi. Section 180.2(b)2Av does not apply to replacement of electric reheat of equivalent or lower capacity electric resistance space heaters, when natural gas is not available.

EXCEPTION 2 to Section 180.2(b)2Bi. Section 170.2(c)4L is not applicable to new or replacement space conditioning systems.

EXCEPTION 3 to Section 141.0(b)2C: Section 140.4(e) is applicable to systems, other than single package air-cooled commercial unitary air conditioners and heat pumps, with cooling capacity less than 54,000 Btu/h.

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 160.3(c)2 and meet a or b below:

a. RESERVED.

b. Entirely new or replacement duct systems installed as part of an alteration shall be leakage- tested in accordance with Section 160.2(c)2H. 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 meets the criteria in Subsections I, II, and III below. The duct system shall be sealed to a leakage rate not to exceed 15 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:

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;

B. In a space directly under a roof that

C. 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, or

D. Has fixed vents or openings to the outside or unconditioned spaces; or

E. In an unconditioned crawlspace; or

F. In other unconditioned spaces.

EXCEPTION 1 to Section 180.2(b)2Biib: When it is not possible to achieve the duct leakage criteria in Section 180.2(b)2Biib, 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 NA2.1.4.2.2a.

EXCEPTION 2 to Section 180.2(b)2Biib: Duct Sealing. Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos are exempt from the requirements of subsection 180.2(b)2Biib.

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 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 180.2(b)2Bii.

EXCEPTION 1 to Section 180.2(b)2Biiib: Duct Sealing. Buildings altered so that the duct system no longer meets the criteria of Section 170.2(c)4Ji are exempt from the requirements of Subsection 180.2(b)2Biiib.

EXCEPTION 2 to Section 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 180.2(b)2Biiib.

EXCEPTION 3 to Section 180.2(b)2Biiib: Duct Sealing. Existing duct systems constructed, insulated or sealed with asbestos are exempt from the requirements of Subsection 180.2(b)2Biiib.

3. Hot Water Systems. Altered or replacement water-heating systems or components serving individual dwelling units shall meet the applicable requirements below:

A. Pipe Insulation. For newly installed piping and existing accessible piping, the insulation requirements of Section 160.4(f) 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. 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 has an ANSI/CTA-2045-B communication port; or

iii. A single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher; or

iv. If the existing water heater is an electric resistance water heater, a consumer electric water heater.

v. A water-heating system determined by the Executive Director to use no more energy than the one specified in Section 180.2(b)3Ci through iii 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 Section 180.2(b)3Civ above.

4. Lighting.

A. Dwelling Unit Lighting. The altered lighting system shall meet the lighting requirements of Section 160.5(a). The altered luminaires shall meet the luminaire efficacy requirements of Section 160.5(a) and TABLE 160.5-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.

B. Common Use Area – Lighting, Sign Lighting, and Electrical Power Distribution Systems.

i. Spaces with lighting systems installed for the first time shall meet the applicable requirements of Sections 110.9, 160.5(b)1, 160.5(b)2, 160.5(b)3, 160.5(b)4, 160.5(c), 160.5(e), 170.2(b), and 170.2(e)1, and thru 170.2(e)62.

ii. When the requirements of Section 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 160.5(b)4D.

iii. New internally and externally illuminated signs shall meet the requirements of Sections 110.9, 160.5(d) and 170.2(e)37.

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 a, b, or c below:

a. The alteration shall comply with the indoor lighting power requirements specified in Section 170.2(e)1 thru 4A and the lighting control requirements specified in TABLE 180.2-E; or

b. The alteration shall not exceed 80% of the indoor lighting power requirements specified in Section 170.2(e)1 thru 4, and shall comply with the lighting control requirements specified in TABLE 180.2-DE; 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 180.2-E.

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 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 decorative lighting on shared circuits or controls. New or completely replaced lighting circuits shall comply with the control separation requirements of Sections 160.5(b)4Aiv and 160.5(b)4Cid.

EXCEPTION 1 to Section 180.2(b)4Biv. Alteration of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded as specified in Section 170.2(e)2C.

EXCEPTION 2 to Section 180.2(b)4Biv. Any enclosed space with only one luminaire.

EXCEPTION 3 to Section 180.2(b)4Biv. Any alteration that would directly cause the disturbance of asbestos, unless the alteration is made in conjunction with asbestos abatement.

EXCEPTION 4 to Section 180.2(b)4Biv. Acceptance testing requirements of Section 160.5(e) are not required for alterations where lighting controls are added to control 20 or fewer luminaires.

EXCEPTION 5 to Section 180.2(b)4Biv. Any alteration limited to adding lighting controls or replacing lamps, ballasts, or drivers.

EXCEPTION 6 to Section 180.2(b)4Biv. 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 TABLES 170.2- R or 170.2- S shall meet the applicable requirements of Sections 160.5(b)1, 160.5(b)2, 160.5(b)3, 160.5(c)1, and 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 160.5(c)2 and the requirements of Section 170.2(e)2 6 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 10 percent or more 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 160.5(c)2A and Section 160.5(c)2C;

II. For parking lots and outdoor sales lots where the bottom of the luminaire is mounted greater than 24 feet above the ground and for all other lighting applications, the replacement luminaires shall comply with Section 160.5(c)2A AND EITHER comply with Section 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

EXCEPTION to Section 180.2(b)4Bvb. Alterations where less than 5 existing luminaires are replaced.

c. In alterations that do not increase the connected lighting load, where 50 percent or more of the existing luminaires are replaced in general hardscape or a specific application, the replacement luminaires shall meet the requirements of subsection b above and the requirements of Section 170.2(e)2 6 for general hardscape lighting or specific lighting applications containing the alterations.

EXCEPTION 1 to Section 180.2(b)4Bvc. 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 Section170.2(e)26.

EXCEPTION 2 to Section 180.2(b)4Bvc. Alterations where less than 5 existing luminaires are replaced.

EXCEPTION 3 to Section180.2(b)4Bv. Acceptance testing requirements of Section 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 170.2(e)7.

EXCEPTION to Section 180.2(b)4Bvi. 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 180.2(b)4Bvi.

vii. Alterations to existing electrical power distribution systems shall meet the applicable requirements of the following Sections:

a. Service Electrical Metering. New or replacement electrical service equipment shall meet the requirements of Section 160.6(a) applicable to the electrical power distribution system altered; and

b. Separation of Electrical Circuits for Electrical Energy Monitoring. For entirely new or complete replacement of electrical power distribution systems, the entire system shall meet the applicable requirements of Section 160.6(b); and

c. Voltage Drop. Alterations of feeders and branch circuits where the alteration includes addition, modification, or replacement of both feeders and branch circuits, the altered circuits shall meet the requirements of Section 160.6(c); and EXCEPTION to Section 180.2(b) 4Bviic: 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. For entirely new or complete replacement of electrical power distribution systems, the entire system shall meet the applicable requirements of Section 160.6(d).

TABLE 180.2-E – Control Requirements for Indoor Lighting System Alterations for Common Services Use

Control Specifications	**Projects complying with Section 180.2(b)4Biva**	**Projects complying with Sections 180.2(b)4Bivb and or 180.2(b)4Bivc**
Manual Area Controls 160.5(b)4Ai	Required	Required
Manual Area Controls 160.5(b)4Aii	Required	Required
Manual Area Controls 160.5(b)4Aii	Only required for new or completely replaced circuits	Only required for new or completely replaced circuits
Multi-Level Controls 160.5(b)4B	Required	Not Required
Automatic Shut Off Controls 160.5(c)4Ci	Required; 160.5(b)4Cid only required for new or completely replaced circuits	Required; 160.5(b)4Cid only required for new or completely replaced circuits
Automatic Shut Off Controls 160.5(c)4Cii	Required	Required
Automatic Shut Off Controls 160.5(c)4Cii	Required	Required
Automatic Shut Off Controls 160.5(c)4Civ	Required	Required
Automatic Shut Off Controls 160.5(b)4Cv	Required	Required
Automatic Shut Off Controls 160.5(b)4Cvi	Required	Required
Automatic Shut Off Controls 160.5(b)4Cvii	Required	Required
Daylighting Controls 160.5(b)4D	Required	Not Required
Demand Responsive Controls 160.5(b)4E	Required	Not Required

5. Mechanical Ventilation and Indoor Air Quality for Dwelling Units. Alterations to existing buildings shall comply with subsections A and B below as applicable. When HERS field verification and diagnostic testing is required by Section 180.2(b)5, buildings with three habitable stories or less shall use the applicable procedures in the Residential Appendices, and buildings with four or more habitable stories shall use the applicable procedures in Nonresidential Appendices NA1 and NA2.

A. Entirely New or Complete Replacement Ventilation Systems. Entirely new or complete replacement ventilation systems shall comply with all applicable requirements in Section 160.2(b)2. An entirely new or complete replacement ventilation system includes a new ventilation fan component and an entirely new duct system. An entirely new or complete replacement duct system is 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 filtration devices, and duct material, if the reused parts are accessible and can be sealed to prevent leakage.

B. Altered Ventilation Systems. Altered ventilation system components or newly installed ventilation equipment serving the alteration shall comply with Sections 160.2(b)2 as applicable subject to the requirements specified in subsections i and ii below.

i. Whole-dwelling Unit Mechanical Ventilation.

a. Whole-dwelling unit airflow. If the whole-dwelling ventilation fan is altered or replaced, then one of the following subsections 1 or 2 shall be used for compliance as applicable.

1. Dwellings that were required by a previous building permit to comply with the whole- dwelling unit airflow requirements in 160.2(b)2, 120.1(b), or 150.0(o) shall meet or exceed the whole-dwelling unit mechanical ventilation airflow specified in Sections 160.2(b)2Aiv or 160.2(b)2Av as confirmed through HERS field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Appendix RA3.7 or NA2.2.

2. Dwellings that were not required by a previous building permit to have a whole-dwelling unit ventilation system to comply with Section 160.2(b)2, 120.1(b), or 150.0(o) shall not be required to comply with the whole-dwelling unit ventilation airflow specified in Sections 160.2(b)2Aiv or 160.2(b)2Av.

b. Replacement Ventilation Fans. Whole-dwelling unit replacement ventilation fans shall be rated for airflow and sound in accordance with the requirements of ASHRAE 62.2 Sections 7.1 and 7.2. Additionally,

when conformance to a specified whole-dwelling unit airflow rate is required for compliance, the replacement fans shall be rated at no less than the airflow rate required for compliance.

c. Air Filters. If the air filtration device for a whole-dwelling unit ventilation system is altered or replaced, then one of the following subsections 1 or 2 shall be used for compliance.

1. Dwellings that were required by a previous building permit to comply with the ventilation system air filtration requirements in 160.2(b)1, 120.1(b)1, or 150.0(m)12 shall comply with the air filtration requirements in 160.2(b)1.

2. Dwellings that were not required by a previous building permit to comply with the ventilation system air filtration requirements in Section 160.2(b)1, 120.1(b)1, or 150.0(m)12 shall not be required to comply with the air filtration requirements specified in Section 160.2(b)1.

ii. **Local Mechanical Exhaust.**

a. Bathroom Local Mechanical Exhaust. Altered bathroom local mechanical exhaust systems shall comply with the applicable requirements specified in Section 160.0(b)2Avi.

b. Kitchen Local Mechanical Exhaust. If the kitchen local ventilation fan is altered or replaced, then one of the following subsections 1, 2, or 3 shall be used for compliance.

1. Dwellings that were required by a previous building permit to comply with the kitchen local exhaust requirements in 160.0(b)2Avi, 120.1(b)2vi, or 150.0(o)1G shall meet or exceed the applicable airflow or capture efficiency requirements in Section 160.0(b)2Avi.

2. Dwellings that were required by a previous building permit to install a vented kitchen range hood or other kitchen exhaust fan, shall install a replacement fan that meets or exceeds the airflow required by the previous building permit, or 100 cfm, whichever is greater.

3. Dwellings that were not required to have a kitchen local ventilation exhaust system according to the conditions in either subsection 1 or 2 above shall not be required to comply with the requirements of Section 160.0(b)2Avi.

c. Replacement Ventilation Fans. New or replacement local mechanical exhaust fans shall be rated for airflow and sound in accordance with the requirements of ASHRAE 62.2 Section 7.1 and Title 24, Part 6 Section

160.0(b)2Avif. Additionally, when compliance with a specified exhaust airflow rate is required, the replacement fan shall be rated at no less than the airflow rate required for compliance.

(c) Performance approach. The altered component(s) and any newly installed equipment serving the alteration shall meet the applicable requirements of subsections 1, 2, and 3 below.

1. The altered components shall meet the applicable requirements of Sections 110.0 through 110.9, Section 160.0, 160.1, 160.2(c) and (d), 160.3(a) through 160.3(b)5J, 160.3(b)6, 160.3(c), and 160.5. Entirely new or complete replacement mechanical ventilation systems as these terms are used in Section 180.2(b)5A shall comply with the requirements in Section 180.2(b)5A. Altered mechanical ventilation systems shall comply with the requirements of Sections 180.2(b)5B. Entirely new or complete replacement space-conditioning systems, and entirely new or complete replacement duct systems, as these terms are used in Sections 180.2(b)2Ai and 180.2(b)2Aiia, shall comply with the requirements of Sections 160.2(a)1 and 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 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 shall be verified by a qualified third party.

3. The proposed design shall be based on the actual values of the altered components.

NOTES TO SECTION 180.2(c):

1. 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 180.2(c)2.

2. The standard design shall assume the same geometry and orientation as the proposed design.

3. 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 180.2(c): Any dual-glazed greenhouse or garden window installed as part of an alteration complies with the U-factor requirements in Section 170.2.

EXCEPTION 2 to Section 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.

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 180.3 – REPAIRS

Repairs shall not increase the preexisting energy consumption of the repaired component, system, or equipment.

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 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.

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.

8. Bibliography

Modera, Mark, Antash Najib, and Curtis Harington. 2021. "Analysis of Duct Insulation Requirements for Ducts in Conditioned and Indirectly Conditioned Spaces." https://title24stakeholders.com/wp-content/uploads/2021/05/21_05_15-Insulation-Requirements-for-Ducts-in-Conditioned-and-Indirectly-Conditioned-Spaces-FINAL.pdf.

Statewide CASE Team. 2021. "Docket Number 21-BSTD-01 TN# 239075." *California Energy Commission.* Accessed September 2021.

Statewide CASE Team. 2020. "Residential Energy Savings and Process Improvements for Additions and Alterations." CASE Report.

Statewide CASE Team. 2020. "Residential Energy Savings and Process Improvements for Additions and Alterations." https://title24stakeholders.com/wp-

content/uploads/2020/08/SF-Additions-and-Alterations_Final_-CASE-Report_Statewide-CASE-Team.pdf.

Statewide CASE Team. 2020. "Updated Duct Leakage Cost Effectiveness with Residential TDV – Multifamily Restructuring." https://efiling.energy.ca.gov/GetDocument.aspx?tn=238050&DocumentContentId=71299.

Attachment 1: Public Comments Submitted by the Statewide CASE Team

Attachment 1 presents comments that the Statewide CASE Team submitted to the Energy Commission's docket that are relevant to this measure.

- Statewide CASE Team, Docket #19-BSTD-03 TN# 236073, "Multifamily Restructuring Duct Leakage supplement",12/21/2020, https://efiling.energy.ca.gov/GetDocument.aspx?tn=236073&DocumentContentId=69076
- Statewide CASE Team, Docket #21-BSTD-01 TN# 238377 "Statewide Utility Codes and Standards Enhancement Team Comments - on Multifamily Common Use Area Requirements – 45-Day Language", 6/21/2021, https://efiling.energy.ca.gov/GetDocument.aspx?tn=238377&DocumentContentId=71679
- Statewide CASE Team, Docket #21-BSTD-01 TN#238404 "Statewide Utility Codes and Standards Enhancement Team Comments on 45-Day Express Terms_Part 1", 6/21/2021, https://efiling.energy.ca.gov/GetDocument.aspx?tn=238404&DocumentContentId=71705
- Statewide CASE Team, Docket #21-BSTD-01 TN#238406, "Statewide Utility Codes and Standards Enhancement Team Comments -Comments on 45-Day Express Terms_Part 2", 6/21/2021, https://efiling.energy.ca.gov/GetDocument.aspx?tn=238406&DocumentContentId=71707
- Statewide CASE Team, Docket #21-BSTD-01 TN#238409 "Statewide Utility Codes and Standards Enhancement Team Comments on 45-Day Express Terms_Part 3", 6/21/2021, https://efiling.energy.ca.gov/GetDocument.aspx?tn=238409&DocumentContentId=71710
- Statewide CASE Team, Docket #21-BSTD-01 TN#239075 "Statewide Utility Codes and Standards Enhancement Team Comments - Statewide CASE Team Support for Adoption of 15-Day Express Terms Part 1", 7/29/2021, https://efiling.energy.ca.gov/GetDocument.aspx?tn=239075&DocumentContentId=72509
- Statewide CASE Team, Docket #21-BSTD-01 TN#239074 "Statewide Utility Codes and Standards Enhancement Team Comments - Statewide CASE Team Support for Adoption of 15-Day Express Terms Part 2", 7/29/2021, https://efiling.energy.ca.gov/GetDocument.aspx?tn=239074&DocumentContentId=72510

Attachment 2: Final CASE Report

The final version of the CASE Report is provided in full in Attachment 2 to this report.