Hearing Date: November 22, 2024
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ITEM 3
TEST CLAIM
PROPOSED DECISION

Education Code Sections 17660, 17661

Statutes 2022, Chapter 777, Sections 1 and 2 (AB 2232), Effective January 1, 2023

Heating, Ventilation, and Air Conditioning (HVAC) Program

23-TC-01

Hesperia Unified School District, Claimant

TABLE OF CONTENTS

Exhibit A

For CSM Use Only
Filing Date: RECEIVED November 17, 2023 Commission on State Mandates
TC #: 23-TC-01

STATE of CALIFORNIA
COMMISSION ON STATE MANDATES

TEST CLAIM FORM AND TEST CLAIM AMENDMENT FORM (Pursuant to Government Code section 17500 et seq. and Title 2, California Code of Regulations, section 1181.1 et seq.)

Section 1

Proposed Test Claim Title:

Heating, Ventilation, and Air Conditioning (HVAC) Program

Section 2

Local Government (Local Agency/School District) Name:

Hesperia Unified School District

Name and Title of Claimant's Authorized Official pursuant to CCR, tit.2, § 1183.1(a)(1-5):

David Olney, Superintendent

Street Address, City, State, and Zip:

15576 Main Street, Hesperia, CA 92345

Telephone Number: 760-244-4411

Email Address: david.olney@hesperiausd.org

Section 3 – Claimant designates the following person to act as its sole representative in this test claim. All correspondence and communications regarding this claim shall be sent to this representative. Any change in representation must be authorized by the claimant in writing, and e-filed with the Commission on State Mandates. (CCR, tit.2, § 1183.1(b)(1-5).)

Name and Title of Claimant Representative:

Arthur M. Palkowitz- Attorney

Organization: Law Offices of Arthur M. Palkowitz

Street Address, City, State, Zip:

12807 Calle de la Siena, San Diego, CA 92130

Telephone Number: 8582591055

Email Address: law@artpalk.onmicrosoft.com

Section 4 – Identify all code sections (include statutes, chapters, and bill numbers; e.g., Penal Code section 2045, Statutes 2004, Chapter 54 [AB 290]), regulatory sections (include register number and effective date; e.g., California Code of Regulations, title 5, section 60100 (Register 1998, No. 44, effective 10/29/98), and other executive orders (include effective date) that impose the alleged mandate pursuant to Government Code section 17553 and check for amendments to the section or regulations adopted to implement it:

Assembly Bill No. 2232
Statutes 2022, Chapter 777, Sections 1, 2
Education Code Sections 17660, 17661

Enacted Date: September 29, 2022
Effective Date: January 1, 2023

☑ Test Claim is Timely Filed on [Insert Filing Date] [select either A or B]: 11 / 17 / 2023

☑ A: Which is not later than 12 months (365 days) following [insert effective date] 01 / 01 / 2023, the effective date of the statute(s) or executive order(s) pled; or

☐ B: Which is within 12 months (365 days) of [insert the date costs were *first* incurred to implement the alleged mandate] ___/___/_____, which is the date of first incurring costs as a result of the statute(s) or executive order(s) pled. *This filing includes evidence which would be admissible over an objection in a civil proceeding to support the assertion of fact regarding the date that costs were first incurred.*

(Gov. Code § 17551(c); Cal. Code Regs., tit. 2, §§ 1183.1(c) and 1187.5.)

Section 5 – Written Narrative*:*

☑ Includes a statement that actual or estimated costs exceed one thousand dollars ($1,000). (Gov. Code § 17564.)

☑ Includes all of the following elements for each statute or executive order alleged **pursuant to Government Code section 17553(b)(1)**:

☑ Identifies all sections of statutes or executive orders and the effective date and register number of regulations alleged to contain a mandate, including a detailed description of the *new* activities and costs that arise from the alleged mandate and the existing activities and costs that are *modified* by the alleged mandate;

☑ Identifies *actual* increased costs incurred by the claimant during the fiscal year for which the claim was filed to implement the alleged mandate;

☑ Identifies *actual or estimated* annual costs that will be incurred by the claimant to implement the alleged mandate during the fiscal year immediately following the fiscal year for which the claim was filed;

☑ Contains a statewide cost estimate of increased costs that all local agencies or school districts will incur to implement the alleged mandate during the fiscal year immediately following the fiscal year for which the claim was filed;

Following FY: 2024 - 2025 Total Costs: $10,000,000.00

☑ Identifies all dedicated funding sources for this program;

State: State Distributes ESSER II, III, CARES ACT

Federal: Elementary and Secondary School Emergency Relief (ESSER) II, III; Coronavirus Aid, Relief, and Economic Security Act (CARES Act)

Local agency's general purpose funds: Yes. General Funds

Other nonlocal agency funds: None

Fee authority to offset costs: None

☑ Identifies prior mandate determinations made by the Board of Control or the Commission on State Mandates that may be related to the alleged mandate:

Williams Case Implementation I, II, III (Case No.: 05-TC-04; 07-TC-06; 08-TC-01)

☑ Identifies any legislatively determined mandates that are on, or that may be related to, the same statute or executive order: None

Section 6 – The Written Narrative Shall be Supported with Declarations Under Penalty of Perjury Pursuant to Government Code Section 17553(b)(2) and California Code of Regulations, title 2, section 1187.5, as follows:

☑ Declarations of actual or estimated increased costs that will be incurred by the claimant to implement the alleged mandate.

☑ Declarations identifying all local, state, or federal funds, and fee authority that may be used to offset the increased costs that will be incurred by the claimant to implement the alleged mandate, including direct and indirect costs.

☑ Declarations describing new activities performed to implement specified provisions of the new statute or executive order alleged to impose a reimbursable state-mandated program (specific references shall be made to chapters, articles, sections, or page numbers alleged to impose a reimbursable state-mandated program).

☐ If applicable, declarations describing the period of reimbursement and payments received for full reimbursement of costs for a legislatively determined mandate pursuant to Government Code section 17573, and the authority to file a test claim pursuant to paragraph (1) of subdivision (c) of Government Code section 17574.

☑ The declarations are signed under penalty of perjury, based on the declarant's personal knowledge, information, or belief, by persons who are authorized and competent to do so.

Section 7 – The Written Narrative Shall be Supported with Copies of the Following Documentation Pursuant to Government Code section 17553(b)(3) and California Code of Regulations, title 2, § 1187.5:

☑ The test claim statute that includes the bill number, and/or executive order identified by its effective date and register number (if a regulation), alleged to impose or impact a mandate. Pages HVAC 093 to HVAC 104.

☑ Relevant portions of state constitutional provisions, federal statutes, and executive orders that may impact the alleged mandate. Pages None to None.

☑ Administrative decisions and court decisions cited in the narrative. (Published court decisions arising from a state mandate determination by the Board of Control or the Commission are exempt from this requirement.) Pages None to None.

☑ Evidence to support any written representation of fact. *Hearsay evidence may be used for the purpose of supplementing or explaining other evidence but shall not be sufficient in itself to support a finding unless it would be admissible over objection in civil actions.* (*Cal. Code Regs., tit. 2, § 1187.5*.) Pages 013 to 092.

Section 8 – TEST CLAIM CERTIFICATION Pursuant to Government Code section 17553

☑ The test claim form is signed and dated at the end of the document, under penalty of perjury by the eligible claimant, with the declaration that the test claim is true and complete to the best of the declarant's personal knowledge, information, or belief.

Read, sign, and date this section. Test claims that are not signed by authorized claimant officials pursuant to California Code of Regulations, title 2, section 1183.1(a)(1-5) will be returned as incomplete. In addition, please note that this form also serves to designate a claimant representative for the matter (if desired) and for that reason may only be signed by an authorized local government official as defined in section 1183.1(a)(1-5) of the Commission's regulations, and not by the representative.

This test claim alleges the existence of a reimbursable state-mandated program within the meaning of article XIII B, section 6 of the California Constitution and Government Code section 17514. I hereby declare, under penalty of perjury under the laws of the State of California, that the information in this test claim is true and complete to the best of my own personal knowledge, information, or belief. All representations of fact are supported by documentary or testimonial evidence and are submitted in accordance with the Commission's regulations. (Cal. Code Regs., tit.2, §§ 1183.1 and 1187.5.)

David Olney

Name of Authorized Local Government Official pursuant to Cal. Code Regs., tit.2, § 1183.1(a)(1-5)

Superintendent

Print or Type Title

Signature of Authorized Local Government Official pursuant to Cal. Code Regs., tit.2, § 1183.1(a)(1-5)

CSM Test Claim Form 02/2023

Final Audit Report 2023-11-17

Created:	2023-11-17
By:	CSM Sign (csmsign@csm.ca.gov)
Status:	Signed
Transaction ID:	CBJCHBCAABAAIQq8KHGKgYXw7mX1DdO-ISHEjFIEEYXL

"CSM Test Claim Form 02/2023" History

Document created by CSM Sign (csmsign@csm.ca.gov)
2023-11-17 - 5:23:50 PM GMT

Document emailed to Arthur Palkowitz (law@artpalk.onmicrosoft.com) for filling
2023-11-17 - 5:25:36 PM GMT

Email viewed by Arthur Palkowitz (law@artpalk.onmicrosoft.com)
2023-11-17 - 5:26:08 PM GMT

Form filled by Arthur Palkowitz (law@artpalk.onmicrosoft.com)
Form filling Date: 2023-11-17 - 5:54:02 PM GMT - Time Source: server

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Email viewed by david.olney@hesperiausd.org
2023-11-17 - 6:01:26 PM GMT

Signer david.olney@hesperiausd.org entered name at signing as David Olney
2023-11-17 - 9:07:54 PM GMT

Document e-signed by David Olney (david.olney@hesperiausd.org)
Signature Date: 2023-11-17 - 9:07:56 PM GMT - Time Source: server

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2023-11-17 - 9:07:56 PM GMT

BEFORE THE

COMMISSION ON STATE MANDATES

STATE OF CALIFORNIA

Test Claim of:	No. CSM ___________________ Heating, Ventilation, and Air Conditioning (HVAC) Program Assembly Bill No. 2232
Hesperia Unified School District;	Statutes 2022, Chapter 777, Sections 1, 2 Education Code Sections 17660, 17661
Claimant	Enacted Date: September 29, 2022 Effective Date: January 1, 2023

I.

STATEMENT OF THE CLAIM

Hesperia Unified School District ("Claimant") test claim addresses Education Code Section 17660 and 17661 requiring schools in the State to ensure that facilities have heating, ventilation, and air conditioning (HVAC) systems that meet specified minimum ventilation rate requirements, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate, in which case Assembly Bill (A.B.) No. 2232, Statutes 2022, Chapter 777, Sections 1, 2, would require a public school to ensure its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued.

Assembly Bill 2232 also requires public schools to install filtration that achieves specified minimum efficiency reporting values (MERV) levels, determined by the school to be feasible with the existing HVAC system, as provided. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Sections 1, 2, Education Code Sections 17660, 17661, Enacted on September 29, 2022, Effective Date: January 1, 2023.)

II. Claimant incurred new activities/costs for a new program or a higher level of service.

Claimant incurred new activities and costs to ensure that facilities have heating, ventilation, and air conditioning (HVAC) systems that meet specified minimum ventilation rate requirements, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate, in which to ensure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued. Additionally, schools are required to install filtration that achieves specified minimum efficiency reporting values (MERV) levels, determined by the school to be feasible with the existing HVAC system, as provided.

The new activities and costs incurred by the Claimant includes the purchasing and installation of new filters explained in detail in Section VIII, IX and X of this test claim. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Sections 1, 2, Education Code Section 17661(c)(1), Effective Date: January 1, 2023.)

III. California Constitution requires the State to reimburse all public schools.

Article XIII B, section 6 of the California Constitution states:

Whenever the Legislature or any state agency mandates a new program or higher level of service on any local government, the state shall provide a subvention of funds to reimburse such local government for the costs of such programs or increased level of service.

The intent of Article XIII B, section 6 is to [p]reclude the state from shifting financial responsibility for carrying out governmental functions to local agencies, which are ‘ill equipped’ to assume increased financial responsibilities because of the taxing and spending limitations that article XIII A and XIII B impose. (*County of San Diego v. State of California* (1997) 15 Cal.4th 68, 81.) Thus, the subvention requirement of section 6 is “directed to state-mandated increases in the services provided by [local government]...” (*County of Los Angeles v. State of California (*1987) 43 Cal.3d 46, 56.) Reimbursement under Article XIII B, section 6 is required when the following elements are met:

1. A state statute or executive order requires or “mandates” local agencies or school districts to perform an activity. (*San Diego Unified School Dist. v. Commission on State Mandates*, (2004) 33 Cal.4th 859, 874.)

2. Under the first alternative test set forth by the California Supreme Court, a "new program or higher level of service" is established by "programs that carry out the governmental function of providing services to the public." (*San Diego Unified Sch. Dist. v. Comm'n on State Mandates*, 33 Cal. 4th 859, 874 (2004) (quoting *County of Los Angeles v. State of California*(1987) 43 Cal.3d 46, 56).

3. Under the second alternative test set forth by the California Supreme Court, a "new program or higher level of service" is established by "laws which, to implement a state policy, impose unique requirements on local governments and do not apply generally to all residents and entities in the state." (*San Diego Unified Sch. Dist. v. Comm'n on State Mandates*, 33 Cal. 4th 859, 874 (2004) (quoting *County of Los Angeles v. State of California* (1987) 43 Cal.3d 46, 56).

4. The mandated activity is a new law when compared with the legal requirements in effect immediately before the enactment of the test claim statute, and it increases the level of service provided to the public in enforcing a state policy. (*San Diego Unified School Dist.*, supra 33 Cal.4th 859, 874-875, 878; *Lucia Mar Unified School District v. Honig* (1988) 44 Cal 3d 830, 835.)

IV. The new program is mandated when the schools incur increased costs.

Government Code section 17514 provides that [c]osts mandated by the state means any increased costs which a local agency or school district is required to incur after July 1, 1980, as a result of any statute enacted on or after January 1, 1975, or any executive order implementing any statute enacted on or after January 1, 1975, which mandates a new program or higher level of service of an existing program within the meaning of Section 6 of Article XIII B of the California Constitution.

Government Code section 17564 provides that: [n]o claim shall be made pursuant to Sections 17551, 17561, or 17573, nor shall any payment be made on claims submitted pursuant to Sections 17551, or 17561, or pursuant to a legislative determination under Section 17573, unless these claims exceed one thousand dollars.

Claimant alleges increased costs exceeds the $1,000.00 minimum claim amount articulated in Government Code section 17564(a). Government Code section 17556(e) states that there are no costs mandated by the state, if additional revenue specifically intended to fund the costs of the mandated activities, in an amount sufficient to fund the cost of the state-mandated activities, has been appropriated in a Budget Act or other bill.

There is no evidence that additional on-going revenue has been appropriated, specifically to fund the costs of the mandated activities in this test claim. Thus, Government Code section 17556(e) does not apply to deny this claim. Accordingly, the evidence in the record supports the finding that the claimant has incurred increased costs mandated by the state, pursuant to Government Code section 17514. However, to the extent a district receives any funding or grant funding and applies those funds to the mandated activities, those funds are required to be identified as offsetting revenue and deducted from the costs claimed by the district.

V. Commission on State Mandates has the authority to decide a test claim.

The Commission on State Mandates has the authority, pursuant to Government Code section 17551, subdivision (a), to hear and decide upon a claim by a local agency or school district that the local agency or school district is entitled to be reimbursed by the State for costs mandated by the State, as required by section 6 of Article XIII B of the California Constitution. (*Kinlaw v. State of California* (1991) 54 Cal.3d 326, 331-334; Government Code sections 17551 and 17552.) The determination of whether a statute or executive order imposes a reimbursable state-mandated program is a question of law. (*County of San Diego v. State of California,* (1997) 15 Cal.4th 68,109.)

In construing a statute, our task is to determine the Legislature's intent and purpose for the enactment. (*People v. Tindall* (2000) 24 Cal.4th 767, 772, 102 Cal.Rptr.2d 533.) We look first to the plain meaning of the statutory language, giving the words their usual and ordinary meaning. (Ibid.) If there is no ambiguity in the statutory language, its plain meaning controls; we presume the Legislature meant what it said. (*California School Boards Assn. v. State of California* (2018) 19 Cal.App.5th 566, 584, as modified on denial of reh'g (Feb. 7, 2018)

VI. Test claim is filed within 365 days of the effective date January 1, 2023.

This test claim is filed within 365 days of the effective date January 1, 2023 of Assembly Bill No. 2232, Statutes 2022, Chapter 777, Sections 1, 2, Education Code Sections 17660, 17661, alleging increased actual and estimated costs for the new activities to ensure that school facilities have heating, ventilation, and air conditioning (HVAC) systems that meet specified minimum ventilation rate requirements, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate, in which case the bill would require a covered school to ensure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued. The bill requires schools to periodically install filtration that achieves specified minimum efficiency reporting values (MERV) levels, determined by the school to be feasible with the existing HVAC system, as provided. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Education Code Section 17661(c)(1)).

VII. Test Claim Statute Requires School Facilities to provide a healthy indoor environment for students, teachers, and other occupants.

AB 2232 Section 1.

> The Legislature finds and declares all of the following: (a) It is the policy of this state that school facilities be designed and operated using available measures to provide a healthy indoor environment for students, teachers, and other occupants including, but not limited to, healthy indoor air quality and adequate ventilation with outdoor air.

[1] A 2019 report by the University of California, Davis, Western Cooling Efficiency Center, and the Indoor Environment Group of the Lawrence Berkeley National Laboratory identifies numerous studies finding that underventilation of classrooms is common and negatively impacts student health and learning. Improved heating, ventilation, and air conditioning (HVAC) system performance improves student and teacher health and attendance,

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[1] (b) In November 2003, the State Air Resources Board and the State Department of Health Care Services issued a report to the Legislature detailing the adverse impact that poor indoor air quality is having on California schools. The report found significant indoor air quality problems, including problems with ventilation, temperature, humidity, air pollutants, floor dust contaminants, moisture, mold, noise, and lighting. The report found that ventilation with outdoor air was inadequate during 40 percent of classroom hours and seriously deficient during 10 percent of classroom hours in both portable classrooms and traditional classrooms. (c) In February 2005, the State Air Resources Board approved an indoor air quality report that cites proven health and economic benefits to reducing indoor air pollution, which is estimated to cost California $45 billion per year. The report noted that children are particularly vulnerable to poor indoor air quality. According to the report, children under 12 years of age spend about 86 percent of their time indoors with 21 percent of the time being spent in schools. (d) A 2019 report by the University of California, Davis, Western Cooling Efficiency Center, and the Indoor Environment Group of the Lawrence Berkeley National Laboratory identifies numerous studies finding that underventilation of classrooms is common and negatively impacts student health and learning. Improved heating, ventilation, and air conditioning (HVAC) system performance improves student and teacher health and attendance, student productivity, and the performance of mental tasks, such as better concentration and recall. The report found that students in classrooms with higher ventilation rates have a significantly higher percentage of students—13 to 14 percent—scoring satisfactorily on mathematics and reading tests than students in classrooms with lower outdoor air ventilation rates. (e) A 2018 report in the Environment International Journal found that short-term carbon dioxide exposure beginning at 1,000 parts per million (ppm) negatively affects cognitive performances, including decision making and problem resolution. The Wisconsin Department of Health Services states that carbon dioxide levels between 1,000 and 2,000 ppm are associated with drowsiness and attention issues. Carbon dioxide levels above 2,000 ppm affect concentration and cause headaches, increased heart rate, and nausea. (f) The California Building Energy Efficiency Standards set minimum ventilation rates for classrooms. Sections 17002 and 17070.75 of the Education Code require school districts to ensure schools are maintained in good repair, including HVAC systems that are functional, supply adequate ventilation to classrooms, and maintain interior temperatures within acceptable ranges. Regulations adopted pursuant to Section 142.3 of the Labor Code require that HVAC systems be maintained and operated to provide at least the quantity of outdoor air required by the California Building Standards Code (Title 24 of the California Code of Regulations) in effect at the time the building permit was issued. Despite these requirements, poorly performing HVAC systems and underventilation of classrooms continue to be a significant problem in California. (g) The 2019 report by the University of California, Davis, Western Cooling Efficiency Center, and the Indoor Environment Group of the Lawrence Berkeley National Laboratory found that over one-half of new HVAC systems in schools had significant problems within three years of installation and that the vast majority of classrooms in California, including 95 percent of the classrooms studied in the central valley, continue to fail to meet minimum ventilation rates. Some classrooms were found to have carbon dioxide concentrations above 2,000 ppm for substantial periods of the day. The study recommended periodic testing of HVAC systems and continuous real-time carbon dioxide monitoring to detect and correct these problems. (h) Monitoring levels of carbon dioxide in classrooms will help ensure that California students' school environment is healthy and conducive to learning and performing well on tests. (i) A March 2021 study found that proper ventilation in classrooms could reduce COVID-19 infection risk by over 80 percent compared to classrooms without ventilation. (j) The Centers for Disease Control and Prevention and the American Society of Heating, Refrigerating and Air-Conditioning Engineers recommend that schools, buildings, and homes combine filters and air cleaners to achieve minimum efficiency reporting values (MERV) levels of performance for air cleaning of 13 or higher.

student productivity, and the performance of mental tasks, such as better concentration and recall. The report found that students in classrooms with higher ventilation rates have a significantly higher percentage of students—13 to 14 percent—scoring satisfactorily on mathematics and reading tests than students in classrooms with lower outdoor air ventilation rates adequate ventilation with outdoor air.

VIII. <u>Schools shall ensure their facilities have HVAC systems that meet the minimum ventilation rate.</u>

Claimants contend the following new requirements and new activities are directly related to increased costs of purchasing and installing filters at District's facilities. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2 Education Code Section 17661(c)(1).)

Section 2: Education Code Section 17661 is added by Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Sections 17661, Effective January 1, 2023, [2]requiring that schools HVAC systems meet the minimum ventilation rate requirements unless the existing HVAC system is not capable of safely and efficiently providing the minimum

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[2] Education Code Section 17661. (a) For purposes of this section, the following definitions apply: (1) "Covered school" means a school district, a county office of education, a charter school, a private school, the California Community Colleges, or the California State University. (2) "HVAC" means heating, ventilation, and air conditioning. (3) "MERV" means minimum efficiency reporting values. (b) (1) A covered school shall, and the University of California is requested to, ensure that facilities, including, but not limited to, classrooms for students, have HVAC systems that meet the minimum ventilation rate requirements set forth in Table 120.1-A of Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate. (2) If a school's existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate required pursuant to paragraph (1), then a covered school shall, and the University of California is requested to, ensure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued. In addition, the covered school shall, and the University of California is requested to, document the HVAC system's inability to meet the current ventilation standards set forth in paragraph (1) in the annual HVAC inspection report required by Section 5142 of Title 8 of the California Code of Regulations, which shall be available to the public upon request. (c) (1) Subject to paragraph (2), a covered school shall, and the University of California is requested to, install filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, 2, Education Code Sections 17660, 17661, Enacted on September 29, 2022, Effective Date: January 1, 2023.) (2) If, pursuant to paragraph (1), it is determined that the existing HVAC system is not designed to achieve MERV levels of 13 or higher, a covered school shall, and the University of California is requested to, install filtration that achieves the highest MERV level that the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, 2, Education Code Sections 17660.

ventilation rate. (Education Code Section 17661 (b)(1)); (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Sections 17660, 17661; Effective Date: January 1, 2023.)

To achieve this requirement Claimant is required to perform the new activity to install filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school. (Education Code Section 17661 (c)(1)).

The procedure for replacing and installing the MERV 13 air filters includes the following.

MERV 13 air filters are delivered to different staging areas. They are delivered by the vendor and unloaded by our staff. The process was very easy with the previous MERV 9 1” air filters. The MERV 13 air filters are 2” requiring more storage space. The filters are loaded and transported to the school facility site that may require multiple trips and additional labor hours.

MERV 13 air filters have a shorter filter life span than the MERV 9 previously used by the Claimant. The Claimant averages about three months per filter on roof units, compared to previously six months. Additional maintenance is required to clean the indoor coil where the air filters are located because MERV 13 are box filters with gaps on the indoor coil. These gaps collect dirt and lint. The previous filters were lay in filters and covered the entire coil. The process to clean the coils more frequently involves hosing the indoor coils down, clearing the drains. The process takes about a half hour per unit plus staging and breakdown.

Every school site has rooftop top units. Claimant transport and stage on location. Claimant then uses a rope to lift them all to the roof. The filter changers use cordless drill motors and hand tools to remove and replace the filters. The coils are covered with the new box filters that takes additional time and multiple trips. There is triple the number of boxes because of the larger filters. We then close the units up and dispose of the old filters. There is a significant increase in labor due to the additional work involved in maintaining the units. The MERV 13 air filters at the portable classrooms are changed every three months.

IX. Claimant has incurred increased costs for the labor and the purchase of the MERV 13 air filters.

The Claimant first incurred increased costs for the labor to replace and install the MERV 13 air filters and the purchase of the MERV 13 air filters on January 1, 2023. For the period **January 1, 2023, to June 30, 2023,** the Claimant's actual increased costs of the labor to replace and install the MERV 13 air filters were **$27,443.12.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)). For the period **January 1, 2023, to June 30, 2023,** the Claimant's actual increased cost for purchasing the MERV 13 air filters were **$66,236.22**. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

For the period July 1, 2023, to June 30, 2024, the Claimant's estimated increased cost of the labor to replace and install the MERV 13 air filters is **$81,669.06**. The Claimant hired two employees to perform the replacing and installing the MERV 13 air filters every three months. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)). **For the period July 1, 2023, to June 30, 2024,** the Claimant's estimated increased cost for purchasing the MERV 13 air filters is **$100,119.04.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

Claimant Hesperia Unified School District has provided a declaration with supporting documents evidencing the Claimant's new actual increased costs incurred from January 1, 2023, to June 30, 2023, and the increased estimated costs for Fiscal Year 2023-2024 for the purchasing of the MERV 13 air filters and the hiring of two employees to perform the replacing and installing of the MERV 13 air filters every three months.

X. The actual or estimated annual costs that will be incurred by the claimant Hesperia to implement the alleged mandate during the fiscal year immediately following the fiscal year for which the claim was filed.

Claimant will incur increased estimated costs for the activities for **FY 2024-2025** required by Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section17661, Effective Date: January 1, 2023

For the fiscal year period July 1, 2024, to June 30, 2025, the District's estimated increased cost of the labor to replace and install the MERV 13 air filters is **$120,624.56.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)). **For the fiscal year period July 1, 2024, to June 30, 2025,** the District's estimated cost of purchasing the MERV 13 air filters is **$151,920.32.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

Claimant has provided a declaration with supporting documents evidencing the District's estimated costs for labor and purchasing the MERV 13 air filters to be incurred in 2024-2025, the fiscal year after the test claim was filed.

The Claimant's General funds are the funding sources for the purchasing of the MERV 13 costs and labor from January 1, 2023, to June 30, 2023, and in Fiscal Years 2023-2024 and 2024-2025.

XI. <u>A statewide cost estimate of increased costs that all local agencies or school districts will incur to implement the alleged mandate during the fiscal year immediately following the fiscal year for which the claim was filed.</u>

$10,000,000.00.

XII. <u>Identification of all of the following funding sources available for this program.</u>

The Claimant received Elementary and Secondary School Emergency Relief (ESSER) II funds in the amount of $26,295,815. These funds were distributed from June 2021 to August 2023 towards the districtwide HVAC project to remove and replace HVAC systems at elementary, middle, and high schools. Prior to January 1, 2023, ESSER funds were used to purchase MERV 13 filters in the initial implementation of the new HVAC systems.

The Claimant received Elementary and Secondary School Emergency Relief (ESSER) III funds in the amount of $58,852,535. The Claimant allocated $13 million towards the districtwide HVAC project the districtwide HVAC project to remove and replace HVAC systems at elementary, middle, and high schools. The difference is due to the district having other priorities in spending the remainder of ESSER III funds. The Claimant has until September 30, 2024, to spend this allocation. There will be no additional allocations of ESSER funds. Attached are Department of General Services approval plans for the District's HVAC upgrade to its facilities.

The Coronavirus Aid, Relief, and Economic Security Act (CARES Act) provides funding to Local Education Agencies through the Elementary and Secondary School Emergency Relief (ESSER) Fund, to address the impact of COVID-19 on elementary and secondary schools.

(i) Dedicated state funds

Other than CARES Act and ESSER, Claimant is unaware at this time of any other dedicated state funds available for this program.

(ii) Dedicated federal funds

Other than CARES Act and ESSER, Claimant is unaware at this time of any other dedicated state funds available for this program.

(iii) Other nonlocal agency funds

Claimant is unaware at this time of any other nonlocal agency funds available for this program.

(iv) The local agency's general purpose funds.

Claimant has used their general purpose funds for the costs related to the FAFSA program.

(v) Fee authority to offset costs.

Claimant is unaware at this time of any fee authority to offset costs.

XIII. Identification of prior mandate determinations made by the Board of Control or the Commission on State Mandates that may be related to the alleged mandate.

The Commission decided in the test claim Williams Case Implementation I, II, III (Case No.: 05-TC-04; 07-TC-06; 08-TC-01) that Education Code sections 33126(b), 35186, 14501, 41020, and 42127.6 imposed a reimbursable state-mandated program for school districts and county offices of education. Education Code section 33126(b) requires the reporting of any needed maintenance to ensure good repair within the School Accountability Report Card. As such, the use of MERV 13 air filters may be related to maintenance to ensure good repair.

Various sections of the law, in different Codes and Code sections, require school facilities to be in good working order and well maintained, including specified inspections. In 2004, the state settled the *Williams v. California* lawsuit and agreed to a number of initiatives intended to provide equal access to instructional materials, safe and decent school facilities, and qualified teachers. The settlement resulted in an agreement to provide funds to low performing schools (deciles 1-3 on the Academic Performance Index), including $800 million for emergency repair of school facilities. COEs were charged with inspection of the low-performing schools based on criteria of schools in good repair. "Good repair" is defined as a facility that is clean, safe, and functional. The settlement also included a lengthy list of facilities components required to be inspected, including gas pipes, doors and windows, fences, fire sprinklers, fire extinguishers, alarm systems, electrical systems, lighting, drinking fountains, roofs, gutters, and mechanical systems, which includes HVAC systems. (Assembly Floor Analysis AB 2232 (McCarty) As Amended June 28, 2022)

XIV. <u>Identification of a legislatively determined mandate pursuant to Government Code section 17573 that is on the same statute or executive order.</u>

Claimant is unaware at this time of any other mandate that is on the same statute or executive order.

Test Claim: Heating, Ventilation, and Air Conditioning (HVAC)
Claimant: Hesperia Unified School District
Section: 6 Declaration- Dr. George Landon, Deputy Superintendent, Business Service, Hesperia Unified School District

SECTION NUMBER: 6
Heading: DECLARATION

I, Dr. George Landon, Deputy Superintendent, Business Service, Hesperia Unified School District (Claimant) declare as follows:

1. I am currently employed with the Claimant, and I have been employed with the Claimant since July 1, 2016.

2. I have personal knowledge of the actual and estimated costs incurred by the Claimant for the School Facilities: Heating, Ventilation, and Air Conditioning ("HVAC") Systems commencing on January 1, 2023. The information contained in my declaration is from preparing and reviewing Claimant's business records, my personal knowledge and my information or belief pertaining to the Claimant's HVAC Systems.

3. The new requirements included in test claim statute Assembly Bill No. 2232, Statutes 2022, Chapter 777, Sections 1, 2, Education Code Sections 17660, 17661, Enacted on September 29, 2022, Effective January 1, 2023, include the activities of purchasing and installing MERV 13 air filters in the Claimant's facilities HVAC Systems.

4. The procedure for receiving and installing the MERV 13 air filters is as follows. MERV 13 air filters are delivered to different staging areas. They are delivered by the vendor and unloaded by our staff. The process was very easy with the previous MERV 9 1" air filters. The MERV 13 filters are 2" requiring more storage space. The filters are loaded and transported to the school facility site that may require multiple trips and additional labor hours.

5. MERV 13 air filters have a shorter filter life span than the MERV 9 previously used by the Claimant. The Claimant averages about three months per MERV 13 air filter on roof units, compared to previously six months. Additional maintenance is required to clean the indoor coil where the air filters are located because MERV 13 are box filters with gaps on the indoor coil. These gaps collect dirt and lint. The previous filters were lay in filters and covered the entire coil. The process to clean the coils more frequently involves hosing the indoor coils down, clearing the drains. The process takes about a half hour per unit plus staging and breakdown.

Test Claim: Heating, Ventilation, and Air Conditioning (HVAC)
Claimant: Hesperia Unified School District
Section: 6 Declaration- Dr. George Landon, Deputy Superintendent, Business Service, Hesperia Unified School District

6. Every school site has rooftop top units. Claimant will transport and stage on location. Claimant then uses a rope to lift them all to the roof. The filter changers use cordless drill motors and hand tools to remove and replace the filters. The coils are covered with the new box filters that takes additional time and multiple trips. There is triple the number of boxes because of the larger filters. We then close the units up and dispose of the old filters. There is a significant increase in labor due to the additional work involved in maintaining the units. The MERV 13 air filters at the portable classrooms are changed every three months.

7. The Claimant first incurred increased costs for the labor to replace and install the MERV 13 air filters and the purchase of the MERV 13 air filters on January 1, 2023. For the period **January 1, 2023, to June 30, 2023,** the Claimant's actual increased cost of the labor to replace and install the MERV 13 air filters were **$27,443.12.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

8. For the period **January 1, 2023, to June 30, 2023,** the Claimant's actual increased cost for purchasing the MERV 13 air filters were **$66,236.22.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

9. For the period **July 1, 2023, to June 30, 2024,** the Claimant's increased estimated cost of the labor to replace and install the MERV 13 air filters is **$81,669.06.** The Claimant hired two employees to perform the replacing and installing of the MERV 13 air filters every three months. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

10. For the period **July 1, 2023, to June 30, 2024,** the Claimant's increased estimated cost for purchasing the MERV 13 air filters is **$100,119.04.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

I have attached documents in support of the Claimant's increased actual costs incurred from January 1, 2023, to June 30, 2023, and for Fiscal Year 2023-2024 the increased estimated costs for purchasing the MERV 13 air filters, the hiring of two employees to perform the replacing and installing of the MERV 13, air filter invoices and air filter data sheets. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

11. For the fiscal year period **July 1, 2024, to June 30, 2025,** the Claimant's estimated cost of the labor to replace and install the MERV 13 air filters is **$120,624.56.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

12. For the fiscal year period **July 1, 2024, to June 30, 2025,** the Claimant's estimated cost for purchasing the MERV 13 air filters is **$151,920.32.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

I have attached documents in support of the Claimant's estimated costs for labor to replace and install the MERV 13 air filters and for the purchasing of the MERV 13 air filters in Fiscal Year 2024-2025, the fiscal year immediately following the fiscal year for which the claim was filed. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

13. The Claimant's General funds are the funding sources for the purchasing of the MERV 13 air filter costs and the labor of replacing and installing the MERV 13 air filters from January 1, 2023, to June 30, 2023, and in Fiscal Years 2023-2024 and 2024-2025.

14. The Claimant received Elementary and Secondary School Emergency Relief (ESSER) II funds in the amount of $26,295,815. These funds were distributed from June 2021 to August 2023 towards the Districtwide HVAC project to remove and replace HVAC systems at elementary, middle, and high schools. Prior to January 1, 2023, ESSER funds were used to purchase MERV 13 filters in the initial implementation of the new HVAC systems.

15. The Claimant received Elementary and Secondary School Emergency Relief (ESSER) III funds in the amount of $58,852,535. The Claimant allocated $13 million towards the Districtwide HVAC project to remove and replace HVAC systems at elementary, middle, and high schools. The difference is due to the Claimant having other priorities in spending the remainder of ESSER III funds. The Claimant has until September 30, 2024, to spend this allocation. There will be no additional allocations of ESSER funds. Attached are Department of General Services, Division of the State Architect approval plans for the replacement of the District's HVAC.

16. The Coronavirus Aid, Relief, and Economic Security Act (CARES Act) provides funding to Local Education Agencies through the Elementary and Secondary School Emergency Relief (ESSER) Fund, to address the impact of COVID-19 on elementary and secondary schools.

17. I am unaware of any local, state, or federal funds or fee authority that may be used to offset the increased costs that will be incurred by claimant to implement the alleged mandate, including direct and indirect costs.

18. An estimate of the statewide cost schools will incur to implement the alleged mandate during the fiscal year immediately following the fiscal year for which the claim was filed is the amount of $10 Million.

I certify by my signature below, under penalty of perjury under the laws of the State of California, that the statements made in this document are true and complete to the best of my own personal knowledge or information and belief and I am authorized and competent to do so.

Dated: November 15, 2023

DR. GEORGE LANDON, DEPUTY
SUPERINTENDENT, BUSINESS SERVICE
HERSPERIA UNIFIED SCHOOL DISTRICT

HVAC 017

Filter Comparison

School	MERV 9 Filters: Rooftop – MERV 9 Filter - Twice a Year	Labor Hours	Portables – MERV 9 Filter - Four Times a year	Labor Hours	Total Labor Hours for Rooftop and Portables	Senior Maintenance Worker Hourly Rate with Statutories	Total Labor Cost	MERV 13 Filters: Rooftop – MERV 13 Filter - Four Times a Year	Labor Hours	Portables – MERV 13 Filter - Six Times a year	Labor Hours	Total Labor Hours for Rooftop and Portables	Senior Maintenance Worker Hourly Rate with Statutories	Total Labor Cost	Labor Cost Difference Between MERV 9 vs MERV 13
Carmel	2	16	4	8	24	$ 41.33	$ 1,653.20	4	32	6	12	44	$ 41.33	$ 3,141.08	$ 1,487.88
Cottonwood	2	16	4	8	24	$ 41.33	$ 1,653.20	4	32	6	12	44	$ 41.33	$ 3,141.08	$ 1,487.88
Cypress	2	24	4	8	32	$ 41.33	$ 2,314.48	4	48	6	12	60	$ 41.33	$ 4,463.64	$ 2,149.16
Eucalyptus	2	16	4	8	24	$ 41.33	$ 1,653.20	4	32	6	12	44	$ 41.33	$ 3,141.08	$ 1,487.88
Hollyvale	2	16	4	8	24	$ 41.33	$ 1,653.20	4	32	6	12	44	$ 41.33	$ 3,141.08	$ 1,487.88
Joshua Circle	2	20	4	16	36	$ 41.33	$ 2,314.48	4	40	6	24	64	$ 41.33	$ 4,298.32	$ 1,983.84
Juniper	2	16	4	8	24	$ 41.33	$ 1,653.20	4	32	6	12	44	$ 41.33	$ 3,141.08	$ 1,487.88
Kingston	2	20	4	16	36	$ 41.33	$ 2,314.48	4	40	6	24	64	$ 41.33	$ 4,298.32	$ 1,983.84
Krystal	2	12	4	8	20	$ 41.33	$ 1,322.56	4	24	6	12	36	$ 41.33	$ 2,479.80	$ 1,157.24
Lime Street	2	16	4	16	32	$ 41.33	$ 1,983.84	4	32	6	24	56	$ 41.33	$ 3,637.04	$ 1,653.20
Maple	2	16	4	12	28	$ 41.33	$ 1,818.52	4	32	6	18	50	$ 41.33	$ 3,389.06	$ 1,570.54
Mesa Granda	2	20	4	16	36	$ 41.33	$ 2,314.48	4	40	6	24	64	$ 41.33	$ 4,298.32	$ 1,983.84
Mesquite Trails	2	16	4	8	24	$ 41.33	$ 1,653.20	4	32	6	12	44	$ 41.33	$ 3,141.08	$ 1,487.88
Mission Crest	2	16	4	12	28	$ 41.33	$ 1,818.52	4	32	6	18	50	$ 41.33	$ 3,389.06	$ 1,570.54
Topaz	2	16	4	8	24	$ 41.33	$ 1,653.20	4	32	6	12	44	$ 41.33	$ 3,141.08	$ 1,487.88
Cedar Middle	2	24	4	20	44	$ 41.33	$ 2,810.44	4	48	6	30	78	$ 41.33	$ 5,207.58	$ 2,397.14
Hesperia Jr	2	24	4	24	48	$ 41.33	$ 2,975.76	4	48	6	36	84	$ 41.33	$ 5,455.56	$ 2,479.80
Ranchero Middle	2	40	4	12	52	$ 41.33	$ 3,802.36	4	80	6	18	98	$ 41.33	$ 7,356.74	$ 3,554.38
Hesperia High	2	68	4	60	128	$ 41.33	$ 8,100.68	4	136	6	90	226	$ 41.33	$ 14,961.46	$ 6,860.78
Sultana	2	60	4	20	80	$ 41.33	$ 5,786.20	4	120	6	30	150	$ 41.33	$ 11,159.10	$ 5,372.90
Oak Hills	2	60	4	40	100	$ 41.33	$ 6,612.80	4	120	6	60	180	$ 41.33	$ 12,399.00	$ 5,786.20
Canyon Ridge	2	20	4	8	28	$ 41.33	$ 1,983.84	4	40	6	12	52	$ 41.33	$ 3,802.36	$ 1,818.52
Mojave	2	24	4	32	56	$ 41.33	$ 3,306.40	4	48	6	48	96	$ 41.33	$ 5,951.52	$ 2,645.12
Shadowridge	2	16	4	0	16	$ 41.33	$ 1,322.56	4	32	6	0	32	$ 41.33	$ 2,645.12	$ 1,322.56
Total							$ 64,474.80							$ 121,179.56	$ 56,704.76

HVAC 018

Filter Comparison

School	MERV 13 Filters — Rooftop: MERV 13 Filter - Four Times a Year	Labor Hours	Portables: MERV 13 Filter - Six Times a year	Labor Hours	Total Labor Hours for Rooftop and Portables	Senior Maintenance Worker Hourly Rate with Statutories	Total Labor Cost
Carmel	4	32	6	12	44	$ 41.33	$ 1,570.54
Cottonwood	4	32	6	12	44	$ 41.33	$ 1,570.54
Hollyvale	4	32	6	12	44	$ 41.33	$ 1,570.54
Joshua Circle	4	40	6	24	64	$ 41.33	$ 2,149.16
Juniper	4	32	6	12	44	$ 41.33	$ 1,570.54
Kingston	4	40	6	24	64	$ 41.33	$ 2,149.16
Lime Street	4	32	6	24	56	$ 41.33	$ 1,818.52
Maple	4	32	6	18	50	$ 41.33	$ 1,694.53
Mesa Granda	4	40	6	24	64	$ 41.33	$ 2,149.16
Mesquite Trails	4	32	6	12	44	$ 41.33	$ 1,570.54
Cedar Middle	4	48	6	30	78	$ 41.33	$ 2,603.79
Hesperia Jr	4	48	6	36	84	$ 41.33	$ 2,727.78
Mojave	4	48	6	48	96	$ 41.33	$ 2,975.76
Shadowridge	4	32	6	0	32	$ 41.33	$ 1,322.56
Total							$ 27,443.12

Filter Comparison

	MERV 13 Filters Size of Filters												
School	20x30x2	Cost Per Filter	Cost	16x25x2	Cost per Filter	Cost	16x20x2	Cost per Filter	Cost	20x20x2	Cost per Filter	Cost	Total MERV 13 Filter Cost
Carmel	16	$ 18.04	$ 288.64	56	$ 11.51	$ 644.56	2	$ 9.95	$ 19.90	12	$ 11.51	$ 138.12	$ 1,022.16
Cottonwood	23	$ 18.04	$ 414.92	54	$ 11.51	$ 621.54	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,099.28
Hollyvale	8	$ 18.04	$ 144.32	58	$ 11.51	$ 667.58	8	$ 9.95	$ 79.60	8	$ 11.51	$ 92.08	$ 937.54
Joshua Circle	28	$ 18.04	$ 505.12	44	$ 11.51	$ 506.44	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,074.38
Juniper	32	$ 18.04	$ 577.28	44	$ 11.51	$ 506.44	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,146.54
Kingston	30	$ 18.04	$ 541.20	54	$ 11.51	$ 621.54	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,202.54
Lime Street	21	$ 18.04	$ 378.84	62	$ 11.51	$ 713.62	16	$ 9.95	$ 159.20	2	$ 11.51	$ 23.02	$ 1,263.17
Maple	24	$ 18.04	$ 432.96	54	$ 11.51	$ 621.54	8	$ 9.95	$ 79.60	-	$ 11.51	$ -	$ 1,134.10
Mesa Granda	24	$ 18.04	$ 432.96	58	$ 11.51	$ 667.58	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,140.34
Mesquite Trails	22	$ 18.04	$ 396.88	54	$ 11.51	$ 621.54	2	$ 9.95	$ 19.90	12	$ 11.51	$ 138.12	$ 1,107.38
													$ -
Cedar Middle	64	$ 18.04	$ 1,154.56	28	$ 11.51	$ 322.28	4	$ 9.95	$ 39.80	26	$ 11.51	$ 299.26	$ 1,666.27
Hesperia Jr	46	$ 18.04	$ 829.84	100	$ 11.51	$ 1,151.00	34	$ 9.95	$ 338.30	16	$ 11.51	$ 184.16	$ 2,411.22
													$ -
													$ -
Mojave	40	$ 18.04	$ 721.60	34	$ 11.51	$ 391.34	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,152.74
IT	6	$ 18.04	$ 108.24	0	$ 11.51	$ -	3	$ 9.95	$ 29.85	11	$ 11.51	$ 126.61	$ 201.40
Total			$ 6,927.36			$ 8,057.00			$ 1,004.95			$ 1,139.49	$ 16,559.06
Changed Quarterly													4
Annual Cost													$ 66,236.22

HVAC 020

Filter Comparison

School	MERV 13 Filters Rooftop MERV 13 Filter - Four Times a Year	Labor Hours	Portables MERV 13 Filter - Six Times a year	Labor Hours	Total Labor Hours for Rooftop and Portables	Senior Maintenance Worker Hourly Rate with Statutories	Total Labor Cost
Carmel	4	32	6	12	44	$ 45.83	$ 3,483.08
Cottonwood	4	32	6	12	44	$ 45.83	$ 3,483.08
Cypress	4	48	6	12	60	$ 45.83	$ 4,949.64
Eucalyptus	4	32	6	12	44	$ 45.83	$ 3,483.08
Hollyvale	4	32	6	12	44	$ 45.83	$ 3,483.08
Joshua Circle	4	40	6	24	64	$ 45.83	$ 4,766.32
Juniper	4	32	6	12	44	$ 45.83	$ 3,483.08
Kingston	4	40	6	24	64	$ 45.83	$ 4,766.32
Lime Street	4	32	6	24	56	$ 45.83	$ 4,033.04
Maple	4	32	6	18	50	$ 45.83	$ 3,758.06
Mesa Granda	4	40	6	24	64	$ 45.83	$ 4,766.32
Mesquite Trails	4	32	6	12	44	$ 45.83	$ 3,483.08
Cedar Middle	4	48	6	30	78	$ 45.83	$ 5,774.58
Hesperia Jr	4	48	6	36	84	$ 45.83	$ 6,049.56
Sultana	4	120	6	30	150	$ 45.83	$ 12,374.10
Mojave	4	48	6	48	96	$ 45.83	$ 6,599.52
Shadowridge	4	32	6	0	32	$ 45.83	$ 2,933.12
Total							$ 81,669.06

Filter Comparison

School	MERV 13 Filters Size of Filters 20x30x2	Cost Per Filter	Cost	16x25x2	Cost per Filter	Cost	16x20x2	Cost per Filter	Cost	20x20x2	Cost per Filter	Cost	Total MERV 13 Filter Cost
Carmel	16	$ 20.69	$ 331.07	56	$ 13.20	$ 739.31	2	$ 9.95	$ 19.90	12	$ 11.51	$ 138.12	$ 1,228.40
Cottonwood	23	$ 20.69	$ 475.91	54	$ 13.20	$ 712.91	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,274.66
Cypress	6	$ 20.69	$ 124.15	70	$ 13.20	$ 924.14	5	$ 9.95	$ 49.75	8	$ 11.51	$ 92.08	$ 1,190.12
Eucalyptus	17	$ 20.69	$ 351.76	54	$ 13.20	$ 712.91	4	$ 9.95	$ 39.80	8	$ 11.51	$ 92.08	$ 1,196.55
Hollyvale	8	$ 20.69	$ 165.54	58	$ 13.20	$ 765.71	8	$ 9.95	$ 79.60	8	$ 11.51	$ 92.08	$ 1,102.93
Joshua Circle	28	$ 20.69	$ 579.37	44	$ 13.20	$ 580.89	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,246.10
Juniper	32	$ 20.69	$ 662.14	44	$ 13.20	$ 580.89	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,328.87
Kingston	30	$ 20.69	$ 620.76	54	$ 13.20	$ 712.91	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,373.46
Lime Street	21	$ 20.69	$ 434.53	62	$ 13.20	$ 818.52	16	$ 9.95	$ 159.20	2	$ 11.51	$ 23.02	$ 1,435.27
Maple	24	$ 20.69	$ 496.61	54	$ 13.20	$ 712.91	8	$ 9.95	$ 79.60	-	$ 11.51	$ -	$ 1,289.11
Mesa Granda	24	$ 20.69	$ 496.61	58	$ 13.20	$ 765.71	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,302.12
Mesquite Trails	22	$ 20.69	$ 455.22	54	$ 13.20	$ 712.91	2	$ 9.95	$ 19.90	12	$ 11.51	$ 138.12	$ 1,326.15
Cedar Middle	64	$ 20.69	$ 1,324.28	28	$ 13.20	$ 369.66	4	$ 9.95	$ 39.80	26	$ 11.51	$ 299.26	$ 2,033.00
Hesperia Jr	46	$ 20.69	$ 951.83	100	$ 13.20	$ 1,320.20	34	$ 9.95	$ 338.30	16	$ 11.51	$ 184.16	$ 2,794.48
Sultana	26	$ 20.69	$ 537.99	143	$ 13.20	$ 1,887.88	52	$ 9.95	$ 517.40	32	$ 11.51	$ 368.32	$ 3,311.59
Mojave	40	$ 20.69	$ 827.68	34	$ 13.20	$ 448.87	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,316.34
IT	6	$ 20.69	$ 124.15	0	$ 13.20	$ -	3	$ 9.95	$ 29.85	11	$ 11.51	$ 126.61	$ 280.61
Total			$ 8,959.58			$ 12,766.30			$ 1,611.90			$ 1,691.97	$ 25,029.76
Changed Quarterly													4
Annual Cost													$ 100,119.04

HVAC 022

Filter Comparison

	MERV 13 Filters						
	Rooftop		Portables				
School	MERV 13 Filter - Four Times a Year	Labor Hours	MERV 13 Filter - Six Times a year	Labor Hours	Total Labor Hours for Rooftop and Portables	Senior Maintenance Worker Hourly Rate with Statutories	Total Labor Cost
Carmel	4	32	6	12	44	$ 45.83	$ 3,483.08
Cottonwood	4	32	6	12	44	$ 45.83	$ 3,483.08
Cypress	4	48	6	12	60	$ 45.83	$ 4,949.64
Eucalyptus	4	32	6	12	44	$ 45.83	$ 3,483.08
Hollyvale	4	32	6	12	44	$ 45.83	$ 3,483.08
Joshua Circle	4	40	6	24	64	$ 45.83	$ 4,766.32
Juniper	4	32	6	12	44	$ 45.83	$ 3,483.08
Kingston	4	40	6	24	64	$ 45.83	$ 4,766.32
Krystal	4	24	6	12	36	$ 45.83	$ 2,749.80
Lime Street	4	32	6	24	56	$ 45.83	$ 4,033.04
Maple	4	32	6	18	50	$ 45.83	$ 3,758.06
Mesa Granda	4	40	6	24	64	$ 45.83	$ 4,766.32
Mesquite Trails	4	32	6	12	44	$ 45.83	$ 3,483.08
Mission Crest	4	32	6	18	50	$ 45.83	$ 3,758.06
Topaz	4	32	6	12	44	$ 45.83	$ 3,483.08
Cedar Middle	4	48	6	30	78	$ 45.83	$ 5,774.58
Hesperia Jr	4	48	6	36	84	$ 45.83	$ 6,049.56
Ranchero Middle	4	80	6	18	98	$ 45.83	$ 8,157.74
Hesperia High	4	136	6	90	226	$ 45.83	$ 16,590.46
Sultana	4	120	6	30	150	$ 45.83	$ 12,374.10

Canyon Ridge	4	40	6	12	52	$	45.83	$	4,216.36
Mojave	4	48	6	48	96	$	45.83	$	6,599.52
Shadowridge	4	32	6	0	32	$	45.83	$	2,933.12
Total								$	120,624.56

HVAC 024

Filter Comparison

	MERV 13 Filters Size of Filters												
School	**20x30x2**	**Cost Per Filter**	**Cost**	**16x25x2**	**Cost per Filter**	**Cost**	**16x20x2**	**Cost per Filter**	**Cost**	**20x20x2**	**Cost per Filter**	**Cost**	**Total MERV 13 Filter Cost**
Carmel	16	$ 20.69	$ 331.07	56	$ 13.20	$ 739.31	2	$ 9.95	$ 19.90	12	$ 11.51	$ 138.12	$ 1,228.40
Cottonwood	23	$ 20.69	$ 475.91	54	$ 13.20	$ 712.91	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,274.66
Cypress	6	$ 20.69	$ 124.15	70	$ 13.20	$ 924.14	5	$ 9.95	$ 49.75	8	$ 11.51	$ 92.08	$ 1,190.12
Eucalyptus	17	$ 20.69	$ 351.76	54	$ 13.20	$ 712.91	4	$ 9.95	$ 39.80	8	$ 11.51	$ 92.08	$ 1,196.55
Hollyvale	8	$ 20.69	$ 165.54	58	$ 13.20	$ 765.71	8	$ 9.95	$ 79.60	8	$ 11.51	$ 92.08	$ 1,102.93
Joshua Circle	28	$ 20.69	$ 579.37	44	$ 13.20	$ 580.89	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,246.10
Juniper	32	$ 20.69	$ 662.14	44	$ 13.20	$ 580.89	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,328.87
Kingston	30	$ 20.69	$ 620.76	54	$ 13.20	$ 712.91	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,373.46
Krystal	6	$ 20.69	$ 124.15	80	$ 13.20	$ 1,056.16	10	$ 9.95	$ 99.50	20	$ 11.51	$ 230.20	$ 1,510.01
Lime Street	21	$ 20.69	$ 434.53	62	$ 13.20	$ 818.52	16	$ 9.95	$ 159.20	2	$ 11.51	$ 23.02	$ 1,435.27
Maple	24	$ 20.69	$ 496.61	54	$ 13.20	$ 712.91	8	$ 9.95	$ 79.60	-	$ 11.51	$ -	$ 1,289.11
Mesa Granda	24	$ 20.69	$ 496.61	58	$ 13.20	$ 765.71	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,302.12
Mesquite Trails	22	$ 20.69	$ 455.22	54	$ 13.20	$ 712.91	2	$ 9.95	$ 19.90	12	$ 11.51	$ 138.12	$ 1,326.15
Mission Crest	8	$ 20.69	$ 165.54	80	$ 13.20	$ 1,056.16	25	$ 9.95	$ 248.75	16	$ 11.51	$ 184.16	$ 1,654.60
Topaz	15	$ 20.69	$ 310.38	54	$ 13.20	$ 712.91	0	$ 9.95	$ -	12	$ 11.51	$ 138.12	$ 1,161.40
Cedar Middle	64	$ 20.69	$ 1,324.28	28	$ 13.20	$ 369.66	4	$ 9.95	$ 39.80	26	$ 11.51	$ 299.26	$ 2,033.00
Hesperia Jr	46	$ 20.69	$ 951.83	100	$ 13.20	$ 1,320.20	34	$ 9.95	$ 338.30	16	$ 11.51	$ 184.16	$ 2,794.48
Ranchero Middle	30	$ 20.69	$ 620.76	120	$ 13.20	$ 1,584.24	78	$ 9.95	$ 776.10	-	$ 11.51	$ -	$ 2,981.09
Hesperia High	125	$ 20.69	$ 2,586.49	110	$ 13.20	$ 1,452.22	10	$ 9.95	$ 99.50	44	$ 11.51	$ 506.44	$ 4,644.64
Sultana	26	$ 20.69	$ 537.99	143	$ 13.20	$ 1,887.88	52	$ 9.95	$ 517.40	32	$ 11.51	$ 368.32	$ 3,311.59
Canyon Ridge	5	$ 20.69	$ 103.46	6	$ 13.20	$ 79.21	82	$ 9.95	$ 815.90	-	$ 11.51	$ -	$ 998.57
Mojave	40	$ 20.69	$ 827.68	34	$ 13.20	$ 448.87	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,316.34
IT	6	$ 20.69	$ 124.15	0	$ 13.20	$ -	3	$ 9.95	$ 29.85	11	$ 11.51	$ 126.61	$ 280.61
Total			$ 12,870.35			$ 18,707.19			$ 3,651.65			$ 2,750.89	$ 37,980.08
Changed Quarterly													4
Annual Cost													$ 151,920.32

Summary Cost

	Labor	Filter	Total
January 1, 2023 - June 30, 2023	$ 27,443.12	$ 66,236.22	$ 93,679.34
July 1, 2023 - June 30, 2024	$ 81,669.06	$ 100,119.04	$ 181,788.10
July 1, 2024 - June 30, 2025	$ 120,624.56	$ 151,920.32	$ 272,544.88
Total	$ 229,736.74	$ 318,275.58	$ 548,012.32

HVAC 025

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : 110484-1
Customer : HESPERIA UNIFIED SCHOOL DISTRI
Invoice Date : 03/27/2023
Due Date : 04/26/2023
Job/Ref# : CARMEL
Terms : Net 30
Ship Via : HOLLYWOOD DELIVERY SERVICE
Customer PO : 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O WAREHOUSE
ATT: KEVIN NICHOLS
11107 SANTA FE
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						RESTROOM ROOF		
0002	1	1	0	EA	2L2532	25x32 2 Ply Link 2-16"panels Vendor Item# 054251602	14.92	14.92 T
0003	1	1	0	EA	2L2032	20x32 2 Ply Link 2-16"panels Vendor Item# 054201602	13.24	13.24 T
						MAIN ROOF		
0005	48	48	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	552.48 T
0006	12	12	0	EA	2482020213	20x20x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482020213	11.51	138.12 T
						500 BUILDING		
0008	6	6	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	69.06 T
						PORTABLES		
0010	16	16	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	288.64 T

I certify that materials/services on this document were received.

Signature Date 04-03-2023

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	1,076.46
Shipping Cost	34.86
Tax	83.43
Total USD	1,194.75

T = Item is taxed

Page: 1

We appreciate your business!

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : **110485-2**
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : COTTONWOOD
Terms : Net 30
Ship Via : ~~HOLLYW~~OOD DELIVERY SERVICE
Customer PO : 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O WAREHOUSE
ATT: KEVIN NICHOLS
11107 SANTA FE
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						PORTABLES / ROOMS 19-47		
0002	21	21	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	378.84 T
0003	1	1	0	EA	2481630213	16x30x2 TRI-PLEAT GREEN - MERV 13 Vendor Item# 24815DE29213	34.78	34.78 T
						ROOM 37 ROOF		
0005	3	3	0	EA	2P1224	12X24 2 PLY PANEL Vendor Item# 054122401	6.54	19.62 T
						KINDERGARTEN		
0007	8	8	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - MERV 13 Vendor Item# 2481625213	11.51	92.08 T
						EAST ROOF		
0009	18	18	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - MERV 13 Vendor Item# 2481625213	11.51	207.18 T
0010	4	4	0	EA	2481620213	16x20x2 TRI-PLEAT GREEN - MERV 13 Vendor Item# 2481620213	9.45	37.80 T
						WEST ROOF		
0012	18	18	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - MERV 13 Vendor Item# 2481625213	11.51	207.18 T

Continued on next page....

JUN 02 2023

We appreciate your business!

Invoice

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice Number : 110485-2
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : COTTONWOOD

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
0013	4	4	0	EA	2482020213	20x20x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482020213 FRONT OFFICE/KITCHEN ROOF	11.51	46.04 T
0015	10	10	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - MERV 13 Vendor Item# 2481625213	11.51	115.10 T

I certify that materials/services on this document were received.

Signature Date 05-31-2023

JUN 02 2023

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	1,138.62
Shipping Cost	31.22
Tax	88.24
Total USD	1,258.08

T = Item is taxed
Page: 2

We appreciate your business!

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : 110364-1
Customer : HESPERIA UNIFIED SCHOOL DISTRI
Invoice Date : 12/30/2022
Due Date : 01/29/2023
Job/Ref# : JOSHUA CIRCLE
Terms : Net 30
Ship Via : ~~HOLLYWOOD~~ DELIVERY SERVICE
Customer PO : 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O Warehouse
ATT: KEVIN NICHOLS
11107 Santa Fe
Hesperia, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						KITCHEN / CAFETERIA / KINDER / OFFICE		
0002	1	1	0	EA	2P1818	18x18 2 Ply Panel Vendor Item# 054181801	7.80	7.80 T
						PORTABLES 18-21 30-42		
0004	17	17	0	EA	2P2030	20x30 2 Ply Panel Vendor Item# 054203001	12.79	217.43 T
						PORTABLES 50-55 59-61		
0006	4	4	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	29.84 T
0007	11	11	0	EA	2P2030	20x30 2 Ply Panel Vendor Item# 054203001	12.79	140.69 T
						ROOF TOP		
0009	44	44	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	328.24 T

I certify that materials/services on this document were received.

JUN 22 2023

[signature] 06-20-2023

Signature Date

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	724.00
Shipping Cost	33.22
7.750% Tax	56.11
Total USD	813.33

T = Item is taxed

Page: 1

We appreciate your business!

HVAC 029

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : **111993-1**
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : JOSHUA CIRCLE
Terms : Net 30
Ship Via : HOLLYWOOD DELIVERY SERVICE
Customer PO : 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- HESPERIA HIGH SCHOOL
C/O HUSD CONTAINERS
ATT: VINCENT 760-220-8096
9898 MAPLE AVE.
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						KITCHEN/CAFETERIA/KINDER/OFFIC		
0002	4	4	0	EA	2482020213	20x20x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482020213	11.51	46.04 T
0003	1	1	0	EA	2481818213	18x18x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481818213	19.69	19.69 T
						PORTABLES 18-21 30-42		
0005	17	17	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	306.68 T
						PORTABLES 50-55 59-61		
0007	11	11	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	198.44 T
0008	4	4	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	46.04 T
						ROOF TOP		
0010	44	44	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	506.44 T

I certify that materials/services on this document were received.

05-31-2023

Signature Date

JUN 02 2023

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	1,123.33
Shipping Cost	31.22
Tax	87.06
Total USD	1,241.61

T = Item is taxed
Page: 1

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PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : **110364-1**
Customer : HESPERIA UNIFIED SCHOOL DISTRI
Invoice Date : 12/30/2022
Due Date : 01/29/2023
Job/Ref# : JOSHUA CIRCLE
Terms : Net 30
Ship Via : ~~HOLLYWOOD~~ DELIVERY SERVICE
Customer PO : 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O Warehouse
ATT: KEVIN NICHOLS
11107 Santa Fe
Hesperia, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						KITCHEN / CAFETERIA / KINDER / OFFICE		
0002	1	1	0	EA	2P1818	18x18 2 Ply Panel Vendor Item# 054181801	7.80	7.80 T
						PORTABLES 18-21 30-42		
0004	17	17	0	EA	2P2030	20x30 2 Ply Panel Vendor Item# 054203001	12.79	217.43 T
						PORTABLES 50-55 59-61		
0006	4	4	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	29.84 T
0007	11	11	0	EA	2P2030	20x30 2 Ply Panel Vendor Item# 054203001	12.79	140.69 T
						ROOF TOP		
0009	44	44	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	328.24 T

I certify that materials/services on this document were received.

JUN 22 2023

06-20-2023

Signature Date

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	724.00
Shipping Cost	33.22
7.750% Tax	56.11
Total USD	813.33

T = Item is taxed
Page: 1

We appreciate your business!

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : **110365-1**
Customer : HESPERIA UNIFIED SCHOOL DISTRI
Invoice Date : 03/27/2023
Due Date : 04/26/2023
Job/Ref# : JUNIPER
Terms : Net 30
Ship Via : HOLLYWOOD DELIVERY SERVICE
Customer PO: 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O WAREHOUSE
ATT: KEVIN NICHOLS
11107 SANTA FE
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						CAFETERIA		
0002	4	4	0	EA	3P2020	20X20 3 PLY PANEL Vendor Item# 050202001	7.83	31.32 T
0003	12	12	0	EA	3P2025	20X25 3 PLY PANEL Vendor Item# 050202501	8.92	107.04 T
						ROOMS 8-13 ROOF		
0005	12	12	0	EA	3P1625	16X25 3 PLY PANEL Vendor Item# 050162501	7.97	95.64 T
						OFFICE/ROOMS K 1 - 6 (ROOF)		
0007	18	18	0	EA	3P1625	16X25 3 PLY PANEL Vendor Item# 050162501	7.97	143.46 T
						ROOMS 15-20 34 ROOF		
0009	14	14	0	EA	2P1625	16x25 2 Ply Panel Vendor Item# 054162501	7.46	104.44 T
						PORTABLES		
0011	22	22	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	396.88 T
						PORTABLES - SET #2		
0013	22	22	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	396.88 T

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

I certify that materials/services on this document were received.

Signature: [signature] Date: 04-03-2023

SubTotal	1,275.66
Shipping Cost	34.86
Tax	98.86
Total USD	1,409.38

T = Item is taxed
Page: 1

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PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228

www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : 110366-1
Customer : HESPERIA UNIFIED SCHOOL DISTRI
Invoice Date : 12/30/2022
Due Date : 01/29/2023
Job/Ref# : KINGSTON ELEMENTARY
Terms : Net 30
Ship Via : HOLLYWOOD DELIVERY SERVICE
Customer PO : 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

PAID

Ship to: HUSD- M & O WAREHOUSE
ATT: KEVIN NICHOLS
11107 SANTA FE
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						OFFICE		
0002	4	4	0	EA	2P1616	16x16 2 Ply Panel Vendor Item# 054161601	6.08	24.32 T
0003	2	2	0	EA	2P1625	16x25 2 Ply Panel Vendor Item# 054162501	7.46	14.92 T
						ROOMS 13-18 ROOF		
0005	14	14	0	EA	2P1625	16x25 2 Ply Panel Vendor Item# 054162501	7.46	104.44 T
						KINDERGARTEN		
0007	6	6	0	EA	2P1625	16x25 2 Ply Panel Vendor Item# 054162501	7.46	44.76 T
						CAFETERIA ROOF		
0009	10	10	0	EA	2P1625	16x25 2 Ply Panel Vendor Item# 054162501	7.46	74.60 T
						LIBRARY ROOF		
0011	14	14	0	EA	2P1625	16x25 2 Ply Panel Vendor Item# 054162501	7.46	104.44 T
						ROOMS 7-10 ROOF		
0013	8	8	0	EA	2P1625	16x25 2 Ply Panel Vendor Item# 054162501	7.46	59.68 T
						PORTABLES 27-45		
0015	17	17	0	EA	2P2030	20x30 2 Ply Panel Vendor Item# 054203001	12.79	217.43 T

Continued on next page....

I certify that materials/services on this document were received.

NEagle 1/3/2023
Signature Date

We appreciate your business!

HVAC 033

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : 110366-1
Customer : HESPERIA UNIFIED SCHOOL DISTRI
Invoice Date : 12/30/2022
Due Date : 01/29/2023
Job/Ref# : KINGSTON ELEMENTARY

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
0016	3	3	0	EA	2P1630	16x30 2 Ply Panel Vendor Item# 054163001	13.33	39.99 T
						PORTABLES 3-6 11-12 RESTROOM		
0018	6	6	0	EA	2P2030	20x30 2 Ply Panel Vendor Item# 054203001	12.79	76.74 T
0019	1	1	0	EA	2P1630	16x30 2 Ply Panel Vendor Item# 054163001	13.33	13.33 T
0020	2	2	0	EA	2P2020	20X20 2 PLY PANEL Vendor Item# 054202001	7.29	14.58 T

PAID

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

I certify that materials/services on this document were received.

Signature: M Taylor   Date: 1/3/2023

T = Item is taxed
Page: 2

We appreciate your business!

SubTotal	789.23
Shipping Cost	33.22
7.750% Tax	61.17
Total USD	883.62

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number :	**111997-1**
Customer :	HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date :	05/26/2023
Due Date :	06/25/2023
Job/Ref# :	KINGSTON ELEMENTARY
Terms :	Net 30
Ship Via :	~~HOLLYW~~OOD DELIVERY SERVICE
Customer PO	230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- SULTANA HIGH SCHOOL
C/O HUSD CONTAINERS
ATT: VINCENT 760-220-8096
17311 SULTANA ST
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						OFFICE		
0002	4	4	0	EA	2481616213	16x16x2 TRI-PLEAT GREEN - M13 Vendor Item# 24815DE15DE213	20.64	82.56 T
0003	2	2	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	23.02 T
						ROOMS 13-18 ROOF		
0005	14	14	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	161.14 T
						KINDERGARTEN		
0007	6	6	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	69.06 T
						CAFETERIA ROOF		
0009	10	10	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	115.10 T
						LIBRARY ROOF		
0011	14	14	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	161.14 T
						ROOMS 7-10 ROOF		
0013	8	8	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	92.08 T
						PORTABLES 27-45		
0015	17	17	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	306.68 T

Continued on next page....

JUN 02 2023

We appreciate your business!

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : 111997-1
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : KINGSTON ELEMENTARY

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
0016	3	3	0	EA	2481630213	16x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 24815DE29213	34.78	104.34 T
						PORTABLES 3-6 11-12 RESTROOM		
0018	6	6	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	108.24 T
0019	1	1	0	EA	2481630213	16x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 24815DE29213	34.78	34.78 T
0020	2	2	0	EA	2482020213	20x20x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482020213	11.51	23.02 T

JUN 02

I certify that materials/services on this document were received.

05-31-2023

Signature Date

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	1,281.16
Shipping Cost	31.22
Tax	99.29
Total USD	1,411.67

T = Item is taxed

We appreciate your business!

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : 110366-1
Customer : HESPERIA UNIFIED SCHOOL DISTRI
Invoice Date : 12/30/2022
Due Date : 01/29/2023
Job/Ref# : KINGSTON ELEMENTARY

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
0016	3	3	0	EA	2P1630	16x30 2 Ply Panel Vendor Item# 054163001	13.33	39.99 T
						PORTABLES 3-6 11-12 RESTROOM		
0018	6	6	0	EA	2P2030	20x30 2 Ply Panel Vendor Item# 054203001	12.79	76.74 T
0019	1	1	0	EA	2P1630	16x30 2 Ply Panel Vendor Item# 054163001	13.33	13.33 T
0020	2	2	0	EA	2P2020	20X20 2 PLY PANEL Vendor Item# 054202001	7.29	14.58 T

PAID

Credit Card Payment: Additional 4% to total will be applied.

ACH Payment: Accepted with no additional fee.

I certify that materials/services on this document were received.

Signature NTaylor Date 1/3/2023

SubTotal	789.23
Shipping Cost	33.22
7.750% Tax	61.17
Total USD	883.62

T = Item is taxed

Page: 2

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PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number :	111998-1
Customer :	HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date :	05/26/2023
Due Date :	06/25/2023
Job/Ref# :	LIME STREET
Terms :	Net 30
Ship Via :	HOLLYWOOD DELIVERY SERVICE
Customer PO :	230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- SULTANA HIGH SCHOOL
C/O HUSD CONTAINERS
ATT: VINCENT 760-220-8096
17311 SULTANA ST
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						MAIN ROOF		
0002	46	46	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	529.46 T
0003	8	8	0	EA	2481620213	16x20x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481620213	9.45	75.60 T
						K BUILDING		
0005	8	8	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	92.08 T
						ROOMS 38-40 ROOF		
0007	8	8	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	92.08 T
						PORTABLES/RESTROOM		
0009	22	22	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	396.88 T

I certify that materials/services on this document were received.

05-31-2023

Signature Date

JUN 02 2023

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	1,186.10
Shipping Cost	31.22
Tax	91.92
Total USD	1,309.24

T = Item is taxed

Page: 1

We appreciate your business!

HVAC 038

Invoice

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228

www.pacwestfilter.com
Fax: 951-698-0998

Invoice Number : 110368-1
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : MAPLE
Terms : Net 30
Ship Via : HOLLYWOOD DELIVERY SERVICE
Customer PO : 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O WAREHOUSE
ATT: KEVIN NICHOLS
11107 SANTA FE
HESPERIA, CA 92345

JUN 02 2023

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						MAIN ROOF FRONT OFFICE/KITCHEN		
0002	10	10	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	74.60 T
						MAIN ROOF (EAST ROOF)		
0004	20	20	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	149.20 T
0005	4	4	0	EA	2P1620	16X20 2 PLY PANEL Vendor Item# 054162001	6.62	26.48 T
						MAIN ROOF (WEST ROOF)		
0007	20	20	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	149.20 T
0008	4	4	0	EA	2P1620	16X20 2 PLY PANEL Vendor Item# 054162001	6.62	26.48 T
						K ROOF		
0010	4	4	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	29.84 T
						PORTABLES		
0012	24	24	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	432.96 T
						PORTABLES - SET #2		
0014	24	24	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	432.96 T

Credit Card Payment: Additional 4% to total
ACH Payment: Accepted with no additional fee

I certify that all materials/services on this document were received.

05-31-2023

Signature Date

SubTotal	1,321.72
Shipping Cost	31.22
Tax	102.43
Total USD	1,455.37

T = Item is taxed
Page: 1

We appreciate your business!

HVAC 039

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : **110488-1**
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : MESA GRANDE
Terms : Net 30
Ship Via : HOLLYWOOD DELIVERY SERVICE
Customer PO : 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O WAREHOUSE
ATT: KEVIN NICHOLS
11107 SANTA FE
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						PORTABLES / ROOMS 30-36		
0002	7	7	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	126.28 T
						K BUILDING		
0004	14	14	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	104.44 T
						PORTABLES F1-F5		
0006	8	8	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	92.08 T
0007	2	2	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	36.08 T
						OFFICE ROOF		
0009	4	4	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	46.04 T
						ROOMS 1 - 5 ROOF		
0011	10	10	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	115.10 T
						ROOMS 6 - 11 ROOF		
0013	12	12	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	138.12 T
						ROOMS 12 - 17 ROOF		
0015	12	12	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	138.12 T

Continued on next page....

JUN 02

We appreciate your business!

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : 110488-1
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : MESA GRANDE

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						CAFETERIA		
0017	4	4	0	EA	2481616213	16x16x2 TRI-PLEAT GREEN - M13 Vendor Item# 24815DE15DE213	20.64	82.56 T
0018	8	8	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	92.08 T
						PORTABLES 18-29		
0020	15	15	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	270.60 T

I certify that materials/services on this document were received.

05-31-2023

Signature Date

JUN 02

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	1,241.50
Shipping Cost	31.22
Tax	96.22
Total USD	1,368.94

T = Item is taxed

We appreciate your business!

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : 110489-1
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : MESQUITE TRAILS
Terms : Net 30
Ship Via : HOLLYWOOD DELIVERY SERVICE
Customer PO 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O WAREHOUSE
ATT: KEVIN NICHOLS
11107 SANTA FE
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						PORTABLES/RESTROOM PORT		
0002	21	21	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	378.84 T
						KINDERGARTEN		
0004	6	6	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	69.06 T
						MAIN ROOF - RESTROOMS		
0006	2	2	0	EA	2481620213	16X20X2 MERV 13 PLEAT Vendor Item# 2481620213	9.45	18.90 T
0007	2	2	0	EA	2481625213	16X25X2 MERV 13 PLEAT Vendor Item# 2481625213	11.51	23.02 T
						EAST POD		
0009	22	22	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	253.22 T
0010	4	4	0	EA	2482020213	20x20x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482020213	11.51	46.04 T
						WEST POD		
0012	22	22	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	253.22 T
0013	4	4	0	EA	2482020213	20x20x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482020213	11.51	46.04 T
						OFFICE ROOF		
0015	4	4	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13	11.51	46.04 T

Continued on next page....

JUN 0

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PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : **110489-1**
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : MESQUITE TRAILS

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						Vendor Item# 2481625213		
0016	4	4	0	EA	2482020213	20x20x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482020213	11.51	46.04 T

JUN 02 2023

I certify that materials/services on this document were received

Signature

05-31-2023
Date

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	1,180.42
Shipping Cost	31.22
Tax	91.48
Total USD	1,303.12

T = Item is taxed

We appreciate your business!

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228

www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number :	110360-1
Customer :	HESPERIA UNIFIED SCHOOL DISTRI
Invoice Date :	12/30/2022
Due Date :	01/29/2023
Job/Ref# :	MISSION CREST
Terms :	Net 30
Ship Via :	HOLLYWOOD DELIVERY SERVICE
Customer PO :	230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

PAID

Ship to: HUSD- M & O WAREHOUSE
ATT: KEVIN NICHOLS
11107 SANTA FE
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						MAIN ROOF		
0002	8	8	0	EA	2L2040	20x40 2 Ply Link (2- 20"" pane s) Vendor Item# 054202002	14.58	116.64 T
0003	10	10	0	EA	2P1220	12x20 2 Ply Panel Vendor Item# 054122001	7.24	72.40 T
0004	4	4	0	EA	2P1620	16x20 2 Ply Panel Vendor Item# 054162001	6.62	26.48 T
0005	78	78	0	EA	2P1625	16x25 2 Ply Panel Vendor Item# 054162501	7.46	581.88 T
						MPR		
0007	4	4	0	EA	2L2072	20x72 2 Ply Link (3- 24"" pane s) Vendor Item# 054202403	24.42	97.68 T
						KITCHEN		
0009	2	2	0	EA	2P1220	12x20 2 Ply Panel Vendor Item# 054122001	7.24	14.48 T
0010	2	2	0	EA	2P1625	16x25 2 Ply Panel Vendor Item# 054162501	7.46	14.92 T
						G ROOF / PORTABLES		
0012	9	9	0	EA	2P1224	12x24 2 Ply Panel Vendor Item# 054122401	6.54	58.86 T
0013	8	8	0	EA	2P2030	20x30 2 Ply Panel Vendor Item# 054203001	12.79	102.32 T

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

I certify that materials/services on this document were received.

[signature] 1/3/2023
Signature Date

SubTotal	1,085.66
Shipping Cost	33.22
7.750% Tax	84.14
Total USD	1,203.02

T = Item is taxed
Page: 1

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HVAC 044

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : **110353-2**
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : HESPERIA JR HIGH
Terms : Net 30
Ship Via : HOLLYWOOD DELIVERY SERVICE
Customer PO 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O WAREHOUSE
ATT: KEVIN NICHOLS
11107 SANTA FE
HESPERIA, CA 92345

JUN 02 2023

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						KITCHEN (ROOF)		
0002	4	4	0	EA	2P1625	16x25 2 Ply Panel Vendor Item# 054162501	7.46	29.84 T
0003	2	2	0	EA	2L2040	20x40 2 Ply Link (2- 20"" pane s) Vendor Item# 054202002	14.58	29.16 T
						BUILDING A - MPR - OFFICE		
0005	6	6	0	EA	2P1625	16x25 2 Ply Panel Vendor Item# 054162501	7.46	44.76 T
0006	4	4	0	EA	2P2020	20x20 2 Ply Panel Vendor Item# 054202001	7.29	29.16 T
0007	4	4	0	EA	2P1620	16x20 2 Ply Panel Vendor Item# 054162001	6.62	26.48 T
0008	2	2	0	EA	3L1872	18X72 3 PLY LINK 3-24" PANELS Vendor Item# 050182403	26.34	52.68 T
0009	2	2	0	EA	2L2040	20x40 2 Ply Link (2- 20"" pane s) Vendor Item# 054202002	14.58	29.16 T
						PORTABLES N W R - ROOMS 51/52		
0011	16	16	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	288.64 T
						PORTABLES N W R - ROOMS 51/52 SET #2		
0013	16	16	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	288.64 T

Continued on next page....

We appreciate your business!

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : 110353-2
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : HESPERIA JR HIGH

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						L PORTABLES		
0015	6	6	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	108.24 T
						L PORTABLES - SET #2		
0017	6	6	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	108.24 T
						K BUILDING (ROOF)		
0019	10	10	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	74.60 T
						PORTABLES O P Q		
0021	15	15	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	270.60 T
						PORTABLES O P Q - SET #2		
0023	15	15	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	270.60 T
						PORTABLES J I		
0025	9	9	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	162.36 T
						PORTABLES - SET #2		
0027	9	9	0	EA	2482030213	20X30X2 MERV 13 PLEAT Vendor Item# 2482030213	18.04	162.36 T
						F BUILDING (ROOF)		
0029	28	28	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	208.88 T
						C D E FRONT (ROOF)		
0031	42	42	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	313.32 T
						H COUNTY BUILDING (ROOF)		
0033	4	4	0	EA	2P1625	16X25 2 PLY PANEL Vendor Item# 054162501	7.46	29.84 T
						B-INSIDE		
0035	2	2	0	EA	2P2525	25X25 2 PLY PANEL Vendor Item# 054252501	9.32	18.64 T
						GYM		

Continued on next page....

JUN 02 2023

We appreciate your business!

HVAC 046

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : 110353-2
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : HESPERIA JR HIGH

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
0037	4	4	0	EA	2L2075	20x75 2 Ply Link (3- 25"" pane s) Vendor Item# 054202503	24.90	99.60 T
0038	8	8	0	EA	2P2020	20x20 2 Ply Panel Vendor Item# 054202001	7.29	58.32 T

JUN 02 2023

I certify that materials/services on this document were received.

Signature: [signature]   Date: 05-31-2023

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	2,704.12
Shipping Cost	31.22
Tax	209.57
Total USD	2,944.91

T = Item is taxed
Page: 3

We appreciate your business!

Invoice

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice Number : 110347-1
Customer : HESPERIA UNIFIED SCHOOL DISTRI
Invoice Date : 03/27/2023
Due Date : 04/26/2023
Job/Ref# : ALTERNATIVE ED
Terms : Net 30
Ship Via : HOLLYWOOD DELIVERY SERVICE
Customer PO : 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O WAREHOUSE
ATT: VINCENT 760-220-8096
9898 MAPLE AVE.
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						PORTABLES 1-10 21-26		
0002	13	13	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	234.52 T
0003	3	3	0	EA	2481630213	16x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 24815DE29213	34.78	104.34 T
						OFFICE/PORTABLES-RMS 11-20, 27		
0005	15	15	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	270.60 T
0006	1	1	0	EA	2483030113	30x30x1 TRI-PLEAT GREEN - M13 Vendor Item# 24829DE29DE113	73.85	73.85 T
0007	1	1	0	EA	2482525213	25x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482525213	16.24	16.24 T

PAID

I certify that materials/services on this document were received.

Signature 04-03-2023 Date

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	733.87
Shipping Cost	34.86
Tax	56.87
Total USD	825.60

T = Item is taxed
Page: 1

We appreciate your business!

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228
www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number : 110490-1
Customer : HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date : 05/26/2023
Due Date : 06/25/2023
Job/Ref# : MOJAVE HIGH SCHOOL
Terms : Net 30
Ship Via : HOLLYWOOD DELIVERY SERVICE
Customer PO : 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O WAREHOUSE
ATT: KEVIN NICHOLS
11107 SANTA FE
HESPERIA, CA 92345

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
						MAIN BLDG		
0002	34	34	0	EA	2481625213	16x25x2 TRI-PLEAT GREEN - M13 Vendor Item# 2481625213	11.51	391.34 T
0003	21	21	0	EA	2482030213	20x30x2 TRI-PLEAT GREEN - M13 Vendor Item# 2482030213	18.04	378.84 T
0004	4	4	0	EA	2481616213	16X16X2 MERV 13 PLEAT Vendor Item# 2481SDE1SDE213	20.64	82.56 T

JUN 02 2023

I certify that materials/services on this document were received.

Signature 05-31-2023
Date

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	852.74
Shipping Cost	31.22
Tax	66.09
Total USD	950.05

T = Item is taxed

Page: 1

We appreciate your business!

PACWEST

PacWest Air Filter, LLC
26550 Adams Ave
Murrieta, CA 92562
Ph: 951-698-2228

www.pacwestfilter.com
Fax: 951-698-0998

Invoice

Invoice Number: 110374-1
Customer: HESPERIA UNIFIED SCHOOL DISTRICT
Invoice Date: 05/26/2023
Due Date: 06/25/2023
Job/Ref#: IT/ MULTI-LINGUAL
Terms: Net 30
Ship Via: HOLLYWOOD DELIVERY SERVICE
Customer PO 230659

Bill to: HESPERIA UNIFIED SCHOOL DISTRICT
ATT: ACCOUNTS PAYABLE
15576 MAIN STREET
HESPERIA, CA 92345

Ship to: HUSD- M & O WAREHOUSE
ATT: KEVIN NICHOLS
11107 SANTA FE
HESPERIA, CA 92345

JUN 02 2023

Line	Order	Ship	B/O	U/M	Item #	Description	Price	Extension
0001	9	9	0	EA	2P2020	20x20 2 Ply Panel Vendor Item# 054202001	7.29	65.61 T
0002	2	2	0	EA	2P2245EX	22x45ex 2 Ply Panel Vendor Item# 0542245E01	16.90	33.80 T
0003	3	3	0	EA	2P1620	16x20 2 Ply Panel Vendor Item# 054162001	6.62	19.86 T
0004	12	12	0	EA	2481630213	16X30X2 MERV 13 PLEAT SET 1&2 Vendor Item# 24815DE29213	34.78	417.36 T

I certify that materials/services on this document were received.

Signature | 05-31-2023
Date

Credit Card Payment: Additional 4% to total will be applied.
ACH Payment: Accepted with no additional fee.

SubTotal	536.63
Shipping Cost	31.22
Tax	41.59
Total USD	609.44

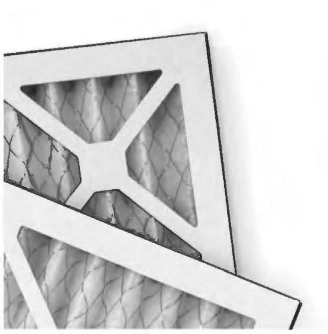
T = Item is taxed
Page: 1

We appreciate your business!

Prime13 High Capacity Pleated Air Filters

FEATURES

- MERV 13
- High dust holding capacity
- Extended surface
- Wire supported electrostatic media
- Moisture resistant beverage board frame
- Available in 1", 2" & 4" depths
- Max operating temp: 180°F
- UL 900 Classified
- Made in the USA



Close-up of Prime13 frame, media & wire

PRIME13 HIGH CAPACITY CONSTRUCTION & APPLICATIONS

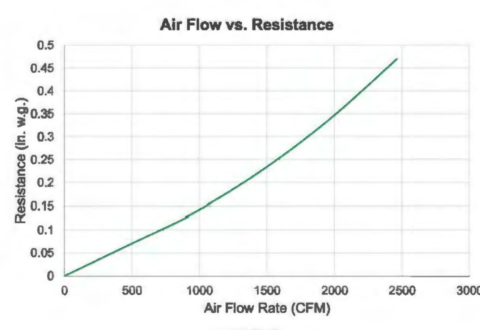
The Prime13 is an extended surface pleated air filter, designed to provide high efficiency, high dust holding capacity and low pressure drop. As an extended-surface air filter, the Prime13, performs at superior levels in comparison to standard pleated filters. The Prime13 has a MERV 13 rating per ASHRAE Test Standards 52.2. The Prime13 also ANSI/UL 900 Classified.

The Prime13's rating of MERV 13 makes it the perfect upgrade from standard MERV 7, MERV 8, MERV 10 and MERV 11 pleated filters as the media allows for the removal of concerning fine particulate, including some virus carriers.

The Prime13 has a durable, moisture resistant, beverage board frame with wire supported media. The Prime13's media is a mechanical blend of synthetic fibers that is designed for use specifically in extended surface pleated filters. Our Prime13 media means that these filters are highly efficient, have a high dust holding capacity and a low pressure drop.

The Prime13 should be used anywhere a higher level of indoor air quality is required. Applications that would benefit from the Prime13 pleated air filter include schools, hotels, commercial office buildings, hospitals, pharmaceutical plants, laboratories, and other facilities where pressure drop and high particle removal efficiency is important.

TECHNICAL DATA



MANN+HUMMEL

PRIME 13 HIGH CAPACITY PERFORMANCE DATA

Nominal Depth	Nominal Size (in.) (WxHxD)	Actual Size (in.) Width	Height	Depth	Air Flow @ Capacity (CFM)	Resistance @ Capacity (in. w.g.)	Total Media Area (sq. ft.)	Number of Pleats Per Linear Foot
1"	10x10x1	9.50	9.50	0.75	208	0.27	1.2	15
	10x20x1	9.50	19.50		417		2.5	
	10x25x1	9.50	24.50		521		3.2	
	12x12x1	11.38	11.38		300		1.8	
	12x20x1	11.50	19.50		500		3.1	
	12x24x1	11.50	23.50		600		3.7	
	12x25x1	11.75	24.75		625		4.0	
	14x20x1	13.50	19.50		583		3.6	
	14x25x1	13.50	24.50		729		4.5	
	15x20x1	14.50	19.50		625		3.9	
	15x25x1	14.50	24.50		781		4.9	
	16x16x1	15.75	15.75		533		3.4	
	16x20x1	15.50	19.50		667		4.2	
	16x24x1	15.50	23.50		800		5.0	
	16x25x1	15.50	24.50		833		5.2	
	18x18x1	17.75	17.75		675		4.3	
	18x20x1	17.50	19.50		750		4.7	
	18x24x1	17.50	23.50		900		5.7	
	18x25x1	17.50	24.50		938		5.9	
	20x20x1	19.50	19.50		833		5.2	
	20x24x1	19.50	23.50		1000		6.3	
	20x25x1	19.50	24.50		1042		6.6	
	22x22x1	21.75	21.75		1008		6.5	
	24x24x1	23.50	23.50		1200		7.6	
2"	10x20x2	9.50	19.50	1.75	700	0.34	6.0	15
	12x24x2	11.38	23.38		1000		8.7	
	14x20x2	13.50	19.50		975		8.5	
	14x25x2	13.50	24.50		1220		10.7	
	15x20x2	14.50	19.50		1040		9.1	
	16x20x2	15.50	19.50		1110		9.8	
	16x24x2	15.38	23.38		1333		11.8	
	16x25x2	15.50	24.50		1390		12.2	
	18x18x2	17.75	17.75		1125		10.2	
	18x20x2	17.50	19.50		1250		11.0	
	18x24x2	17.38	23.38		1500		13.3	
	18x25x2	17.50	24.50		1565		13.8	
	20x20x2	19.50	19.50		1390		12.3	
	20x24x2	19.38	23.38		1670		14.8	
	20x25x2	19.50	24.50		1740		15.4	
	24x24x2	23.38	23.38		2000		17.8	
4"	12x24x4	11.38	23.38	3.75	1000	0.24	11.2	9
	16x20x4	15.50	19.50		1110		12.6	
	16x25x4	15.50	24.50		1390		15.8	
	18x24x4	17.38	23.38		1500		17.1	
	20x20x4	19.50	19.50		1390		15.8	
	20x24x4	19.38	23.38		1670		19.0	
	20x25x4	19.50	24.50		1740		19.8	
	24x24x4	23.38	23.38		2000		23.0	

Notes:
- 2" & 4" deep filters are rated at 500 fpm and 1" deep filters are rated at 300 fpm.
- Performance data is based on ASHRAE Test Standards 52.2-2017.
- More sizes are available. Please contact customer service for a full list of sizes.

MANN+HUMMEL is committed to continual product development – all descriptions, specifications and performance data are subject to change without notice. MANN+HUMMEL products are manufactured to exacting criteria – there can be a ±5% variance in filter performance.

LOCAL REPRESENTATIVE

HESPERIA UNIFIED SCHOOL DISTRICT
PERSONNEL SERVICES

To: David Olney, Superintendent

From: Karen Kelly-Pelayes, Assistant Superintendent – Personnel Services

Date: September 13, 2021

Subject: Discussion/Action - Approval of the Creation of Two 8.00 Hour/12 month Senior Maintenance Worker Positions for Maintenance & Operations

RECOMMENDATION/SUGGESTED MOTION:
The Board approve the request by Matt Machado, Director of Maintenance & Operations, to create two new 8.00 hours/day Senior Maintenance Worker positions.

BACKGROUND:
Senior Maintenance Workers work a 12 months/8 hour-per day position. There are currently five HVAC positions.

RATIONALE:
Due to the district-wide HVAC system upgrade, there is a need to create two new Senior Maintenance Worker positions.

COST/FUNDING:
These positions will work a 12-month work year at 8.00 hours per day. The approximate annual cost, per position and includes salary and mandatory benefits, is shown below. The cost will be paid out of the RR Maintenance Fund.

Range 19 @ 8.00 hrs.	Salary	Benefits	Total Cost PER Position
Step A ($23.19/hr.)	$48,421.00	$29,560.00	$77,981.00
Step E ($30.39/hr.)	$63,455.00	$34,720.00	$98,175.00

ATTACHMENTS:

HESPERIA UNIFIED SCHOOL DISTRICT

Hesperia, California

CERTIFICATE OF MINUTES

GOVERNING BOARD OF THE HESPERIA UNIFIED SCHOOL DISTRICT

The Governing Board met in Regular session on the 13th day of September, 2021 at 6:03 PM, at Hesperia Administration and Educational Support Center (Annex).

The following motion was made by member Mark Dundon, seconded by member Maria Gomez and on a vote of the members of the Board, passed with the following roll call vote:

RESULT:	**APPROVED [UNANIMOUS]**
MOVER:	Mark Dundon, Board Member
SECONDER:	Maria Gomez, Vice President
AYES:	Swanson, Gomez, Gregg, Dundon, Kittinger

On MSC Mark Dundon, Maria Gomez, [Unanimous]

The Board approved the request by Matt Machado, Director of Maintenance & Operations, to create two new 8.00 hours/day Senior Maintenance Worker positions.

I, David Olney, Superintendent/Secretary of the governing board of the Hesperia Unified School District of San Bernardino County, do hereby certify that the above is a true and correct copy of the motion duly made, adopted, and entered on the minutes of the governing board of said school district on September 13, 2021.

Dated: September 14, 2021

Signed: ______________________
Secretary, Governing Board

6/11/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project: CARMEL ELEMENTARY SCHOOL

Total Scope of Project: Alterations to 15-Classroom Buildings R01-R15 (Relocatable) HVAC replacement, 5-K.G. 500, ADMIN 100, TOILET 400, C.R. 200 AND 300 HVAC replacement

Increment #: 0

Application #: 04-120066

File #: 36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 6/11/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

- [x] Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.
- [x] Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.
- [ ] This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)
- [ ] Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

Application #: 04-120066
File #: 36-28

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________ .

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3** . An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.06.14
10:19:26 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency

DEPARTMENT OF GENERAL SERVICES

Division of the State Architect - San Diego Office

6/11/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project:	**COTTONWOOD ELEMENTARY SCHOOL**
Total Scope of Project:	**Alterations to 1-Administration Building 100 HVAC upgrade, 2-Classroom Buildings: 200 & 300 HVAC upgrade, 1-Kindergarten Building 500 HVAC upgrade, 23-Classroom Buildings: R01- R23 (Relocatable)**
Increment #:	**0**
Application #:	**04-120068**
File #:	**36-28**

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on **6/11/2021** . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

- [x] Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.
- [x] Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.
- [ ] This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)
- [ ] Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

Application #: 04-120068
File #: 36-28

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________ .

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3** . An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.06.29
17:08:25 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

6/12/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project: MESA GRANDE ELEMENTARY SCHOOL

Total Scope of Project: Alterations to 5-Classroom Buildings: A06, B05,C01,C02,C03 HVAC upgrade, 1-Kindergarten Building B03 HVAC upgrade, 1-Administration Building B04 HVAC upgrade, 21-Relocatable Classroom Buildings: A01, A02,A04,A07,A08,A09,A10,B01,B02,C04,C05,C06,C07,C08,C09,C10,C11,C12,C13,C14,C15 HVAC upgrade

Increment #: 0

Application #: 04-120069

File #: 36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 6/12/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

☒ Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.

☒ Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.

☐ This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

Application #: 04-120069
File #: 36-28

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________.

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3**. An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by Craig Rush , SE
Date: 2021.06.29 17:08:46 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

8/3/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project: CYPRESS SCHOOL OF THE ARTS

Total Scope of Project: Alterations to 1-Campus-wide HVAC upgrade BLDG. 100 Admin., CR BLDGS. 200 & 300, BLDGS. 600A & 600B Kindergarten and RELO CR RLC1 thru RLC35)

Increment #: 0

Application #: 04-120070

File #: 36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 8/3/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

☒ Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.

☒ Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.

☐ This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

☒ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

Application #: 04-120070
File #: 36-28

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________ .

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3** . An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.08.12
15:47:46 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency
DEPARTMENT OF GENERAL SERVICES
Division of the State Architect - San Diego Office

6/12/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project:	MESQUITE TRAILS ELEMENTARY SCHOOL
Total Scope of Project:	Alterations to 1-Kindergarten Building B08 HVAC upgrade, 10-Relocatable Classroom Buildings: A01,A02,A04,A05,A06,A07,A08,A09,A11,B04 HVAC upgrade, 1-Administration/C.R. Building A10 HVAC upgrade
Increment #:	0
Application #:	04-120071
File #:	36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 6/12/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

☒ Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.

☒ Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.

☐ This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

Application #: 04-120071
File #: 36-28

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # _____-___ .

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3** . An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.06.29
17:09:07 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency

DGS **DEPARTMENT OF GENERAL SERVICES**

Division of the State Architect - San Diego Office

8/3/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project:	**KINGSTON ELEMENTARY SCHOOL**
Total Scope of Project:	**Alterations to 26-Classroom Building (Relocatable RLC1 thru RLC26): HVAC replacement, 6-Buildings: Kindergarten 100, Classroom 200,300; ADMIN/MP 400; (E)ADMIN. 500; Prefab Sectional 600: HVAC replacement**

Increment #:	**0**
Application #:	**04-120072**
File #:	**36-28**

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 8/3/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

☒ Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.

☒ Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.

☐ This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

Application #: 04-120072
File #: 36-28

☒ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ____.____.

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3** . An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.08.12
15:48:09 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

8/17/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project: HOLLYVALE INNOVATION ACADEMY

Total Scope of Project: Alterations to 3-Classroom Buildings 200, 300 & 500 (HVAC Upgrade), 9-Classroom Buildings (Relocatable) RLC1 - RLC9 (HVAC Upgrade), 1-Administration Building 100 (HVAC Upgrade)

Increment #: 0

Application #: 04-120102

File #: 36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 8/17/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

- [x] Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.
- [x] Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.
- [ ] This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)
- [ ] Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

Application #: 04-120102
File #: 36-28

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________.

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3**. An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.08.30
15:56:06 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency
DEPARTMENT OF GENERAL SERVICES
Division of the State Architect - San Diego Office

6/8/2022 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 MAIN STREET
HESPERIA, CA 92345

Project: HESPERIA HIGH SCHOOL
Total Scope of Project: Alterations to 1-Campus-wide HVAC upgrade

Increment #: 0
Application #: 04-120103
File #: 36-H21

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 6/8/2022 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

- [x] Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.
- [x] Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.
- [ ] This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)
- [ ] Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

Application #: 04-120103
File #: 36-H21

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________ .

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3**. An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2022.06.15
17:18:49 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency
DEPARTMENT OF GENERAL SERVICES
Division of the State Architect - San Diego Office

9/29/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project:	HESPERIA JUNIOR HIGH SCHOOL
Total Scope of Project:	Alterations to 1-Gymnasium Building 300 (HVAC Upgrade), 1-Shower/Locker Building B (HVAC Upgrade), 5-Classroom Buildings C, D, E, F & H (HVAC Upgrade), 39-Classroom Buildings (Relocatable) RLC1 - RLC22, RLC24 - RLC40 (HVAC Upgrade), 1-Multi-purpose/Administration Building A (HVAC Upgrade)
Increment #:	0
Application #:	04-120104
File #:	36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 9/29/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

- [x] Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.
- [x] Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.
- [ ] This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

Application #: 04-120104
File #: 36-28

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________.

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3** . An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.10.12
18:11:02 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency

DEPARTMENT OF GENERAL SERVICES

Division of the State Architect - San Diego Office

10/6/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project:	**JOSHUA CIRCLE ELEMENTARY SCHOOL**
Total Scope of Project:	**Alterations to 1-Cafeteria Building I (HVAC Upgrade), 1-Administration Building A (HVAC Upgrade), 22-Relocatable Classroom Buildings 2-4, 7, 8/9, 11-13, 16-20, 24-32 (HVAC Upgrade), 5-Classroom Buildings B, C, D, E & H (HVAC Upgrade)**
Increment #:	**0**
Application #:	**04-120105**
File #:	**36-28**

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 10/6/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

- [x] Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.
- [x] Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.
- [ ] This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

Application #: 04-120105
File #: 36-28

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________-__.

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

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☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3**. An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.10.12
18:12:01 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

9/29/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project: JUNIPER ELEMENTARY SCHOOL

Total Scope of Project: Alterations to 3-Classroom Buildings 100, 200, 400 (HVAC Upgrade), 1-Multi-purpose Building 500 (HVAC Upgrade), 23-Classroom Buildings (Relocatable) RLC1 - RLC12, RLC14 - RLC18, RLC20, RLC21, RLC23 - RLC26 (HVAC Upgrade), 1-Kindergarten Building 300 (HVAC Upgrade)

Increment #: 0

Application #: 04-120154

File #: 36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 9/29/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

☒ Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.

☒ Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.

☐ This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

Application #: 04-120154
File #: 36-28

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________.

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3** . An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.10.12
18:11:34 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency
DEPARTMENT OF GENERAL SERVICES
Division of the State Architect - San Diego Office

8/24/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project: LIME STREET ELEMENTARY SCHOOL

Total Scope of Project: Alterations to 1-Kindergarten Building 400 (HVAC Upgrade), 1-Classroom Building 100A/B (HVAC Upgrade), 22-Classroom Buildings (Relocatable) RLC1 - RLC22 (HVAC Upgrade), 1-Administration Building 300 (HVAC Upgrade)

Increment #: 0

Application #: 04-120155

File #: 36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 8/24/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

- ☒ Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.
- ☒ Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.
- ☐ This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

Application #: 04-120155
File #: 36-28

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ___.___ .

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3** . An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.09.15
09:22:05 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency

DEPARTMENT OF GENERAL SERVICES

Division of the State Architect - San Diego Office

9/15/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project:	MAPLE ELEMENTARY SCHOOL
Total Scope of Project:	Alterations to 1-Administration Building 3 (HVAC Upgrade), 10-Relocatable Classroom Buildings RCL7, RCL9 - RCL17 (HVAC Upgrade), 2-Classroom Buildings 1 and 2 (HVAC Upgrade), 1-Relocatable Kindergarten Building 5 (HVAC Upgrade)

Increment #:	0
Application #:	04-120156
File #:	36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 9/15/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

- [x] Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.
- [x] Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.
- [ ] This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

Application #: 04-120156
File #: 36-28

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________.

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3**. An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.09.22
14:28:13 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

8/24/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project: CEDAR MIDDLE SCHOOL

Total Scope of Project: Alterations to 1-Multi-purpose Building 200 (HVAC Upgrade), 1-Gymnasium Building 300 (HVAC Upgrade), 13-Classroom Building 500A, 500B, 500C, 500D, 600A, 600B, 600C, 600D, 600E, 600F, 800, 900, 1000 (HVAC Upgrade), 1-Administration Building 100 (HVAC Upgrade)

Increment #: 0

Application #: 04-120158

File #: 36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 8/24/2021. This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

- [x] Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.
- [x] Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.
- [ ] This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

Application #: 04-120158
File #: 36-28

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________.

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3**. An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.09.15
09:22:27 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

8/24/2021 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project: EUCALYPTUS ELEMENTARY SCHOOL

Total Scope of Project: Alterations to 1-Classroom Building 100 (HVAC Upgrade), 6-Classroom Buildings (Relocatable) RLC6 - RLC11 (HVAC Upgrade), 1-Kindergarten Building 200 (HVAC Upgrade)

Increment #: 0

Application #: 04-120159

File #: 36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 8/24/2021 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

- [x] Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.
- [x] Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.
- [ ] This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)
- [ ] Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

Application #: 04-120159
File #: 36-28

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________.

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3**. An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2021.09.15
09:23:08 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency
DGS DEPARTMENT OF GENERAL SERVICES
Division of the State Architect - San Diego Office

6/9/2022 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project: KRYSTAL SCHOOL OF SCIENCE, MATH & TECHNOLOGY

Total Scope of Project: Alterations to 1-Indoor Elementary School Building 100 (HVAC Upgrade), 2-Modular Classroom Buildings M1 and M2 (HVAC Upgrade)

Increment #: 0

Application #: 04-120496

File #: 36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 6/9/2022 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

☒ Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.

☒ Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.

☐ This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

Application #: 04-120496
File #: 36-28

- ☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________.
- ☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.
- ☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.
- ☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.
- ☐ Deferred Approval(s) Items:

This project has been classified as **Class 3**. An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2022.06.15
17:19:15 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency

DEPARTMENT OF GENERAL SERVICES

Division of the State Architect - San Diego Office

6/8/2022 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project: MISSION CREST ELEMENTARY SCHOOL

Total Scope of Project: Alterations to 1-Indoor School Building 100 (HVAC Upgrade), 3-Modular Classroom Buildings M1, M2 and M3 (HVAC Upgrade)

Increment #: 0

Application #: 04-120497

File #: 36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 6/8/2022 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

☒ Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.

☒ Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.

☐ This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

Application #: 04-120497
File #: 36-28

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________ .

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

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☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3** . An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2022.06.15
17:14:31 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency
DGS DEPARTMENT OF GENERAL SERVICES
Division of the State Architect - San Diego Office

5/19/2022 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project: TOPAZ PREPARATORY ACADEMY

Total Scope of Project: Alterations to 1-Administration Building 100 (HVAC Upgrade), 3-Classroom Buildings 200, 300 and 500 (HVAC Upgrade), 11-Relocatable Classroom Buildings RLC1-RLC4, RLC6-RLC12 (HVAC Upgrade)

Increment #: 0

Application #: 04-120499

File #: 36-28

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 5/19/2022 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

☒ Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.

☒ Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.

☐ This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

San Diego Regional Office * 10920 Via Frontera, Suite 300 * San Diego, CA 92127 * (858) 674-5400

Application #: 04-120499
File #: 36-28

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________ .

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

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☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3**. An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2022.06.07
11:37:35 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

State of California • Gavin Newsom, Governor
California Government Operations Agency
DEPARTMENT OF GENERAL SERVICES
Division of the State Architect - San Diego Office

6/8/2022 - APPROVAL OF PLAN(S)

David Olney
HESPERIA UNIFIED SCHOOL DISTRICT
15576 Main Street
Hesperia, CA 92345

Project:	**RANCHERO MIDDLE SCHOOL**
Total Scope of Project:	**Alterations to 1-Multi-purpose Building 200 (HVAC Upgrade), 1-Gymnasium/Locker Building 1000 (HVAC Upgrade), 7-Classroom Buildings 400, 500, 600, 700, 800, 1100 and 1200 (HVAC Upgrade), 6-Classroom Buildings (Relocatable) RLC15-RLC20 (HVAC Upgrade), 1-Library Building 300 (HVAC Upgrade)**
Increment #:	**0**
Application #:	**04-120500**
File #:	**36-28**

Drawings and specifications for the subject project have been examined and stamped by the Division of the State Architect (DSA) for identification on 6/8/2022 . This letter constitutes the "written approval of the plans as to the safety of design and construction" required before letting any contract for construction, and applies to the work shown on these drawings and specifications. The date of this letter is the DSA approval date.

Approval is limited to the particular location shown on the drawings and is conditioned on construction starting within one year from the stamped date. The inspector must be approved and the contract information, including the construction start date, must be given to DSA prior to start of construction.

DSA does not review drawings and specifications for compliance with Parts 3 (California Electrical Code), 4 (California Mechanical Code), and 5 (California Plumbing Code) of Title 24. It is the responsibility of the professional consultants named on the application to verify this compliance.

Please refer only to the boxes checked below which indicate applicable conditions specific to this project.

- [x] Buildings constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for structural safety.

- [x] Buildings or site improvements constructed in accordance with approved drawings and specifications will meet minimum required standard given in Title 24, California Code of Regulations, for fire and life safety.

- [ ] This constitutes the written approval certifying that the drawings and specifications are in compliance with state regulations for the accommodation of the disabled which are required before letting any contract for construction. (See Section 4454, Government Code.)

Application #: 04-120500
File #: 36-28

☐ Due to the nature of the building(s), certain precautions considered necessary to assure long service have not been required. In the condition as built, the building(s) will meet minimum required standards for structural, and fire and life safety. The owner must observe and correct deterioration in the building in order to maintain it in a safe condition.

☐ Your attention is drawn to the fact that this application was submitted under the provisions of Sections 39140/81130 of the Education Code which permit repairs or replacement of a fire damaged building to be made in accordance with the drawings and specifications previously approved by this office. The drawings and specifications approved for the reconstruction of this building conform to the drawings and specifications approved under application # ________.

☐ Due to the nature of the poles, certain precautions considered necessary to assure long service have not been insisted upon. In their condition as built, they will meet minimum required safety standards; however, your attention is directed to the comparatively short life of wood poles. It will be the responsibility of the owner to maintain them in a safe condition.

☐ Bleachers or grandstands constructed in accordance with approved drawings and specifications will meet minimum required standards for structural, and fire and life safety. The owner should provide for and require periodic safety inspections throughout the period of use to ensure framing and other parts have not been damaged or removed. On bleachers or grandstands having bolts, locking or safety devices, the owner should require that all such components be properly tightened or locked prior to each use.

☐ The building(s) was designed to support a snow load of __0__ pounds per square foot of roof area. Snow removal must be considered if the amount of snow exceeds that for which the building(s) was designed.

☐ Deferred Approval(s) Items:

This project has been classified as **Class 3**. An Inspector who is certified by DSA to inspect this class of project must be approved by DSA prior to start of construction.

Please refer to the above application number in all correspondence, reports, etc., in connection with this project.

Sincerely,

Digitally signed by
Craig Rush , SE
Date: 2022.06.15
17:18:27 -07'00'

for Ida Antoniolli Clair, AIA
State Architect

cc:
Architect

Assembly Bill No. 2232

CHAPTER 777

An act to add Chapter 8 (commencing with Section 17660) to Part 10.5 of Division 1 of Title 1 of the Education Code, relating to school facilities.

[Approved by Governor September 29, 2022. Filed with Secretary of State September 29, 2022.]

LEGISLATIVE COUNSEL'S DIGEST

AB 2232, McCarty. School facilities: heating, ventilation, and air conditioning systems.

Existing law establishes the California State University, which is administered by the Board of Trustees of the California State University, and the University of California, under the administration of the Regents of the University of California, as segments of public postsecondary education in this state.

Existing law, the Leroy F. Greene School Facilities Act of 1998, provides for the adoption of rules, regulations, and procedures, under the administration of the Director of General Services, for the allocation of state funds by the State Allocation Board for the construction and modernization of public school facilities.

This bill would require a covered school, defined as a school district, a county office of education, a charter school, a private school, the California Community Colleges, or the California State University, and would request the University of California, to ensure that facilities have heating, ventilation, and air conditioning (HVAC) systems that meet specified minimum ventilation rate requirements, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate, in which case the bill would require a covered school, and request the University of California, to ensure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued. The bill would also require a covered school, and request the University of California, to install filtration that achieves specified minimum efficiency reporting values (MERV) levels, determined by the school to be feasible with the existing HVAC system, as provided. The bill would require, upon the next triennial update of the California Building Standards Code, the California Building Standards Commission and the Division of the State Architect to research, develop, and propose for adoption mandatory standards for carbon dioxide monitors in classrooms of a covered school and the University of California. By imposing new duties on local educational agencies, this bill would impose a state-mandated local program.

The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement.

This bill would provide that, if the Commission on State Mandates determines that the bill contains costs mandated by the state, reimbursement for those costs shall be made pursuant to the statutory provisions noted above.

The people of the State of California do enact as follows:

SECTION 1. The Legislature finds and declares all of the following:

(a) It is the policy of this state that school facilities be designed and operated using available measures to provide a healthy indoor environment for students, teachers, and other occupants including, but not limited to, healthy indoor air quality and adequate ventilation with outdoor air.

(b) In November 2003, the State Air Resources Board and the State Department of Health Care Services issued a report to the Legislature detailing the adverse impact that poor indoor air quality is having on California schools. The report found significant indoor air quality problems, including problems with ventilation, temperature, humidity, air pollutants, floor dust contaminants, moisture, mold, noise, and lighting. The report found that ventilation with outdoor air was inadequate during 40 percent of classroom hours and seriously deficient during 10 percent of classroom hours in both portable classrooms and traditional classrooms.

(c) In February 2005, the State Air Resources Board approved an indoor air quality report that cites proven health and economic benefits to reducing indoor air pollution, which is estimated to cost California $45 billion per year. The report noted that children are particularly vulnerable to poor indoor air quality. According to the report, children under 12 years of age spend about 86 percent of their time indoors with 21 percent of the time being spent in schools.

(d) A 2019 report by the University of California, Davis, Western Cooling Efficiency Center and the Indoor Environment Group of the Lawrence Berkeley National Laboratory identifies numerous studies finding that underventilation of classrooms is common and negatively impacts student health and learning. Improved heating, ventilation, and air conditioning (HVAC) system performance improves student and teacher health and attendance, student productivity, and the performance of mental tasks, such as better concentration and recall. The report found that students in classrooms with higher ventilation rates have a significantly higher percentage of students—13 to 14 percent—scoring satisfactorily on mathematics and reading tests than students in classrooms with lower outdoor air ventilation rates.

(e) A 2018 report in the Environment International Journal found that short-term carbon dioxide exposure beginning at 1,000 parts per million (ppm) negatively affects cognitive performances, including decisionmaking and problem resolution. The Wisconsin Department of Health Services states that carbon dioxide levels between 1,000 and 2,000 ppm are associated with drowsiness and attention issues. Carbon dioxide levels above 2,000 ppm affect concentration and cause headaches, increased heart rate, and nausea.

(f) The California Building Energy Efficiency Standards set minimum ventilation rates for classrooms. Sections 17002 and 17070.75 of the Education Code require school districts to ensure schools are maintained in good repair, including HVAC systems that are functional, supply adequate ventilation to classrooms, and maintain interior temperatures within acceptable ranges. Regulations adopted pursuant to Section 142.3 of the Labor Code require that HVAC systems be maintained and operated to provide at least the quantity of outdoor air required by the California Building Standards Code (Title 24 of the California Code of Regulations) in effect at the time the building permit was issued. Despite these requirements, poorly performing HVAC systems and underventilation of classrooms continue to be a significant problem in California.

(g) The 2019 report by the University of California, Davis, Western Cooling Efficiency Center and the Indoor Environment Group of the Lawrence Berkeley National Laboratory found that over one-half of new HVAC systems in schools had significant problems within three years of installation and that the vast majority of classrooms in California, including 95 percent of the classrooms studied in the central valley, continue to fail to meet minimum ventilation rates. Some classrooms were found to have carbon dioxide concentrations above 2,000 ppm for substantial periods of the day. The study recommended periodic testing of HVAC systems and continuous real-time carbon dioxide monitoring to detect and correct these problems.

(h) Monitoring levels of carbon dioxide in classrooms will help ensure that California students' school environment is healthy and conducive to learning and performing well on tests.

(i) A March 2021 study found that proper ventilation in classrooms could reduce COVID-19 infection risk by over 80 percent compared to classrooms without ventilation.

(j) The Centers for Disease Control and Prevention and the American Society of Heating, Refrigerating and Air-Conditioning Engineers recommend that schools, buildings, and homes combine filters and air cleaners to achieve minimum efficiency reporting values (MERV) levels of performance for air cleaning of 13 or higher.

SEC. 2. Chapter 8 (commencing with Section 17660) is added to Part 10.5 of Division 1 of Title 1 of the Education Code, to read:

Chapter 8. Heating, Ventilation, And Air Conditioning Systems

17660. The Legislature finds and declares that it is the policy of the state that school facilities provide healthy indoor air quality, including adequate ventilation, to students, teachers, and other occupants in order to protect occupant health, reduce sick days, and improve student productivity and performance.

17661. (a) For purposes of this section, the following definitions apply:

(1) “Covered school” means a school district, a county office of education, a charter school, a private school, the California Community Colleges, or the California State University.

(2) “HVAC” means heating, ventilation, and air conditioning.

(3) “MERV” means minimum efficiency reporting values.

(b) (1) A covered school shall, and the University of California is requested to, ensure that facilities, including, but not limited to, classrooms for students, have HVAC systems that meet the minimum ventilation rate requirements set forth in Table 120.1-A of Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate.

(2) If a school’s existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate required pursuant to paragraph (1), then a covered school shall, and the University of California is requested to, ensure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued. In addition, the covered school shall, and the University of California is requested to, document the HVAC system’s inability to meet the current ventilation standards set forth in paragraph (1) in the annual HVAC inspection report required by Section 5142 of Title 8 of the California Code of Regulations, which shall be available to the public upon request.

(c) (1) Subject to paragraph (2), a covered school shall, and the University of California is requested to, install filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school.

(2) If, pursuant to paragraph (1), it is determined that the existing HVAC system is not designed to achieve MERV levels of 13 or higher, a covered school shall, and the University of California is requested to, install filtration that achieves the highest MERV level that the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system.

(d) Upon the next triennial update of the California Building Standards Code (Title 24 of the California Code of Regulations), the California Building Standards Commission and the Division of the State Architect shall research, develop, and propose for adoption mandatory standards for carbon dioxide monitors in classrooms of a covered school and the University of California.

(e) This section shall apply to the University of California only to the extent that the Regents of the University of California, by resolution, make it applicable.

SEC. 3. If the Commission on State Mandates determines that this act contains costs mandated by the state, reimbursement to local agencies and school districts for those costs shall be made pursuant to Part 7 (commencing with Section 17500) of Division 4 of Title 2 of the Government Code.

O

State of California

EDUCATION CODE

Section 17660

17660. The Legislature finds and declares that it is the policy of the state that school facilities provide healthy indoor air quality, including adequate ventilation, to students, teachers, and other occupants in order to protect occupant health, reduce sick days, and improve student productivity and performance.

(Added by Stats. 2022, Ch. 777, Sec. 2. (AB 2232) Effective January 1, 2023.)

State of California

EDUCATION CODE

Section 17661

17661. (a) For purposes of this section, the following definitions apply:

(1) "Covered school" means a school district, a county office of education, a charter school, a private school, the California Community Colleges, or the California State University.

(2) "HVAC" means heating, ventilation, and air conditioning.

(3) "MERV" means minimum efficiency reporting values.

(b) (1) A covered school shall, and the University of California is requested to, ensure that facilities, including, but not limited to, classrooms for students, have HVAC systems that meet the minimum ventilation rate requirements set forth in Table 120.1-A of Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate.

(2) If a school's existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate required pursuant to paragraph (1), then a covered school shall, and the University of California is requested to, ensure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued. In addition, the covered school shall, and the University of California is requested to, document the HVAC system's inability to meet the current ventilation standards set forth in paragraph (1) in the annual HVAC inspection report required by Section 5142 of Title 8 of the California Code of Regulations, which shall be available to the public upon request.

(c) (1) Subject to paragraph (2), a covered school shall, and the University of California is requested to, install filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school.

(2) If, pursuant to paragraph (1), it is determined that the existing HVAC system is not designed to achieve MERV levels of 13 or higher, a covered school shall, and the University of California is requested to, install filtration that achieves the highest MERV level that the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system.

(d) Upon the next triennial update of the California Building Standards Code (Title 24 of the California Code of Regulations), the California Building Standards Commission and the Division of the State Architect shall research, develop, and propose for adoption mandatory standards for carbon dioxide monitors in classrooms of a covered school and the University of California.

(e) This section shall apply to the University of California only to the extent that the Regents of the University of California, by resolution, make it applicable.

(Added by Stats. 2022, Ch. 777, Sec. 2. (AB 2232) Effective January 1, 2023.)

CONCURRENCE IN SENATE AMENDMENTS
AB 2232 (McCarty)
As Amended June 28, 2022
Majority vote

SUMMARY

Requires a covered school (school district, county office of education (COE), charter school, private school, the California Community Colleges (CCC), the California State University (CSU)), and requests the University of California (UC), to ensure that facilities, including classrooms for students, have heating, ventilation, and air conditioning (HVAC) systems that meet minimum ventilation rate requirements, as specified, and to install filtration that achieves minimum efficiency reporting values (MERV) levels of 13 or higher. Requires the California Building Standards Commission and the Division of the State Architect (DSA) to propose for adoption mandatory standards for carbon dioxide monitors in classrooms of a covered school and the UC.

Senate Amendments

1) Require a covered school, and request the UC, to install filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school.

2) Require a covered school, and request the UC, if it is determined that an existing HVAC system is not designed to achieve MERV levels of 13 or higher, to install filtration that achieves the highest MERV level that the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system.

3) Require that, upon the next triennial update of the California Building Standards Code, the California Building Standards Commission and the DSA research, develop, and propose for adoption mandatory standards for carbon dioxide monitors in classrooms of a covered school and the University of California.

COMMENTS

HVAC requirements. Various sections of the law, in different Codes and Code sections, require school facilities to be in good working order and well maintained, including specified inspections. In 2004, the state settled the *Williams v. California* lawsuit and agreed to a number of initiatives intended to provide equal access to instructional materials, safe and decent school facilities, and qualified teachers. The settlement resulted in an agreement to provide funds to low performing schools (deciles 1-3 on the Academic Performance Index), including $800 million for emergency repair of school facilities. COEs were charged with inspection of the low-performing schools based on criteria of schools in good repair. "Good repair" is defined as a facility that is clean, safe and functional. The settlement also includes a lengthy list of facilities components required to be inspected, including gas pipes, doors and windows, fences, fire sprinklers, fire extinguishers, alarm systems, electrical systems, lighting, drinking fountains, roofs, gutters, and mechanical systems, which includes HVAC systems.

Under the Labor Code, the Occupational Safety and Health Standards Board (Board) is authorized to develop health and safety requirements for the protection of workers. Regulations adopted by the Board (Title 8, Section 5142) require HVAC systems to be maintained and operated in accordance with the State Building Standards Code and continuously functioning during working hours with some exceptions (e.g., during scheduled maintenance). The regulations also require the HVAC system to be inspected at least annually and problems found during the inspections to be corrected within a reasonable time. The employer is required to document in writing the name of the individual inspecting or maintaining the system, the date of the inspection and/or maintenance, and the specific findings and actions taken. The records are required to be retained for at least five years and made available for examination and copying, within 48 hours of a request, to the Division of Industrial Relations, any employee of the employer, and to any designated representative of employees.

Carbon dioxide monitors. Studies have found a link between low ventilation rates (supply of outdoor air) in classrooms and attendance, health and student performance. Adequate ventilation helps students be more alert and focused and is associated with fewer respiratory symptoms and absences due to illness. Ventilation standards are specified in Title 24 regulations. In a 2020 article, researchers at the Lawrence Berkeley National Laboratory and the Western Cooling Efficiency Center at UC Davis reported findings of a study of 11 K-12 schools, monitoring 104 classrooms, with ventilation rates of a majority of the classrooms exceeding the Title 24 level. Carbon dioxide monitors can be used as a proxy for the level of ventilation in a classroom. When classrooms are empty, carbon dioxide levels will be lower. When classrooms are occupied, carbon dioxide levels will be higher as carbon dioxide is exhaled by the people in the room.

The construction of school district, COE and CCC facilities is required to comply with Title 24 regulations. Beginning January 1, 2023, Title 24 requires carbon dioxide monitors to be installed in all new classrooms. According to the DSA, during the next Title 24 regulatory code cycle, carbon dioxide monitors for existing schools doing repairs or alterations may be considered. Charter and private schools are required to comply with local building codes and not Title 24 regulations.

According to the Author
"Poor air quality in classrooms is a pervasive problem that negatively impacts student health and learning. Despite laws requiring schools to maintain functional HVAC systems to supply adequate ventilation and safe indoor air quality, poor indoor air quality remains an extensive problem. Additionally, poor installment of HVAC systems substantially increase energy costs and fail to maintain good indoor air quality. AB 2232 will require comprehensive HVAC inspections and air monitors in classrooms to ensure the wellbeing and learning of California students are protected from the harmful effects of poor air quality."

Arguments in Support
The [United States] Green Building Council states, "Under-ventilated schools are associated with increased transmission of infection, asthma exacerbation, cognitive impairment, and health impacts. This, in turn, affects how students learn. Students who attend schools with poor ventilation rates find it more challenging to learn, perform simple and complex tasks, and make decisions. Setting a minimum ventilation rate requirement would set the expectation that fresh air is not something that is nice to have, but rather is *necessary* for students and teachers to function at school."

Arguments in Opposition
The California Catholic Conference states, "The goals and intent of AB 2232 are laudable. And while we agree that all of California's students should learn in modernized facilities, not all of California's schools have access to the same resources to that end. We would note that the Leroy F. Greene School Facilities Act of 1998 (California Education (Ed.) Code Sections 17070.10 – 17079.30), which serves as the legal anchor for AB 2232's proposed provisions, is specific to public schools. Nowhere in that Act's General Provisions (Ed. Code Section 17070.10 – 17070.99) are private schools mentioned. Neither are private schools referenced in the Act's Modernization Eligibility Determination section (Ed. Code Section 17073.10 – 17073.25). Further, the bill seemingly acknowledges that private educational entities (not entitled to receipt of state funding for purposes of modernizing, or otherwise improving physical facilities) ought not be made subject to AB 2232's provisions via the omission of private institutions of higher education from the bill's enumeration of 'covered schools.' Private K-12 schools should be similarly excluded."

FISCAL COMMENTS

According to the Senate Appropriations Committee:

1) This bill could result in unknown, but potentially significant costs for school districts and community colleges to inspect and ensure that their HVAC systems meet the minimum ventilation rate requirements. However, it is unclear how many school and community college districts statewide need to install new filtration as a result of the inspections. The associated costs for these activities could be deemed to be reimbursable by the state.

2) This bill could also result in additional, state reimbursable mandated costs for school and community college districts to install new carbon dioxide monitors classrooms. The amount would depend on the number of classrooms that do not already have carbon dioxide monitors installed (that meet the new standards to be adopted) and the extent of the installation costs, but the one-time costs could be in the hundreds of thousands to low millions of dollars.

3) The CSU indicates that its campuses have already taken steps to improve filtration on their existing HVAC systems to bring them into compliance with COVID era safety era rules and regulations. Therefore, any additional costs as a result of this measure will be minor and absorbable within existing resources. The bill's costs for UC are also likely to be minor and absorbable within existing resources.

VOTES:

ASM EDUCATION: 5-1-1
YES: O'Donnell, Bennett, Lee, McCarty, Quirk-Silva
NO: Megan Dahle
ABS, ABST OR NV: Chen

ASM HIGHER EDUCATION: 9-2-1
YES: Medina, Arambula, Bloom, Gabriel, Irwin, Levine, Low, Santiago, Akilah Weber
NO: Choi, Kiley
ABS, ABST OR NV: Valladares

ASM APPROPRIATIONS: 12-4-0
YES: Holden, Bryan, Calderon, Carrillo, Mike Fong, Gabriel, Eduardo Garcia, Levine, Quirk, Robert Rivas, Akilah Weber, Wilson
NO: Bigelow, Megan Dahle, Davies, Fong

ASSEMBLY FLOOR: 59-9-10
YES: Aguiar-Curry, Arambula, Bauer-Kahan, Bennett, Bloom, Boerner Horvath, Mia Bonta, Bryan, Calderon, Carrillo, Cervantes, Cooley, Cooper, Cunningham, Daly, Mike Fong, Friedman, Gabriel, Cristina Garcia, Eduardo Garcia, Gipson, Gray, Grayson, Haney, Holden, Irwin, Jones-Sawyer, Kalra, Lee, Levine, Low, Maienschein, Mayes, McCarty, Medina, Mullin, Muratsuchi, Nazarian, Petrie-Norris, Quirk, Quirk-Silva, Ramos, Reyes, Luz Rivas, Robert Rivas, Rodriguez, Blanca Rubio, Salas, Santiago, Stone, Ting, Villapudua, Waldron, Ward, Akilah Weber, Wicks, Wilson, Wood, Rendon
NO: Bigelow, Megan Dahle, Davies, Fong, Gallagher, Kiley, Patterson, Seyarto, Smith
ABS, ABST OR NV: Berman, Chen, Choi, Flora, Lackey, Mathis, Nguyen, O'Donnell, Valladares, Voepel

UPDATED

VERSION: June 28, 2022

CONSULTANT: Tanya Lieberman / ED. / (916) 319-2087 FN: 0003874

DECLARATION OF SERVICE BY EMAIL

I, the undersigned, declare as follows:

I am a resident of the County of Sacramento and I am over the age of 18 years, and not a party to the within action. My place of employment is 980 Ninth Street, Suite 300, Sacramento, California 95814.

On January 17, 2024, I served the:

- **Current Mailing List dated January 16, 2024**
- **Notice of Complete Test Claim, Schedule for Comments, and Notice of Tentative Hearing Date issued January 17, 2024**
- **Test Claim filed by the Hesperia Unified School District on November 17, 2023**

  Heating, Ventilation, and Air Conditioning (HVAC) Program, 23-TC-01
  Statutes 2022, Chapter 777, Sections 1, 2 (AB 2232);
  Education Code Sections 17660, 17661, Effective January 1, 2023
  Hesperia Unified School District, Claimant

by making it available on the Commission's website and providing notice of how to locate it to the email addresses provided on the attached mailing list.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that this declaration was executed on January 17, 2024 at Sacramento, California.

Jill Magee

Jill L. Magee
Commission on State Mandates
980 Ninth Street, Suite 300
Sacramento, CA 95814
(916) 323-3562

COMMISSION ON STATE MANDATES

Mailing List

Last Updated: 1/16/24

Claim Number: 23-TC-01

Matter: Heating, Ventilation, and Air Conditioning (HVAC) Program

Claimant: Hesperia Unified School District

TO ALL PARTIES, INTERESTED PARTIES, AND INTERESTED PERSONS:

Each commission mailing list is continuously updated as requests are received to include or remove any party or person on the mailing list. A current mailing list is provided with commission correspondence, and a copy of the current mailing list is available upon request at any time. Except as provided otherwise by commission rule, when a party or interested party files any written material with the commission concerning a claim, it shall simultaneously serve a copy of the written material on the parties and interested parties to the claim identified on the mailing list provided by the commission. (Cal. Code Regs., tit. 2, § 1181.3.)

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Exhibit B

DEPARTMENT OF FINANCE

Gavin Newsom ▪ Governor

915 L Street ▪ Sacramento CA ▪ 95814-3706 ▪ www.dof.ca.gov

RECEIVED
February 15, 2024
Commission on
State Mandates

February 7, 2024

Heather Halsey
Executive Director
Commission on State Mandates
980 Ninth Street, Suite 300
Sacramento, CA 95814

Response to Test Claim 23-TC-01, Heating, Ventilation, and Air Conditioning (HVAC) Program

Dear Heather Halsey:

The Department of Finance has reviewed Test Claim 23-TC-01, submitted to the Commission on State Mandates (Commission) by the Hesperia Unified School District (Claimant) alleging state-mandated, reimbursable costs associated with Chapter 777, Statutes 2022 (AB 2232). The test claim statute requires schools in the State to ensure that facilities have heating, ventilation, and air conditioning (HVAC) systems that meet specified minimum ventilation rate requirements. Existing HVAC systems not capable of safely and efficiently providing the minimum ventilation rate must meet the minimum ventilation rates in effect when the building permits for the systems were issued.

Finance is concerned with some of the mandatory activities and claimed costs listed by the Claimant. On page 9, the Claimant states the following, emphasis added:

"For the period **January 1, 2023, to June 30, 2023**, the Claimant's actual increased costs of the labor to replace and install the MERV 13 air filters were **$27,443.12**. For the period **January 1, 2023, to June 30, 2023**, the Claimant's actual increased cost for purchasing the MERV 13 air filters were **$66,236.22**."

"For the period July 1, 2023, to June 30, 2024, the Claimant's estimated increased cost of the labor to replace and install the MERV 13 air filters is **$81,669.06**. The Claimant hired two employees to perform the replacing and installing the MERV 13 air filters every three months. **For the period July 1, 2023, to June 30, 2024**, the Claimant's estimated increased cost for purchasing the MERV 13 air filters is **$100,119.04**."

To the extent that AB 2232 establishes new responsibilities, it appears that activities and claimed costs are overstated in the test claim. We specifically note the following concerns related to cost estimates provided by the Claimant on pages 7, 8, and 9:

1. Although AB 2232 requires schools to meet specified minimum ventilation rate requirements, it does not require schools to hire additional staff. The Claimant indicates a need for two additional full-time employees; however, AB 2232 does not require schools to employ additional staff. Nevertheless, the Claimant must provide sufficient justification that hiring additional personnel is required pursuant to Education Code section 17660 and 17661.

   Additionally, it is unclear whether the newly added employees will only supervise and maintain the HVAC systems during their 40-hour work week or if they will also be responsible for additional tasks not required by the test claim statute. This lack of clarity may result in excessive costs which need to be addressed and clarified. The Claimant states that four established positions already cover HVAC maintenance and filter replacement. Therefore, it is not clear why there is a need for two additional full-time Supervisor positions. Further, any local educational agency opting to receive resources to support school facilities construction through the Leroy F. Greene School Facilities Act of 1998 or its predecessor program, the State School Building Lease-Purchase Law of 1976, are already required to keep those facilities at all times in good repair, working order, and condition. At a minimum, the Claimant should provide the following information to justify the claimed costs:

   - Documented evidence of the labor hours needed to replace the MERV 13 filter, which would be part of the annual HVAC inspection report required by Section 5142 of Title 8 of the California Code of Regulations.
   - The total number of HVAC systems within its district.
   - Duty Statements for the existing positions and the two additional positions that highlight any extra duties these positions are expected to perform, in addition to maintaining the MERV 13 filters.
   - Documentation that the identified facilities are not already subject to the good repair, working order, and condition requirements of the Leroy F. Greene School Facilities Act of 1998 or its predecessor program, the State School Building Lease-Purchase Law of 1976.

2. The Claimant included purchases for products not aligned with the requirements in AB 2232. The bill requires public schools to install filtration that achieves specified minimum efficiency reporting values (MERV) levels which can be accomplished by replacing existing filters with MERV 13 filters. However, the Claimant provided a purchase receipt for multiple Ply Panels, and it is not clear why these panels were purchased, as AB 2232 does not require the purchase of Ply Panels. Reimbursement for these products should be denied because they are not required by the plain language of the test claim statute and are not reasonably necessary to implement the test claim statute.

Finance believes the Commission should deny reimbursement for these costs because they are not required by the plain language of the test claim statute, and there is not substantial evidence that they are reasonably necessary to carry out any required activity.

If you have any questions regarding this letter, please contact Michelle Nguyen, Principal Program Budget Analyst, at (916) 445-0328 x2754.

Sincerely,

Chris Ferguson

Chris Ferguson
Program Budget Manager

DECLARATION OF SERVICE BY EMAIL

I, the undersigned, declare as follows:

I am a resident of the County of Sacramento and I am over the age of 18 years, and not a party to the within action. My place of employment is 980 Ninth Street, Suite 300, Sacramento, California 95814.

On February 15, 2024, I served the:

- **Current Mailing List dated January 19, 2024**
- **Finance's Comments on the Test Claim filed February 15, 2024**

  Heating, Ventilation, and Air Conditioning (HVAC) Program, 23-TC-01
  Statutes 2022, Chapter 777, Sections 1, 2 (AB 2232);
  Education Code Sections 17660, 17661, Effective January 1, 2023
  Hesperia Unified School District, Claimant

by making it available on the Commission's website and providing notice of how to locate it to the email addresses provided on the attached mailing list.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that this declaration was executed on February 15, 2024 at Sacramento, California.

David Chavez
Commission on State Mandates
980 Ninth Street, Suite 300
Sacramento, CA 95814
(916) 323-3562

COMMISSION ON STATE MANDATES

Mailing List

Last Updated: 1/19/24

Claim Number: 23-TC-01

Matter: Heating, Ventilation, and Air Conditioning (HVAC) Program

Claimant: Hesperia Unified School District

TO ALL PARTIES, INTERESTED PARTIES, AND INTERESTED PERSONS:

Each commission mailing list is continuously updated as requests are received to include or remove any party or person on the mailing list. A current mailing list is provided with commission correspondence, and a copy of the current mailing list is available upon request at any time. Except as provided otherwise by commission rule, when a party or interested party files any written material with the commission concerning a claim, it shall simultaneously serve a copy of the written material on the parties and interested parties to the claim identified on the mailing list provided by the commission. (Cal. Code Regs., tit. 2, § 1181.3.)

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Exhibit C

RECEIVED
March 14, 2024
Commission on State Mandates

March 13, 2024

Heather Halsey
Executive Director
Commission on State Mandates
980 Ninth Street, Suite 300
Sacramento, CA 95814

Re: *Rebuttal Comments to Test Claim 23-TC-01, Heating, Ventilation, and Air Conditioning (HVAC)Program*

Dear Ms. Halsey:

Hesperia Union School District ("Claimant") has reviewed the Department of Finance ("Finance") comments dated February 7, 2024, received on February 15, 2024, in response to the Test Claim 23-TC-01, submitted to the Commission on State Mandates (Commission). Claimant provides the following rebuttal comments.

A. Introduction

Test Claim 23-TC-01, Heating, Ventilation, and Air Conditioning (HVAC) Program addresses Education Code Section 17660 and 17661 requiring schools in the State to ensure that facilities have heating, ventilation, and air conditioning (HVAC) systems that meet specified minimum ventilation rate requirements, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate, requiring a public school to ensure its HVAC system meets the minimum ventilation rates.

Assembly Bill 2232 also requires public schools to install filtration that achieves specified minimum efficiency reporting values (MERV) levels, determined by the school to be feasible with the existing HVAC system, as provided. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Sections 1, 2, Education Code Sections 17660, 17661, Enacted on September 29, 2022, Effective Date: January 1, 2023.)

Education Code Section 17661 states a school *shall* ensure that facilities, including, but not limited to, classrooms for students, have HVAC systems that meet the minimum ventilation rate requirements set forth in Table 120.1-A ("HVAC   ") of Part 6 of Title 24 of the California Code of Regulations, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate. (emphasis added.) If a school's existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate required pursuant to paragraph (1), then a school *shall* ensure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued. (emphasis added.)

The new activities required by Education Code section 17661 as added by Statutes 2021, Chapter 144, are mandated by the State on school districts. To be reimbursable under article XIII B, section 6 of the California Constitution, the new requirements imposed by Education Code section 51225.7(b), (d), and (e)(1), must be mandated by the state; or ordered, commanded, or legally compelled by state law. (*San Diego Unified School Dist. v. Commission on State Mandates* (2004) 33 Cal.4th 859, 874; *Department of Finance v. Commission on State Mandates (Kern High School Dist.*) (2003) 30 Cal.4th 727, 741.) Education Code section 75 provides that shall is mandatory and may is permissive.

The California Supreme Court defined legal compulsion as follows: Legal compulsion occurs when a statute or executive action uses mandatory language that require[s]' or 'command[s]' a local entity to participate in a program or service. Legal compulsion is present when the local entity has a mandatory, legally enforceable duty to obey. (*Coast Community College Dist. v. Commission on State Mandates* (2022) 13 Cal.5th 800, 815; (*San Diego Unified School Dist. v. Commission on State Mandates* (2004) 33 Cal.4th 859, 874.) Here, the plain language of Education Code section 17661 states school districts "shall" perform the activities of confirming HVAC systems meet the minimum ventilation rate requirements. To meet the ventilation rate requirements require public schools to install filtration that achieves specified minimum efficiency reporting values (MERV) levels.

Claimant's Rebuttal Comments:

1. The District provided documented evidence with the filing of the test claim supporting the labor hours needed to replace the MERV 13 filter. (HVAC 013- HVAC 025; HVAC 054.) . The Claimant first incurred increased costs for the labor to replace and install the MERV 13 air filters. For the period January 1, 2023, to June 30, 2023, the Claimant's actual increased cost of the labor to replace and install the MERV 13 air filters were $27,443.12.

For the period July 1, 2023, to June 30, 2024, the Claimant's increased estimated cost of the labor to replace and install the MERV 13 air filters were $81,669.06. The Claimant hired two employees to perform the replacing and installing of the MERV 13 air filters every six months for the HVAC rooftop units and every three months for the portable (wall) HVAC units.

2. Documentation submitted (HVAC 105-HVAC 106) includes the following information:

The District has twenty-two (22) school sites with eight hundred thirty (830) HVAC rooftop units and six hundred fifteen (614) HVAC wall (portable) units.

3. Documentation attached (HVAC 107-HVAC 155) includes the following information:

Work Orders (Duty Statements) for the employees positions performing installing and replacing the MERV 13 filters.

4. Documentation attached (HVAC 156-HVAC 162) includes the following information:

Claimant's Ventilation Maintenance Policy and Procedure and checklist for Indoor Air Quality. Code of California Regulations Title 24, Part 6, Section 120.1, Building Energy Efficient Standards. (HVAC 163-HVAC 174)

5. The good repair, working order, and condition requirements of the Leroy F. Greene School Facilities Act of 1998 or its predecessor program, the State School Building Lease-Purchase Law of 1976 does not include Assembly Bill 2232 requiring public schools to install filtration that achieves specified minimum efficiency reporting values (MERV) levels, determined by the school to be feasible with the existing HVAC system. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Sections 1, 2, Education Code Sections 17660, 17661, Enacted on September 29, 2022, Effective Date: January 1, 2023)

6. Claimant withdraws request for reimbursement for the following activities:

(i) Developing and implementation of internal policies, training, procedures relating to the purchase, installation, stocking of menstrual products.

(ii) Train certificated, classified and other personnel to administer the availability of menstrual products in the district's restrooms.

Finance fails to provide any evidence supporting their "concerns with the costs identified." The costs submitted by the claimant meet the threshold to approve the test claim. Other issues of costs may be addressed during the parameters and guidelines process.

Finance's Comments Fail To Comply With Statutory Requirements.

Oral or written representations of fact offered by any person ***shall*** be under oath or affirmation and signed under penalty of perjury by persons who are authorized and competent to do so and must be based on the declarant's personal knowledge, information, or belief. (Cal.

Code. Regs., tit. 2 §§ 1183.2 and 1187.5.) (emphasis added.) If representations of fact are made, they ***must*** be supported with documentary evidence filed with the comments on the test claim. (Cal. Code. Regs., tit. 2 §§ 1183.2 and 1187.5.) (emphasis added.)

Finance comments fail to include the required oath and affirmation. Nor were the comments supported with documentary evidence. Accordingly, Commission shall disregard comments submitted by Finance.

Claimant submits the attached declaration in support of their test claim.

Certification

I certify by my signature below, under penalty of perjury under the laws of the State of California, that the statements made in this document are true and complete to the best of my own personal knowledge or based on information and belief and that I am authorized and competent to do so.

March 13, 2024

Arthur Palkowitz

Arthur M. Palkowitz
Representative for the Claimant

Test Claim: Heating, Ventilation, and Air Conditioning (HVAC)
Claimant: Hesperia Unified School District
Section: 6 Declaration- Dr. George Landon, Deputy Superintendent, Business Service, Hesperia Unified School District

SECTION NUMBER: 6
Heading: DECLARATION

I, Dr. George Landon, Deputy Superintendent, Business Service, Hesperia Unified School District (Claimant) declare as follows:

1. I am currently employed with the Claimant, and I have been employed with the Claimant since July 1, 2016.

2. I have personal knowledge of the actual and estimated costs incurred by the Claimant for the School Facilities: Heating, Ventilation, and Air Conditioning ("HVAC") Systems commencing on January 1, 2023. The information contained in my declaration is from preparing and reviewing Claimant's business records, my personal knowledge and my information or belief pertaining to the Claimant's HVAC Systems.

3. The new requirements included in test claim statute Assembly Bill No. 2232, Statutes 2022, Chapter 777, Sections 1, 2, Education Code Sections 17660, 17661, Enacted on September 29, 2022, Effective January 1, 2023, include the activities of purchasing and installing MERV 13 air filters in the Claimant's facilities HVAC Systems.

4. The procedure for receiving and installing the MERV 13 air filters is as follows. MERV 13 air filters are delivered to different staging areas. They are delivered by the vendor and unloaded by our staff. The process was very easy with the previous MERV 9 1" air filters. The MERV 13 filters are 2" requiring more storage space. The filters are loaded and transported to the school facility site that may require multiple trips and additional labor hours.

5. The Claimant averages about six months per MERV 13 air filter on roof units, Additional maintenance is required to clean the indoor coil where the air filters are located because MERV 13 are box filters with gaps on the indoor coil. These gaps collect dirt and lint. The previous filters were lay in filters and covered the entire coil. The process to clean the coils more frequently involves hosing the indoor coils down, clearing the drains. The process takes about a half hour per unit plus staging and breakdown. The portable (wall) unit filters are replaced every three months since they are closer to the ground.

6. Every school site has roof top units. Claimant uses a rope to lift the roof top units on to the roof. The filter changers use cordless drill motors and hand tools to remove and replace the filters. The coils are covered with the new box filters that takes additional time and multiple trips. There is triple the number of boxes because of the larger filters. The units are closed and the old filters are disposed of. There is a significant increase in labor due to the additional work involved in maintaining the units.

7. I have submitted documentation (HVAC 105-HVAC 106) stating the following: List of District Schools (22); Total Units (830); Total Roof Tops Replaced (815); Total Roof Tops Not Replaced (15); Total Wall Mounts (614); Total Wall Units Replaced (517); Total Roof Tops Not Replaced (97).

8. The Claimant first incurred increased costs for the labor to replace and install the MERV 13 air filters and the purchase of the MERV 13 air filters on January 1, 2023. For the period **January 1, 2023, to June 30, 2023,** the Claimant's actual increased cost of the labor to replace and install the MERV 13 air filters were **$27,443.12.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

9. For the period **January 1, 2023, to June 30, 2023,** the Claimant's actual increased cost for purchasing the MERV 13 air filters were **$66,236.22.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

10. For the period **July 1, 2023, to June 30, 2024,** the Claimant's increased estimated cost of the labor to replace and install the MERV 13 air filters is **$81,669.06.** The Claimant hired two employees to perform the replacing and installing of the MERV 13 air filters every three months. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

11. For the period **July 1, 2023, to June 30, 2024,** the Claimant's increased estimated cost for purchasing the MERV 13 air filters is **$100,119.04.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

I previously submitted documents in support of the Claimant's increased actual costs incurred from January 1, 2023, to June 30, 2023, and for Fiscal Year 2023-2024 the increased estimated costs for purchasing the MERV 13 air filters, the hiring of two employees to perform the replacing and installing of the MERV 13, air filter invoices and air filter data sheets. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

12. For the fiscal year period **July 1, 2024, to June 30, 2025,** the Claimant's estimated cost of the labor to replace and install the MERV 13 air filters is **$120,624.56.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

13. For the fiscal year period **July 1, 2024, to June 30, 2025,** the Claimant's estimated cost for purchasing the MERV 13 air filters is **$151,920.32.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

I previously submitted documents in support of the Claimant's estimated costs for labor to replace and install the MERV 13 air filters and for the purchasing of the MERV 13 air filters in Fiscal Year 2024-2025, the fiscal year immediately following the fiscal year for which the claim was filed. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

14. The Claimant's General funds are the funding sources for the purchasing of the MERV 13 air filter costs and the labor of replacing and installing the MERV 13 air filters from January 1, 2023, to June 30, 2023, and in Fiscal Years 2023-2024 and 2024-2025.

15. I have submitted Documentation (HVAC 107-HVAC 155) that includes the following information: Work Order (Duty Statements) for the work performed by Claimant's employees for installing and replacing the MERV 13 filters twice a year for the rooftop HVA units and four times a year for the HVAC portable units.

16. I have submitted Documentation that includes the following information:

Claimant's Ventilation Maintenance Policy and Procedure and checklist for Indoor Air Quality. (HVAC 156-HVAC 162) . CALIFORNIA CODE OF REGULATIONS / BUILDING ENERGY EFFICIENCY STANDARDS-TITLE 24, PART 6 / SUBCHAPTER 3 SECTION 120.1 (HVAC 163-HVAC 174)

17. The good repair, working order, and condition requirements of the Leroy F. Greene School Facilities Act of 1998 or its predecessor program, the State School Building Lease-Purchase Law of 1976 does not include Assembly Bill 2232 requiring public schools to install filtration that achieves specified minimum efficiency reporting values (MERV) levels, determined by the school to be feasible with the existing HVAC system. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Sections 1, 2, Education Code Sections 17660, 17661, Enacted on September 29, 2022, Effective Date: January 1, 2023)

Test Claim: Heating, Ventilation, and Air Conditioning (HVAC)
Claimant: Hesperia Unified School District
Section: 6 Declaration- Dr. George Landon, Deputy Superintendent, Business Service, Hesperia Unified School District

18. The Claimant received Elementary and Secondary School Emergency Relief (ESSER) II funds in the amount of $26,295,815. These funds were distributed from June 2021 to August 2023 towards the Districtwide HVAC project to remove and replace HVAC systems at elementary, middle, and high schools. Prior to January 1, 2023, ESSER funds were used to purchase MERV 13 filters in the initial implementation of the new HVAC systems.

19. The Claimant received Elementary and Secondary School Emergency Relief (ESSER) III funds in the amount of $58,852,535. The Claimant allocated $13 million towards the Districtwide HVAC project to remove and replace HVAC systems at elementary, middle, and high schools. The difference is due to the Claimant having other priorities in spending the remainder of ESSER III funds. The Claimant has until September 30, 2024, to spend this allocation. There will be no additional allocations of ESSER funds. Previously submitted were Department of General Services, Division of the State Architect approval plans for the replacement of the District's HVAC.

20. The Coronavirus Aid, Relief, and Economic Security Act (CARES Act) provides funding to Local Education Agencies through the Elementary and Secondary School Emergency Relief (ESSER) Fund, to address the impact of COVID-19 on elementary and secondary schools.

21. I am unaware of any local, state, or federal funds or fee authority that may be used to offset the increased costs that will be incurred by claimant to implement the alleged mandate, including direct and indirect costs.

I certify by my signature below, under penalty of perjury under the laws of the State of California, that the statements made in this document are true and complete to the best of my own personal knowledge or information and belief and I am authorized and competent to do so.

Dated: March 13, 2024

DR. GEORGE LANDON, DEPUTY
SUPERINTENDENT, BUSINESS SERVICE
HERSPERIA UNIFIED SCHOOL DISTRICT

School	Total Units	Roof Tops Replaced	Total Roof Tops Not Replaced	Total Wall Mounts	Total Wall Mounts Replaced	Wall Mounts Not
Elementary						
Carmel	30	30	0	16	16	0
Cottonwood	30	30	0	14	11	3
Cypress	44	44	0	4	4	0
Eucalyptus	29	29	0	15	6	9
Hollyvale	33	33	0	8	8	0
Joshua Circle	23	22	1	27	22	5
Juniper	25	23	2	21	16	5
Kingston	28	28	0	28	26	2
Krystal	51	51	0	6	4	2
Lime Street	34	34	0	23	20	3
Maple	31	31	0	22	11	11
Mesa Grande	35	35	0	54	28	26
Mesquite Trails	30	30	0	21	15	6
Mission Crest	56	56	0	8	6	2
Topaz	31	31	0	14	13	1
Total Elementary	510	507	3	281	206	75
Middle School						
Cedar	16	16	0	64	64	0
Hesperia Jr	46	35	11	40	33	7
Ranchero	72	72	0	26	24	2
Total Middle School	134	123	11	130	121	9
High Schools						
Hesperia	70	69	1	127	122	5
Sultana	54	54	0	27	23	4
Total High Schools	124	123	1	154	145	9
Alternative Ed Sites						
Canyon Ridge HS	44	44	0	5	1	4
Mojave HS	18	18	0	44	44	0
Total Alternative Ed	62	62	0	49	45	4
Grand Totals	830	815	15	614	517	97

Canyon Ridge High School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	48

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

12850 Muscatel Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Canyon Ridge High School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Includes Summit Academy

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	48.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 12 hours x 4 times a year

Canyon Ridge High School

Replace rooftop filters

DETAILS **START DATE:** January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	56

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION 12850 Muscatel Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Canyon Ridge High School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Includes Summit Academy

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	56.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 28 hours x 2 times a year

Carmel Elementary School

Replace portable filters

AkitaBox

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	48

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

9321 Glendale Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Carmel Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	48.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 12 hours x 4 times a year

Carmel Elementary School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	36

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

9321 Glendale Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Carmel Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	36.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 18 hours x 2 times a year

Cedar Middle School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	120

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

13565 Cedar Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Cedar Middle School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	120.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	60	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	60	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 30 hours x 4 times a year

Cedar Middle School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	60

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

13565 Cedar Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Cedar Middle School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	60.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	30	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	30	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 30 hours x 2 times a year

Cottonwood Elementary School

Replace portable filters

AkitaBox

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	48

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

8850 Cottonwood Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Cottonwood Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	48.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 12 hours x 4 times a year

Cottonwood Elementary School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	36

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

8850 Cottonwood Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Cottonwood Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	36.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 18 hours x 2 times a year

Cypress School of the Arts

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	48

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

10365 Cypress Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Cypress School of the Arts	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	48.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 12 hours x 4 times a year

Cypress School of the Arts

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	56

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

10365 Cypress Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Cypress School of the Arts	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	56.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 28 hours x 2 times a year

Eucalyptus Elementary School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	48

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

11224 10th Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Eucalyptus Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	48.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 12 hours x 4 times a year

Eucalyptus Elementary School

Replace rooftop filters

AkitaBox

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	36

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

11224 10th Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Eucalyptus Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	36.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 18 hours x 2 times a year

Hesperia High School

Replace portable filters

AkitaBox

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	300

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

9898 Maple Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Hesperia High School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	300.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	150	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	150	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 75 hours x 4 times a year

Hesperia High School

Replace rooftop filters

AkitaBox

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	160

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

9898 Maple Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Hesperia High School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	160.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	80	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	80	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 80 hours x 2 times a year

Hesperia Jr High School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	144

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

10275 Cypress Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Hesperia Jr High School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	144.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	72	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	72	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 36 hours x 4 times a year

Hesperia Jr High School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	60

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

10275 Cypress Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Hesperia Jr High School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	60.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	30	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	30	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 30 hours x 2 times a year

Hollyvale Elementary School Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	48

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

11645 Hollyvale Avenue, Victorville, CA 92392, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Hollyvale Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	48.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 12 hours x 4 times a year

Hollyvale Elementary School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	36

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

11645 Hollyvale Avenue, Victorville, CA 92392, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Hollyvale Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	36.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 18 hours x 2 times a year

Joshua Circle Elementary School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	96

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

10140 8th Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Joshua Circle Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	96.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	48	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	48	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 24 hours x 4 times a year

Joshua Circle
Elementary School

Replace rooftop
filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	56

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

10140 8th Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Joshua Circle Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	56.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 28 hours x 2 times a year

Juniper Elementary School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	48

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

9400 I Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Juniper Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	48.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 12 hours x 4 times a year

Juniper Elementary School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	36

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

9400 I Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Juniper Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	36.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 18 hours x 2 times a year

Kingston Elementary School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	96

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

7473 Kingston Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Kingston Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	96.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	48	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	48	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 24 hours x 4 times a year

Kingston Elementary School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	56

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

7473 Kingston Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Kingston Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	56.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 28 hours x 2 times a year

Krystal Elementary School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	48

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

17160 Krystal Drive, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Krystal Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	48.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 12 hours x 4 times a year

Krystal Elementary School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	32

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

17160 Krystal Drive, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Krystal Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	32.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	16	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	16	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 16 hours x 2 times a year

Lime Street
Elementary School

Replace portable
filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	96

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

16852 Lime Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Lime Street Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	96.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	48	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	48	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 24 hours x 4 times a year

Lime Street Elementary School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	36

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

16852 Lime Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Lime Street Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	36.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 18 hours x 2 times a year

Maple Elementary School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	72

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

10616 Maple Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Maple Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	72.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	36	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	36	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 18 hours x 4 times a year

Maple Elementary School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	36

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

10616 Maple Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Maple Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	36.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 18 hours x 2 times a year

Mesa Grande Elementary School

Replace portable filters

AkitaBox

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	96

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

9172 Third Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Mesa Grande Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	96.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	48	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	48	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 24 hours x 4 times a year

Mesa Grande Elementary School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	56

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

9172 Third Avenue, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Mesa Grande Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	56.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 28 hours x 2 times a year

Mesquite Trails Elementary School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	48

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

13884 Mesquite Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Mesquite Trails Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	48.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 12 hours x 4 times a year

Mesquite Trails Elementary School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	36

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

13884 Mesquite Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Mesquite Trails Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	36.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 18 hours x 2 times a year

Mission Crest Elementary School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	72

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

13065 Muscatel Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Mission Crest Elementary School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	72.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	36	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	36	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 18 hours x 4 times a year

Mission Crest
Elementary School

Replace rooftop
filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	36

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

13065 Muscatel Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Mission Crest Elementary School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	36.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 18 hours x 2 times a year

Mojave High School

Replace portable filters

DETAILS

START DATE: January , 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	192

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

16633 Lemon Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Mojave High School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Includes Alternative Education

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	192.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	48	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	48	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 48 hours x 4 times a year

Mojave High School

Replace rooftop filters

DETAILS **START DATE:** January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	56

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION 16633 Lemon Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Mojave High School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Includes Alternative Education

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	56.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	28	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 28 hours x 2 times a year

Oak Hills High School

Replace portable filters

AkitaBox

DETAILS **START DATE:** January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	240

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION 7625 Cataba Road, Oak Hills, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Oak Hills High School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	240.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	120	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	120	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 60 hours x 4 times a year

Oak Hills High School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	140

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

7625 Cataba Road, Oak Hills, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Oak Hills High School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	140.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	70	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	70	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 70 hours x 2 times a year

Ranchero Middle School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	72

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

17607 Ranchero Road, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Ranchero Middle School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	72.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	36	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	36	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 18 hours x 4 times a year

Ranchero Middle School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	100

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

17607 Ranchero Road, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Ranchero Middle School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	100.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	50	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	50	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 50 hours x 2 times a year

Shadow Ridge School

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	36

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

15775 Main Street, Suite #5, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Shadow Ridge School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	36.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 18 hours x 2 times a year

Sultana High School

Replace portable filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	120

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

17311 Sultana Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Sultana High School	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	120.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	60	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	60	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 30 hours x 4 times a year

Sultana High School

Replace rooftop filters

DETAILS **START DATE:** January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	168

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION 17311 Sultana Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Sultana High School	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	168.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	84	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	84	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 84 hours x 2 times a year

Topaz Preparatory Academy

Replace portable filters

AkitaBox

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	48

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

14110 Beech Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Topaz Preparatory Academy	*Not provided*	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	48.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	24	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 filters changed in portables
Portable units = 12 hours x 4 times a year

Topaz Preparatory Academy

Replace rooftop filters

DETAILS

START DATE: January 1, 2023 I **DUE DATE:** December 31, 2023

TYPE	TRADE	PRIORITY	EST. HOURS
Heating or Cooling /HVAC	HVAC	Medium	36

Assignees (2): Vincent Luciano, Daniel (D.J.) Goble

LOCATION

14110 Beech Street, Hesperia, CA 92345, USA – Hesperia, CA

BUILDING	FLOOR	ROOM	ASSET NAME
Topaz Preparatory Academy	Roof	*Not provided*	*Not provided*

WORK ORDER DESCRIPTION

Not provided

WORK SUMMARY

COMPLETED DATE	TOTAL WORK HOURS	TOTAL COST ($)
December 15, 2023	36.00	$0.00

WORK ACTIVITY

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Daniel (D.J.) Goble	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed

PERFORMED BY	DATE OF WORK	WORK HOURS	COST ($)
Vincent Luciano	December 15, 2023	18	*Not provided*

MATERIAL USED:
Merv 13 filters

ACTIONS TAKEN:
Merv 13 rooftop filters changed
Rooftop units = 18 hours x 2 times a year

HESPERIA UNIFIED SCHOOL DISTRICT
MAINTENANCE/OPERATIONS/TRANSPORTATION

Jeff Maestas, DIRECTOR
11107 Santa Fe Ave. East
Hesperia, CA 92345

Telephone (760) 244-0502
Fax (760) 244-5907
EMAIL jeffrey.maestas@hesperiausd.org

Title 8, California Code of Regulations, CAL/OSHA Standards
The Law Concerning HVAC System
Operation, Inspections and Maintenance

As an information service, here is Title 8, California Code of Regulations, section 5142. You can find this on the Internet at www.dir.ca.gov/title8/5142.html

TITLE 8, Sub Chapter 7

§5142 Mechanically Driven Heating, Ventilating and Air Conditioning (HVAC) Systems to Provide Minimum Building Ventilation.

(a) **Operation**:

(1) The HVAC system shall be maintained and operated to provide at least the quantity of outdoor air required by the State Building Standards Code, Title 24, Part 2, California Administrative Code, in effect at the time the building permit was issued.

(2) The HVAC system shall be operated continuously during working hours except:

(A) during scheduled maintenance and emergency repairs;

(B) during periods not exceeding a total of 90 hours per calendar year when a serving electric utility by contractual arrangement requests its customers to decrease electrical power demand; or

(C) during periods for which the employer can demonstrate that the quantity of outdoor air supplied by nonmechanical means meets the outdoor air supply rate required by (a)(1) of this Section. The employer must have available a record of calculations and/or measurements substantiating that the required outdoor air supply rate is satisfied by infiltration and/or by a nonmechanically driven outdoor air supply system.

(b) **Inspection and Maintenance**:

(1) The HVAC system shall be inspected at least annually, and problems found during these inspections shall be corrected within a reasonable time.

(2) Inspections and maintenance of the HVAC system shall be documented in writing. The employer shall record the name of the individual(s) inspecting and/or maintaining the system, the date of the inspection and/or maintenance, and the specific findings and actions taken. The employer shall ensure that such records are retained for at least five years.

(3) The employer shall make all records required by this section available for examination and copying, within 48 hours of a request, to any authorized representative of the Division (as defined in Section 3207), to any employee of the employer affected by this section, and to any designated representative of said employee of the employer affected by this section.

John Larsen	David Shreve	John Collinwood	Ruben Ortega	Paula Sheridan
Maintenance Supervisor	Mechanic Supervisor	Grounds Supervisor	Night Custodial Supervisor	Transportation Supervisor
Ext. 7832	Ext. 7855	Ext. 7816	Ext 7318	Ext.7831

Hesperia Unified Ventilation Maintenance Policy and Procedure

Implementation Date: Revision Date:

A. RESPONSIBILITIES

The Director of Maintenance and Operations designates the Maintenance Supervisor as the person with the authority and the responsibility for implementing and maintaining this policy and procedure for HUSD.

B. COMPLIANCE

This policy and procedure provides compliance with the requirements of California Code of Regulations, Title 8, §5142 Mechanically Driven Heating, Ventilating and Air Conditioning (HVAC) Systems to Provide Minimum Building Ventilation.

C. OPERATION OF VENTILATION SYSTEMS

The District HVAC system(s) shall be maintained and operated to provide at least the quantity of outdoor air required by the State Building Standards Code, Title 24, Part 2, California Administrative Code, in effect at the time the building permit was issued and the HVAC system(s) shall be operated continuously during working hours except:

1) during scheduled maintenance and emergency repairs;

2) during periods not exceeding a total of 90 hours per calendar year when a serving electric utility by contractual arrangement requests its customers to decrease electrical power demand; or

3) during periods for which the employer can demonstrate that the quantity of outdoor air supplied by nonmechanical means meets the outdoor air supply rate required by Title 24, Part 2, California Administrative Code, in effect at the time the building permit was issued. The employer must have available a record of calculations and/or measurements substantiating that the required outdoor air supply rate is satisfied by infiltration and/or by a nonmechanically driven outdoor air supply system.

D. INSPECTION AND MAINTENANCE OF VENTILATION SYSTEMS

The District has implemented a comprehensive maintenance program that assures proper operation of all ventilation systems in each facility. The following is the minimum requirements of the program:

1) The HVAC system(s) shall be inspected at least annually. Any problems found during these inspections shall be corrected within a reasonable time.

1) Inspections and maintenance of HVAC system(s) shall be documented in writing. A standard form is maintained that records the name of the individual(s) or vendor inspection and/or maintaining the system, the date of the inspection and/or maintenance, and the specific findings and actions taken. The Maintenance Supervisor retains these records for at least five years at the Maintenance and Operations Shop.

E. EMPLOYEE ACCESS TO RECORDS

The District makes all records required by this policy and procedure available for examination and copying within 48 hours of a request, to any authorized representative of Cal-OSHA, to any employee affected by this section, and to any designated representative of said employee of the employer affected by this section.

Prepared by: ______________________________ ***Signature on file.*** Date: ____________________

Reviewed by: ______________________________ ***Signature on file.*** Date: ____________________

Approved by: ______________________________ ***Signature on file.*** Date: ____________________

Ventilation Maintenance Policy and Procedure

HVAC Checklist - Short Form

Building Name: ______________________ Address: ______________________

Completed by: ______________________ Date: __________ File Number: ____________

Sections 2, 4 and 6 and Appendix B discuss the relationships between the HVAC system and indoor air quality.

MECHANICAL ROOM

- Clean and dry? ______________ Stored refuse or chemicals? ______________
- Describe items in need of attention ______________________

MAJOR MECHANICAL EQUIPMENT

- Preventive maintenance (PM) plan in use? ______________________

Control System

- Type ______________________
- System operation ______________________
- Date of last calibration ______________________

Boilers

- Rated Btu input __________ Condition ______________________
- Combustion air: is there at least one square inch free area per 2,000 Btu input? ______________
- Fuel or combustion odors ______________________

Cooling Tower

- Clean? no leaks or overflow? ______________ Slime or algae growth? ______________
- Eliminator performance ______________________
- Biocide treatment working? (list type of biocide) ______________________
- Spill containment plan implemented? ______________ Dirt separator working? ______________

Chillers

- Refrigerant leaks? ______________________
- Evidence of condensation problems? ______________________
- Waste oil and refrigerant properly stored and disposed of? ______________________

HVAC Checklist - Short Form

Building Name: ______________________ Address: ______________________

Completed by: ______________________ Date: __________ File Number: __________

AIR HANDLING UNIT

- Unit identification ______________________ Area served ______________________

Outdoor Air Intake, Mixing Plenum, and Damper

- Outdoor air intake location ______________________
- Nearby contaminant sources? (describe) ______________________
- Bird screen in place and unobstructed? ______________________
- Design total cfm __________ outdoor air (O.A.) cfm __________ date last tested and balanced __________
- Minimum % O.A. (damper setting) __________ Minimum cfm O.A. $\frac{\text{(total cfm x minimum \% O.A.)}}{100}$ = __________
- Current O.A. damper setting (date, time, and HVAC operating mode) ______________________
- Damper control sequence (describe) ______________________
- Condition of dampers and controls (note date) ______________________

Fans

- Control sequence ______________________
- Condition (note date) ______________________
- Indicated temperatures supply air ______ mixed air ______ return air ______ outdoor air ______
- Actual temperatures supply air ______ mixed air ______ return air ______ outdoor air ______

Coils

- Heating fluid discharge temperature __________ ΔT ______ cooling fluid discharge temperature ______ ΔT ______
- Controls (describe) ______________________
- Condition (note date) ______________________

Humidifier

- Type ______________________ if biocide is used, note type ______________________
- Condition (no overflow, drains trapped, all nozzles working?) ______________________
- No slime, visible growth, or mineral deposits? ______________________

HVAC Checklist - Short Form

Building Name: ______________________ Address: ______________________

Completed by: ______________________ Date: __________ File Number: ______________

DISTRIBUTION SYSTEM

Zone/ Room	System Type	Supply Air		Return Air		Power Exhaust		
		ducted/ unducted	cfm*	ducted/ unducted	cfm*	cfm*	control	serves (e.g. toilet)

Condition of distribution system and terminal equipment (note locations of problems)

- Adequate access for maintenance? ______________________
- Ducts and coils clean and obstructed? ______________________
- Air paths unobstructed? supply ______ return ______ transfer ______ exhaust ______ make-up ______
- Note locations of blocked air paths, diffusers, or grilles ______________________
- Any unintentional openings into plenums? ______________________
- Controls operating properly? ______________________
- Air volume correct? ______________________
- Drain pans clean? Any visible growth or odors? ______________________

Filters

Location	Type/Rating	Size	Date Last Changed	Condition (give date)

HVAC Checklist - Short Form

Building Name: ______________________ Address: ______________________

Completed by: ______________________ Date: __________ File Number: __________

OCCUPIED SPACE

Thermostat types ______________________

Zone/ Room	Thermostat Location	What Does Thermostat Control? (e.g., radiator, AHU-3)	Setpoints		Measured Temperature	Day/ Time
			Summer	Winter		

Humidistats/Dehumidistats type ______________________

Zone/ Room	Humidistat/ Dehumidistat Location	What Does It Control?	Setpoints (%RH)	Measured Temperature	Day/ Time

- Potential problems (note location) ______________________
- Thermal comfort or air circulation (drafts, obstructed airflow, stagnant air, overcrowding, poor thermostat location)
____
____
- Malfunctioning equipment ______________________
- Major sources of odors or contaminants (e.g., poor sanitation, incompatible uses of space)
____

SECTION 120.1 – REQUIREMENTS FOR VENTILATION AND INDOOR AIR QUALITY

(a) General Requirements.

1. All occupiable spaces in hotel/motel buildings, and nonresidential buildings other than healthcare facilities shall comply with the applicable requirements of Section 120.1(a) through 120.1(g). Healthcare facilities shall be ventilated in accordance with Chapter 4 of the California Mechanical Code.
2. The required outdoor air-ventilation rate and the air-distribution system design shall be clearly identified on the plans in accordance with Section 10-103 of Title 24, Part 1.

(b) Reserved

(c) Nonresidential and Hotel/Motel Buildings.

All occupiable spaces shall meet the requirements of Section 120.1(c)1, and shall also comply with either Section 120.1(c)2 or Section 120.1(c)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 thermal conditioning components. Air Filters shall conform to the requirements of Sections 120.1(c)1B, 120.1(c)1C and 120.1(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 120.1(c)1A: For heat recovery ventilators and energy recovery ventilators the location of the filters required by Section 120.1(c)1A 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.

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

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

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

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

Equation 120.1-A

$$\mathbf{A_{face} = Q_{filter} / V_{face}}$$

Where,

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

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

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

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

2. Natural Ventilation.

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

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

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

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

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

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

EXCEPTION to Section 120.1(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]

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

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

3. Mechanical Ventilation.

Occupiable spaces shall be ventilated with a mechanical ventilation system capable of providing an outdoor airflow rate to the zone (V_z) no less than Equation 120.1-F as described below:

Equation 120.1-F

$$\mathbf{V_z = R_t \times A_z}$$

Where:

R_t = Total outdoor airflow rate required per unit area as determined from Table 120.1-A.

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

EXCEPTION 1 to Section 120.1(c)3: Designed Occupancy. For spaces designed for an expected number of occupants per the **EXCEPTION to Section** 1004.5 of the CBC, or spaces with fixed seating per Section 1004.6 of the CBC, the outdoor airflow rate to the zone (V_z) shall be determined in accordance with Equation 120.1-G;

Equation 120.1-G

$$\mathbf{V_z = \text{The larger of } R_p \times P_z \text{ or } R_a \times A_z}$$

Where:

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

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

R_a = The minimum ventilation airflow rate allowed for DCV in Table 120.1-A. If R_a is not defined for an occupancy category, R_a = 0.

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

EXCEPTION 2 to Section 120.1(c)3: Transfer air. The rate of outdoor air required by Section 120.1(c)3 may be provided with air transferred from other ventilated space if:

A. Use of transfer air is in accordance with Section 120.1(g); and

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

4. Exhaust Ventilation.

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

(d) Operation and Control Requirements for Minimum Quantities of Outdoor Air.

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

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

   EXCEPTION 2 to Section 120.1(d)1: Temporary reduction. The rate of outdoor air provided to a space may be reduced below the level required by Section 120.1(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.

2. **Pre-occupancy.** The lesser of the minimum rate of outdoor air required by Section 120.1(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.

3. **Required Demand Control Ventilation.** Demand ventilation controls complying with Section 120.1(d)4 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 ventilation system serving the space has one or more of the following:

   A. an air economizer; or

   B. modulating outside air control; or

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

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

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

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

4. Demand Control Ventilation Devices.

   A. For each system with demand control ventilation (DCV), CO_2 sensors shall be installed in each room that meets the criteria of Section 120.1(d)3 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 CO_2 is near or at the setpoint within the zone or space shall trigger an increase in ventilation.

   B. CO_2 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.

C. Demand ventilation controls shall maintain CO_2 concentrations less than or equal to 600 ppm plus the outdoor air CO_2 concentration in all rooms with CO_2 sensors.

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

D. Outdoor air CO_2 concentration shall be determined by one of the following:

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

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

E. When the system is operating during hours of expected occupancy, the controls shall maintain system outdoor air ventilation rates no less than the rate listed in Table 120.1-A for DCV, times the conditioned floor area for spaces with CO_2 sensors, plus the rate required by Section 120.1(c)3 for other spaces served by the system, or the exhaust air rate whichever is greater.

F. CO_2 sensors shall be certified by the manufacturer to be accurate within plus or minus 75 ppm at a 600 and 1000 ppm concentration when measured at sea level and 25°C, factory calibrated, and certified by the manufacturer to require calibration no more frequently than once every 5 years. Upon detection of sensor failure, the system shall provide a signal which resets to supply the minimum quantity of outside air to levels required by Section 120.1(c)3 to the zone serviced by the sensor at all times that the zone is occupied.

G. The CO_2 sensor(s) reading for each zone shall be displayed continuously, and shall be recorded on systems with DDC to the zone level.

5. Occupant Sensor Ventilation Control Devices.

Occupant sensing or 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 120.1-A and required to install occupant sensors to comply with Section 130.1(c)5, 6, and 7. Occupant sensor ventilation control devices used to reduce the rate of outdoor airflow when occupants are not present shall comply with the following:

A. Occupant sensors shall have suitable coverage and placement to detect occupants in the entire space ventilated. In 20 minutes or less after no occupancy is detected by any sensors covering the room, occupant sensing controls shall indicate a room is vacant.

B. 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.

C. When a single zone damper or a single zone system serves multiple rooms, there shall be an occupant sensor in each room and the zone shall not be considered vacant until all rooms in the zone are vacant.

D. One hour prior to normal scheduled occupancy, the occupant sensor ventilation control shall allow pre-occupancy purge as described in Section 120.1(d)2.

E. 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.

F. 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.

G. 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.

(e) Ducting for Zonal Heating and Cooling Units.

Where a return plenum is used to distribute outdoor air to a zonal heating or cooling unit which then supplies the air to a space in order to meet the requirements of Section 120.1(c)3, the outdoor air shall be ducted to discharge either:

1. Within 5 feet of the unit; or
2. Within 15 feet of the unit, substantially toward the unit, and at a velocity not less than 500 feet per minute.

(f) Design and Control Requirements for Quantities of Outdoor Air.

1. All mechanical ventilation and space-conditioning systems shall be designed with and have installed ductwork, dampers, and controls that allow design minimum outside air rates to be operated at no less than the larger of (1) the minimum levels specified in Section 120.1(c)3 or (2) the rate required for make-up of exhaust systems that are required for an exempt or covered process, for control of odors, or for the removal of contaminants within the space.
2. All variable air volume mechanical ventilation and space-conditioning systems shall include dynamic controls that are capable of maintaining measured outside air ventilation rates within 10 percent of the design minimum 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.
3. All mechanical ventilation and space-conditioning systems shall be tested to confirm their ability to operate within 10 percent of the design minimum outside air rate.

(g) Air Classification and Recirculation Limitations.

Air classification and recirculation limitations of air shall be based on the air classification as listed in Table 120.1-A or Table 120.1-C, and in accordance with the requirements of Sections 120.1(g)1 through 4.

NOTE: Air class definitions are taken directly from ASHRAE 62.1 and are duplicated here for convenience.

1. **Class 1 Air** is air with low contaminant concentration, low sensory-irritation intensity, or inoffensive odor. Recirculation or transfer of Class 1 air to any space shall be permitted; [ASHRAE 62.1:5.16.3.1]
2. **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 120.1(g)2A through 120.1(g)2E:

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

   B. 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

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

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

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

   EXCEPTION to Section 120.1(g)2E: 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.

3. **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 Section 120.1(g)3A and B:

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

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

   EXCEPTION to Section 120.1(g)3B: 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.

4. **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]
5. **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]
6. **Transfer.** A mixture of air that has been transferred through or returned from 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]
7. **Classification.** Air leaving each space or location shall be designated at an expected air-quality classification not less than that shown in Tables 120.1-A, 120.1-B or 120.1-C. Air leaving spaces or locations that are not listed in Tables 120.1-A, 120.1-B or 120.1-C 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.

(h) Ventilation Only Mechanical Systems.

HVAC Systems without mechanical cooling or mechanical heating shall meet the requirements of Section 120.2(f).

Table 120.1-A – Minimum Ventilation Rates

Occupancy Category	Total Outdoor Air Rate[1] R_t (cfm/ft^2)	Min Ventilation Air Rate for DCV[2] R_a (cfm/ft^2)	Air Class	Notes
Educational Facilities				
Daycare (through age 4)	0.21	0.15	2	
Daycare sickroom	0.15		3	
Classrooms (ages 5-8)	0.38	0.15	1	
Classrooms (age 9 -18)	0.38	0.15	1	
Lecture/postsecondary classroom	0.38	0.15	1	F
Lecture hall (fixed seats)	-	0.15	1	F
Art classroom	0.15		2	
Science laboratories	0.15		2	
University/college laboratories	0.15		2	
Wood/metal shop	0.15		2	
Computer lab	0.15		1	
Media center	0.15		1	A
Music/theater/dance	1.07	0.15	1	F
Multiuse assembly	0.5	0.15	1	F
Food and Beverage Service				
Restaurant dining rooms	0.5	0.15	2	
Cafeteria/fast-food dining	0.5	0.15	2	
Bars, cocktail lounges	0.5	0.2	2	
Kitchen (cooking)	0.15		2	
General				
Break rooms	0.5	0.15	1	F
Coffee Stations	0.5	0.15	1	F
Conference/meeting	0.5	0.15	1	F
Corridors	0.15		1	F
Occupiable storage rooms for liquids or gels	0.15		2	B
Hotels, Motels, Resorts, Dormitories				
Bedroom/living room	0.15		1	F
Barracks sleeping areas	0.15		1	F
Laundry rooms, central	0.15		2	
Laundry rooms within dwelling units	0.15		1	
Lobbies/pre-function	0.5	0.15	1	F
Multipurpose assembly	0.5		1	F
Office Buildings				
Breakrooms	0.5	0.15	1	
Main entry lobbies	0.5	0.15	1	F
Occupiable storage rooms for dry materials	0.15		1	
Office space	0.15		1	F
Reception areas	0.15		1	F
Telephone/data entry	0.15		1	F
Miscellaneous Spaces				
Bank vaults/safe deposit	0.15		2	F
Banks or bank lobbies	0.15		1	F
Computer (not printing)	0.15		1	F
Freezer and refrigerated spaces (<50oF)	-		2	E
General manufacturing (excludes heavy industrial and process using chemicals)	0.15		3	
Pharmacy (prep. Area)	0.15		2	
Photo studios	0.15		1	
Shipping/receiving	0.15		2	B
Sorting, packing, light assembly	0.15		2	
Telephone closets	0.15		1	
Transportation waiting	0.5	0.15	1	F
Warehouses	0.15		2	B
All others	0.15		2	
Public Assembly Spaces				
Auditorium seating area	1.07	0.15	1	F
Places of religious worship	1.07	0.15	1	F
Courtrooms	0.19	0.15	1	F
Legislative chambers	0.19	0.15	1	F
Libraries (reading rooms and stack areas)	0.15		1	
Lobbies	0.5	0.15	1	F

Occupancy Category	Total Outdoor Air Rate[1] R_t (cfm/ft^2)	Min Ventilation Air Rate for DCV[2] R_a (cfm/ft^2)	Air Class	Notes
Museums (children's)	0.25	0.15	1	
Museums/galleries	0.25	0.15	1	F
Residential				
Common corridors	0.15		1	F
Retail				
Sales (except as below)	0.25	0.2	2	
Mall common areas	0.25	0.15	1	F
Barbershop	0.4		2	
Beauty and nail salons	0.4		2	
Pet shops (animal areas)	0.25	0.15	2	
Supermarket	0.25	0.2	1	F
Coin-operated laundries	0.3		2	
Sports and Entertainment				
Gym, sports arena (play area)	0.5	0.15	2	E
Spectator areas	0.5	0.15	1	F
Swimming (pool)	0.15		2	C
Swimming (deck)	0.5	0.15	2	C
Disco/dance floors	1.5	0.15	2	F
Health club/aerobics room	0.15		2	
Health club/weight rooms	0.15		2	
Bowling alley (seating)	1.07	0.15	1	
Gambling casinos	0.68	0.15	1	
Game arcades	0.68	0.15	1	
Stages, studios	0.5	0.15	1	D, F

General footnotes for Table 120.1-A:
1 Rt is determined as being the larger of the area method and the default per person method. The occupant density used in the default per person method is one half of the maximum occupant load assumed for egress purposes in the CBC.
Specific Notes:
A – For high-school and college libraries, the values shown for "Public Assembly Spaces – Libraries" shall be used.
B – Rate may not be sufficient where stored materials include those having potentially harmful emissions.
C – Rate does not allow for humidity control. "Deck area" refers to the area surrounding the pool that is capable of being wetted during pool use or when the pool is occupied. Deck area that is not expected to be wetted shall be designated as an occupancy category.
D – Rate does not include special exhaust for stage effects such as dry ice vapors and smoke.
E – Where combustion equipment is intended to be used on the playing surface or in the space, additional dilution ventilation, source control, or both shall be provided.
F – Ventilation air for this occupancy category shall be permitted to be reduced to zero when the space is in occupied-standby mode.

Table 120.1-B – Minimum Exhaust Rates
[ASHRAE 62.1: Table 6.5]

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

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

Table 120.1-C – Airstreams or Sources
[ASHRAE 62.1:Table 5.16.1]

Description	Air Class
Diazo printing equipment discharge	4
Commercial kitchen grease hoods	4
Commercial kitchen hoods other than grease	3
Laboratory hoods	4[a]
Hydraulic elevator machine room	2

a. Air Class 4 unless determined otherwise by the Environmental Health and Safety professional responsible to the owner or to the owner's designee.

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.

DECLARATION OF SERVICE BY EMAIL

I, the undersigned, declare as follows:

I am a resident of the County of Sacramento and I am over the age of 18 years, and not a party to the within action. My place of employment is 980 Ninth Street, Suite 300, Sacramento, California 95814.

On March 14, 2024, I served the:

- **Current Mailing List dated February 16, 2024**
- **Claimant's Rebuttal Comments filed March 14, 2024**

  Heating, Ventilation, and Air Conditioning (HVAC) Program, 23-TC-01
  Statutes 2022, Chapter 777, Sections 1, 2 (AB 2232);
  Education Code Sections 17660, 17661, Effective January 1, 2023
  Hesperia Unified School District, Claimant

by making it available on the Commission's website and providing notice of how to locate it to the email addresses provided on the attached mailing list.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that this declaration was executed on March 14, 2024 at Sacramento, California.

David Chavez
Commission on State Mandates
980 Ninth Street, Suite 300
Sacramento, CA 95814
(916) 323-3562

COMMISSION ON STATE MANDATES

Mailing List

Last Updated: 2/16/24

Claim Number: 23-TC-01

Matter: Heating, Ventilation, and Air Conditioning (HVAC) Program

Claimant: Hesperia Unified School District

TO ALL PARTIES, INTERESTED PARTIES, AND INTERESTED PERSONS:

Each commission mailing list is continuously updated as requests are received to include or remove any party or person on the mailing list. A current mailing list is provided with commission correspondence, and a copy of the current mailing list is available upon request at any time. Except as provided otherwise by commission rule, when a party or interested party files any written material with the commission concerning a claim, it shall simultaneously serve a copy of the written material on the parties and interested parties to the claim identified on the mailing list provided by the commission. (Cal. Code Regs., tit. 2, § 1181.3.)

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September 3, 2024

Exhibit D

Mr. Chris Hill
Department of Finance
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Mr. Arthur M. Palkowitz
Law Offices of Arthur M. Palkowitz
12807 Calle de la Siena
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And Parties, Interested Parties, and Interested Persons (See Mailing List)

Re: Draft Proposed Decision, Schedule for Comments, and Notice of Hearing
Heating, Ventilation, and Air Conditioning (HVAC) Program, 23-TC-01
Statutes 2022, Chapter 777, Sections 1, 2 (AB 2232);
Education Code Sections 17660, 17661, Effective January 1, 2023
Hesperia Unified School District, Claimant

Dear Mr. Hill and Mr. Palkowitz:

The Draft Proposed Decision for the above-captioned matter is enclosed for your review and comment.

Written Comments

Written comments may be filed on the Draft Proposed Decision no later than **5:00 pm on September 24, 2024**. Please note that all representations of fact submitted to the Commission must be signed under penalty of perjury by persons who are authorized and competent to do so and must be based upon the declarant's personal knowledge, information, or belief. (Cal. Code Regs., tit. 2, § 1187.5.) Hearsay evidence may be used for the purpose of supplementing or explaining other evidence but shall not be sufficient in itself to support a finding unless it would be admissible over an objection in civil actions. (Cal. Code Regs., tit. 2, § 1187.5.) The Commission's ultimate findings of fact must be supported by substantial evidence in the record.[1]

You are advised that comments filed with the Commission are required to be electronically filed (e-filed) in an unlocked legible and searchable PDF file, using the Commission's Dropbox. (Cal. Code Regs., tit. 2, § 1181.3(c)(1).) Refer to https://www.csm.ca.gov/dropbox.shtml on the Commission's website for electronic filing instructions. If e-filing would cause the filer undue hardship or significant prejudice, filing may occur by first class mail, overnight delivery or personal service only upon approval of a written request to the executive director. (Cal. Code Regs., tit. 2, § 1181.3(c)(2).)

If you would like to request an extension of time to file comments, please refer to section 1187.9(a) of the Commission's regulations.

[1] Government Code section 17559(b), which provides that a claimant or the state may commence a proceeding in accordance with the provisions of section 1094.5 of the Code of Civil Procedure to set aside a decision of the Commission on the ground that the Commission's decision is not supported by substantial evidence in the record.

Commission on State Mandates
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Hearing

This matter is set for hearing on **Friday, November 22, 2024**, at 10:00 a.m. The Proposed Decision will be issued on or about November 8, 2024.

Please notify Commission staff not later than the Wednesday prior to the hearing that you or a witness you are bringing plan to testify and please specify the names of the people who will be speaking for inclusion on the witness list. When calling or emailing, please identify the item you want to testify on and the entity you represent. The Commission Chairperson reserves the right to impose time limits on presentations as may be necessary to complete the agenda.

If you would like to request postponement of the hearing, please refer to section 1187.9(b) of the Commission's regulations.

Sincerely,

Heather Halsey
Executive Director

ITEM ___

TEST CLAIM

DRAFT PROPOSED DECISION

Education Code Sections 17660, 17661

Statutes 2022, Chapter 777, Sections 1 and 2 (AB 2232), Effective January 1, 2023

Heating, Ventilation, and Air Conditioning (HVAC) Program

23-TC-01

Hesperia Unified School District, Claimant

EXECUTIVE SUMMARY

Overview

This Test Claim alleges new state-mandated activities and costs resulting from Education Code sections 17660 and 17661 as added by Statutes 2022, chapter 777 (the test claim statute), effective January 1, 2023. The test claim statute generally requires school districts to ensure school facilities have HVAC systems meeting the minimum ventilation rate requirements in the Energy Code and to install the highest efficiency MERV filters feasible for their systems to "provide healthy indoor air quality, including adequate ventilation, to students, teachers, and other occupants in order to protect occupant health, reduce sick days, and improve student productivity and performance."[1]

For reasons stated in the analysis, staff finds the test claim statute does not impose a reimbursable state-mandated program within the meaning of article XIII B, section 6 of the California Constitution and Government Code section 17514 and recommends the Commission deny this Test Claim.

Procedural History

The claimant filed the Test Claim on November 17, 2023.[2] The Department of Finance (Finance) filed comments on the Test Claim on February 15, 2024.[3] The claimant filed rebuttal comments on March 14, 2024.[4]

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[1] Education Code section 17660 (Stats. 2022, ch. 777). Statutory references are to the Education Code unless otherwise indicated.

[2] Exhibit A, Test Claim, filed November 17, 2023, page 1.

[3] Exhibit B, Finance's Comments on the Test Claim, filed February 15, 2024, page 1.

[4] Exhibit C, Claimant's Rebuttal Comments, filed March 14, 2024, page 1.

Commission staff issued the Draft Proposed Decision on September 3, 2024.[5]

Commission Responsibilities

Under article XIII B, section 6 of the California Constitution, local agencies and school districts are entitled to reimbursement for the costs of state-mandated new programs or higher levels of service. For local government to be eligible for reimbursement, one or more similarly situated local agencies or school districts must file a test claim with the Commission. "Test claim" means the first claim filed with the Commission alleging a particular statue or executive order imposes costs mandated by the state. Test claims function similarly to class actions and all members of the class have the opportunity to participate in the test claim process and all are bound by the final decision of the Commission for purposes of that test claim.

The Commission is the quasi-judicial body vested with exclusive authority to adjudicate disputes over the existence of state-mandated programs within the meaning of article XIII B, section 6 of the California Constitution and not apply it as an "equitable remedy to cure the perceived unfairness resulting from political decisions on funding priorities."[6]

Claims

The following chart provides a brief summary of the claims and issues raised and staff's recommendation.

Issue	Description	Staff Recommendation
Was the Test Claim timely filed?	Government Code section 17551(c) requires test claims "be filed not later than 12 months following the effective date of a statute or executive order, or within 12 months of incurring increased costs as a result of a statute or executive order, whichever is later." Section 1183.1(c) of the Commission's regulations defines "12 months" as 365 days.	*Timely filed* - The test claim statute became effective on January 1, 2023.[7] The Test Claim was filed on November 17, 2023,[8] within 12 months of the effective date so the test claim was timely filed. The November 17, 2023 filing date establishes reimbursement eligibility for the 2022-2023 fiscal year, but because the test claim statute became effective on January 1, 2023, the potential period of

[5] Exhibit D, Draft Proposed Decision, issued September 3, 2024.

[6] *County of Sonoma v. Commission on State Mandates* (2000) 84 Cal.App.4th 1264, 1281, citing *City of San Jose v. State of California* (1996) 45 Cal.App.4th 1802, 1817.

[7] Statutes 2022, chapter 777.

[8] Exhibit A, Test Claim, filed November 17, 2023, page 1.

Issue	Description	Staff Recommendation
		reimbursement begins January 1, 2023.
Does Education Code section 17660 and uncodified section 1, as added by the test claim statute, impose a reimbursable state mandate?	Section 17660, as added by the test claim statute, declares "the policy of the state that school facilities provide healthy indoor air quality, including adequate ventilation, to students, teachers, and other occupants in order to protect occupant health, reduce sick days, and improve student productivity and performance."[9] Similarly, uncodified section 1 of the test claim statute consists of legislative declarations regarding studies on poor classroom air quality and cites the labor code and building code regarding schools' responsibilities to ensure air quality measures.	*Deny* - Reimbursement under article XIII B, section 6 is only required if a state statute or executive order requires or "mandates" local agencies or school districts to perform an activity.[10] Section17660 and section 1 of the test claim statute do not require school districts to perform any activities, so state reimbursement is not required.
Does Education Code section 17661 (a), (d), and (e), as added by the test claim statute, impose a reimbursable state mandate?	Section 17661(a) defines "covered school," "HVAC," and "MERV," as used in the test claim statute. Section 17661(d) requires the California Building Standards Commission and the Division of the State Architect to research, develop, and propose for adoption mandatory standards for carbon dioxide	*Deny* - Reimbursement under article XIII B, section 6 is only required if a state statute or executive order requires or "mandates" local agencies or school districts to perform an activity.[11] Education Code section 17661(a), (d), and (e), does not require school districts to perform any activities, so no

[9] Education Code section 17660 (Stats 2022, ch. 777).

[10] *San Diego Unified School Dist. v. Commission on State Mandates* (2004) 33 Cal.4th 859, 874.

[11] *San Diego Unified School Dist. v. Commission on State Mandates* (2004) 33 Cal.4th 859, 874.

Issue	Description	Staff Recommendation
	monitors in classrooms on the next triennial update of the California Building Standards Code. Section 17661(e) states: "This section shall apply to the University of California only to the extent that the Regents of the University of California, by resolution, make it applicable."	state reimbursement is required.
Does Education Code section 17661(b) impose a reimbursable state-mandated program?	Section 17661(b)(1) requires school districts and county offices of education to ensure facilities, including but not limited to classrooms, have HVAC systems that meet the minimum ventilation rate requirements in Table 120.1-A of part 6 of title 24 of the California Code of Regulations, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate. Section 17661(b)(2) requires a school incapable of meeting the minimum ventilation rates in Table 120.1-A to ensure its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued; and document the HVAC system's inability to meet the current ventilation standards in the annual HVAC inspection report required by section 5142 of	*Deny* - The requirement in Education Code section 17661(b)(2), to inspect the HVAC systems to ensure they meet the minimum ventilation rates *in effect when the building permit for HVAC installation was issued* is not new and does not impose a new program or higher level of service. Although the requirements in sections 17661(b)(1) and (b)(2) to inspect HVAC systems to ensure compliance with the *current* minimum ventilation rates in Table 120.1-A of part 6 of the title 24 regulations and document in the annual inspection report the system's inability to meet *current* ventilation standards in Table 120.1-A is new for school districts with HVAC systems approved for installation *before* January 1, 2020 (under the 2016 or earlier Energy Code), there is no evidence in the record of increased costs mandated by the state. The

Issue	Description	Staff Recommendation
	title 8 of the California Code of Regulations, which shall be available to the public upon request.	claimant identifies no costs in the Test Claim or the attached declaration to comply with the section 17661(b) requirements to inspect the HVAC systems for compliance with current standards and document the system's inability to meet current standards.[12]
Does Education Code section 17661(c) impose a reimbursable state-mandated program?	Under section 17661(c), school districts are required to install MERV 13 air filtration or the highest filtration feasible and appropriate for the existing HVAC system, as determined by the school. Or if it is determined the existing HVAC system is not designed to achieve MERV levels of 13 or higher, the school district shall install filtration that achieves the highest MERV level the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system.	*Deny* – The MERV 13 requirement in Education Code section 17661(c) is *not* new to the extent a school received a permit or equivalent approval to install a new HVAC system under the 2019 or 2022 Energy Code (i.e., on or after Jan. 1, 2020) because those Codes already required the HVAC system to have filters with a designated efficiency equal to or greater than MERV 13.[13] Prior law also required these filters be replaced or cleaned regularly.[14] In addition, the MERV 13 requirement is *not* new if there was a COVID-19 outbreak in the school. When the test claim statute became effective on January 1, 2023, MERV 13 filters were required for schools that had a COVID-19 outbreak (meaning three

[12] Exhibit A, Test Claim, filed November 17, 2023, page 13, 18-19 (Landon Declaration).

[13] California Code of Regulations, title 24, part 6, section 120.1(c)(1)(B). The citation is the same under both the 2019 and 2022 Energy Codes.

[14] California Code of Regulations, title 8, section 5143(d)(3). (Register 2003, No. 24.)

Issue	Description	Staff Recommendation
		or more *employee* COVID-19 cases within an exposed group, as defined, who visited the worksite during their infectious period any time during a 14-day period).[15] Under these circumstances, existing regulations required the school to comply with the same filtration requirements as the test claim statute.[16] Therefore, the requirement in Education Code section 17661(c) is new only for schools with HVAC systems approved for installation *before* January 1, 2020 (under the 2016 or earlier Energy Code), and only to the extent these schools did *not* have a COVID-19 outbreak as defined in the title 8 regulations.[17] However, there is no evidence of increased costs mandated by the state in accordance with Government Code section 17514 and section 1183.1(e) of the Commission's regulations to comply with the new requirement.

[15] California Code of Regulations, title 8, section 3205.1(a)(1) (Register 2022, No. 18, eff. May 5, 2022).

[16] California Code of Regulations, title 8, section 3205.1(f) (Register 2022, No. 18, eff. May 5, 2022).

[17] California Code of Regulations, title 8, section 3205.1(f) (Register 2022, No. 18, eff. May 5, 2022).

Staff Analysis

The test claim statute, effective January 1, 2023, seeks to further the declared "policy of the state that school facilities provide healthy indoor air quality, including adequate ventilation, to students, teachers, and other occupants in order to protect occupant health, reduce sick days, and improved student productivity and performance."[18] To do this, the test claim statute adds section 17661(b) to the Education Code to require 'covered schools' (defined as "a school district, a county office of education, a charter school, a private school, the California Community Colleges, or the California State University")[19] to:

> [E]nsure that facilities, including but not limited to, classrooms for students, have HVAC systems that meet the minimum ventilation rate requirements set forth in Table 120.1-A of Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate.[20]

If a school's existing HVAC system is incapable of meeting the minimum ventilation rate standard in Table 120.1-A of Part 6 (commencing with Section 100.0) of title 24, then the school district is required to:

> [E]nsure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued [and;]

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[18] Education Code section 17660 (Stats 2022, ch. 777).

[19] Under Government Code section 17514, "school districts" are eligible to seek reimbursement for state-mandated new programs or higher levels of service within the meaning of article XIII B, section 6 of the California Constitution. Government Code section 17519 defines "school district," as "any school district. . . , or county superintendent of schools." The county superintendent of schools is the executive officer of the county office of education. (Ed. Code, § 1010.) County offices of education provide alternative educational programs for pupils attending county community schools who have been expelled from school, referred as a condition of probation, or who are homeless. (Ed. Code, § 1981, 1984, 48852.7, 48859.) Thus, this Decision applies to K-12 school districts and county offices of education, referred to as "school districts."

The definition of "covered schools" in section 17661(a)(1) also includes the California Community Colleges. A test claim has not been filed by a community college district. Therefore, the Commission makes no findings with respect to community college districts.

[20] Education Code section 17661(b)(1) (Stats 2022, ch. 777). The incorporation by reference of a table in "Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations" refers to California's Building Standards Code. Part 2 of title 24 is known as the "Building Code."

> [D]ocument the HVAC system's inability to meet the current ventilation standards set forth in paragraph (1) (i.e., in the current version of Table 120.1-A of Part 6 of Title 24) in the annual HVAC inspection report required by Section 5142 of Title 8 of the California Code of Regulations, which shall be available to the public upon request.[21]

A covered school is also required to:

> [I]nstall filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school.
>
> If . . . it is determined that the existing HVAC system is not designed to achieve MERV levels of 13 or higher, a covered school shall install filtration that achieves the highest MERV level that the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system.[22]

The Test Claim was timely filed on November 17, 2023.[23] This filing date establishes reimbursement eligibility for the 2022-2023 fiscal year,[24] but because the test claim statute became effective on January 1, 2023, the potential period of reimbursement begins January 1, 2023.

Staff finds Education Code sections 17660 (which states the Legislature's findings and declarations) and 17661(a), (d), and (e), as well as uncodified section 1 of the test claim statute, impose no requirements on school districts so they do not constitute a state-mandated program.

Staff finds Education Code section 17661(b) does not impose a reimbursable state-mandated program for the following reasons:

- The requirement in Education Code section 17661(b)(2), requiring schools to inspect to "[e]nsure that its HVAC system meets the minimum ventilation rates *in effect at the time the building permit for installation of that HVAC system was issued*" is *not* new and does not impose a new program or higher level of service. Since 1987, section 5142(b) of the title 8 regulations has required employers, including school districts, to conduct annual workplace inspections to ensure compliance with the minimum ventilation rate requirements in effect at the time

[21] Education Code section 17661(b)(2) (Stats 2022, ch. 777).

[22] Education Code section 17661(c) (Stats 2022, ch. 777). MERV is the minimum efficiency reporting value as determined by ASHRAE [American Society of Heating, Refrigerating, and Air Conditioning Engineers] Standard 52.2 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. (Cal.Code Regs., tit. 23, pt. 6, § 100.1(b)).

[23] Exhibit A, Test Claim, filed November 17, 2023, page 1.

[24] Government Code section 17557(e) requires a test claim be submitted on or before June 30 following a given fiscal year to establish eligibility for that fiscal year.

the building permit was issued, with inspections and maintenance to be documented in writing.[25]

- The requirements in Education Code section 17661(b)(1) and (b)(2), to inspect HVAC systems to ensure compliance with the *current* minimum ventilation rates in Table 120.1-A of part 6 of title 24 of the California Code of Regulations, as adopted in 2022, and to document the system's inability to meet the *current* ventilation standards in the annual inspection report required by section 5142 of Title 8 of the California Code of Regulations, are ***not* new** and do not impose a new program or higher level of service for school districts that received a permit or equivalent approval for HVAC installation under the 2019 or 2022 Energy Codes (***for HVAC systems approved on or after January 1, 2020***).

  Under existing law, schools were already required to conduct annual inspections to ensure the HVAC system provides "at least the quantity of outdoor air required by . . . Title 24, . . . in effect at the time the building permit was issued" and to document that inspection in writing.[26] Since Table 120.1-A in the 2019 and 2022 Energy Codes are the same, the requirements in the test claim statute to perform the same activities are not new.[27]

- Regarding the requirements in Education Code section 17661(b)(1) and (b)(2), for school districts that received a permit or equivalent approval for an HVAC installation under the 2016 or earlier Energy Code (approved *before* January 1, 2020), to inspect HVAC systems to ensure compliance with the *current* minimum ventilation rates in Table 120.1-A of part 6 of title 24 of the California Code of Regulations, as adopted in 2022, and to document the system's inability to meet the *current* ventilation standards in the annual inspection report required by section 5142 of title 8 of the California Code of Regulations, there is no evidence of increased costs mandated by the state to comply with these requirements in accordance with Government Code section 17514 and section 1183.1(e) of the Commission's regulations. The claimant

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[25] California Code of Regulations, title 8, section 5142 (Register 87, No. 2). Section 5142 is a general industrial safety order (see Cal. Code Regs., tit. 8, § 3200 et. seq.). GISOs apply to ". . . all employments and places of employment in California as defined by Labor Code Section 6303. . . " See also, the Leroy F. Greene School Facilities Act of 1998 and the State School Building Lease Purchase Law of 1976, which require school construction project plans for "major maintenance, repair and replacement," to keep school facilities in "good repair," including heating and cooling systems. (Ed. Code §§ 17002(d)(1)(B), 17014(c), 17075(a), 17070.77(a)-(b); Exhibit X (9), Office of Public School Construction, Facility Inspection Tool, revised April 2022, https://www.dgs.ca.gov/-/media/Divisions/OPSC/Forms/Facility-Inspection-Tool---SAB-Approved-04-27-2022.pdf (accessed on May 1, 2024).)

[26] California Code of Regulations, title 8, section 5142. Emphasis added.

[27] California Code of Regulations, title 24, part 6, section 120.1(h), Table 120.1-A. In the 2019 code, Table 120.1-A is at section 120.1(g).

identifies no costs in the Test Claim or the attached declaration to comply with the section 17661(b) requirements to inspect the HVAC systems for compliance with current standards and document the system's inability to meet current standards.[28]

The Commission further finds reimbursement is not required to comply with Education Code section 17661(c), which requires school districts to install MERV 13 or the highest filtration the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system. Under prior law, the 2016 Energy Code did not require filters rated at MERV 13 or higher.[29] The 2019 amendment to the Energy Code (eff. Jan. 1, 2020) set the minimum requirement to MERV 13.[30] However, reimbursement under article XIII B, section 6 is not required because:

- The MERV 13 requirement in Education Code section 17661(c) is *not* new to the extent a school received a permit or equivalent approval to install a new HVAC system under the 2019 or 2022 Energy Code (i.e., on or after Jan. 1, 2020) because those Codes already required the HVAC system to have filters with a designated efficiency equal to or greater than MERV 13.[31] Prior law also required air filters be replaced or cleaned regularly.[32]
- In addition, the MERV 13 requirement is *not* new if there was a COVID-19 outbreak in the school. At the time the test claim statute became effective on January 1, 2023, MERV 13 filters were required for schools that had a COVID-19 outbreak (meaning three or more *employee* COVID-19 cases within an exposed group, as defined, who visited the worksite during their infectious period any time during a 14-day period).[33] Under these circumstances, existing regulations required the school to comply with the same filtration requirements as the test claim statute.[34]
- Therefore, the requirement in Education Code section 17661(c) is new only for schools with HVAC systems approved for installation *before* January 1, 2020 (under the 2016 or earlier Energy Code), and only to the extent these schools did

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[28] Exhibit A, Test Claim, filed November 17, 2023, page 13, 18-19 (Landon Declaration).

[29] Exhibit X (3), California Energy Commission, 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings, page 241.

[30] Exhibit X (8), International Code Council, *Significant Changes to the California Energy Code*, 2019 Edition, May 2021, pages 91-92.

[31] California Code of Regulations, title 24, part 6, section 120.1(c)(1)(B). The citation is the same under both the 2019 and 2022 Energy Codes.

[32] California Code of Regulations, title 8, section 5143(d)(3) (Register 2003, No. 24).

[33] California Code of Regulations, title 8, section 3205.1(a)(1) (Register 2022, No. 18, eff. May 5, 2022).

[34] California Code of Regulations, title 8, section 3205.1(f) (Register 2022, No. 18, eff. May 5, 2022).

not have a COVID-19 outbreak as defined in the title 8 regulations.[35] Although the claimant alleges the test claim statute requires school districts to replace the MERV 13 filters more often than every three months,[36] the requirement imposed by Education Code section 17661(c) is a *one-time* requirement to purchase and install the required filters since prior law already required employers, including school districts, to regularly replace or clean air filters, regardless of the filter efficiency level.[37] On-going filter purchase and installation is not new.[38]

However, there is no evidence of increased costs mandated by the state in accordance with Government Code section 17514 and section 1183.1(e) of the Commission's regulations. The claimant's Test Claim does not acknowledge any prior law requirements to install MERV 13 filters when a new HVAC system is approved for installation under the 2019 or 2022 Energy Code or when a COVID outbreak occurs, or the existing requirement to regularly replace or clean these filters. Instead, the Test Claim alleges increased costs, supported by a declaration from the claimant's Deputy Superintendent of Business Services, for the costs to install MERV 13 filters in *all* of its schools' HVAC systems since January 1, 2023.[39]

The Declaration submitted by the claimant also identifies revenues received under the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) that provides funding to Local Education Agencies through the Elementary and Secondary School Emergency Relief (ESSER) Fund to address the impact of COVID-19 on elementary and secondary schools. The claimant used these funds to *replace* HVAC systems, beginning in June 2021, and to purchase MERV 13 filters.[40] What this evidence shows is the claimant has schools *not* subject to the newly mandated requirement since any new HVAC installation approved beginning in June 2021 would have been approved under the 2019 and 2022 Energy Codes. As indicated above, the MERV 13 requirement in Education Code section 17661(c) is *not* new and does not mandate a new program or

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[35] California Code of Regulations, title 8, section 3205.1(f) (Register 2022, No. 18, eff. May 5, 2022).

[36] Exhibit A, Test Claim, filed November 17, 2023, page 13.

[37] California Code of Regulations, title 8, section 5143 (as last amended by Register 2003, No. 24.)

[38] Even if purchasing and installing MERV 13 filters is more costly, as asserted by the claimant, increased costs alone do not establish the right to reimbursement under article XIII B, section 6 of the California Constitution. (*County of Los Angeles v. State of California* (1987) 43 Cal.3d 46, 54; *Department of Finance v. Commission on State Mandates* (*Kern High School Dist.*) (2003) 30 Cal.4th 727, 735; *San Diego Unified School Dist. v. Commission on State Mandates* (2004) 33 Cal.4th 859, 876-877.)

[39] Exhibit A, Test Claim, filed November 17, 2023, pages 13, 14, 18-19 (Landon Declaration); Exhibit C, Claimant's Rebuttal Comments, filed March 14, 2024, pages 2, 5 (Landon Declaration).

[40] Exhibit A, Test Claim, filed November 17, 2023, page 20 (Landon Declaration).

higher level of service to the extent a school received a permit or equivalent approval to install a new HVAC system after January 1, 2020 (under the 2019 or 2022 Energy Code) because those Codes already required the HVAC system to have filters with a designated efficiency equal to or greater than MERV 13.[41]

> However, there is *no* evidence in the record the claimant has incurred any increased costs mandated by the state to perform the one-time activity to install filtration that achieves MERV levels of 13 or higher or install filtration that achieves the highest MERV level the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system, in schools that have HVAC systems approved for installation *before* January 1, 2020 (under the 2016 or earlier Energy Code), and only to the extent these schools did *not* have a COVID-19 outbreak as defined in section 3205.1 of the title 8 regulations. The Commission cannot make a finding of increased costs mandated by the state without evidence in the record.[42]

Conclusion

Staff finds the test claim statute does not impose a reimbursable state-mandated program within the meaning of article XIII B, section 6 of the California Constitution and Government Code section 17514.

Staff Recommendation

Staff recommends the Commission adopt the Proposed Decision to deny the Test Claim and authorize staff to make any technical, non-substantive changes to the Proposed Decision following the hearing.

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[41] California Code of Regulations, title 24, part 6, section 120.1(c)(1)(B). The citation is the same under both the 2019 and 2022 Energy Codes.

[42] Government Code section 17514; California Code of Regulations, title 2, section 1183.1(e).

BEFORE THE
COMMISSION ON STATE MANDATES
STATE OF CALIFORNIA

IN RE TEST CLAIM Education Code Sections 17660, 17661 Statutes 2022, Chapter 777, Sections 1 and 2 (AB 2232), Effective January 1, 2023 Filed on November 17, 2023 Hesperia Unified School District, Claimant	Case No.: 23-TC-01 *Heating, Ventilation, and Air Conditioning (HVAC) Program* DECISION PURSUANT TO GOVERNMENT CODE SECTION 17500 ET SEQ.; CALIFORNIA CODE OF REGULATIONS, TITLE 2, DIVISION 2, CHAPTER 2.5, ARTICLE 7. (*Adopted November 22, 2024*)

DECISION

The Commission on State Mandates (Commission) heard and decided this Test Claim during a regularly scheduled hearing on November 22, 2024. [Witness list will be included in the adopted Decision.]

The law applicable to the Commission's determination of a reimbursable state-mandated program is article XIII B, section 6 of the California Constitution, Government Code sections 17500 et seq., and related case law.

The Commission [adopted/modified] the Proposed Decision to [approve/partially approve/deny] the Test Claim by a vote of [vote will be included in the adopted Decision], as follows:

Member	Vote
Lee Adams, County Supervisor	
Shannon Clark, Representative of the Director of the Office of Planning and Research	
Deborah Gallegos, Representative of the State Controller	
Renee Nash, School District Board Member	
William Pahland, Representative of the State Treasurer, Vice Chairperson	
Michelle Perrault, Representative of the Director of the Department of Finance, Chairperson	

Summary of the Findings

The test claim statute, effective January 1, 2023, seeks to further the declared "policy of the state that school facilities provide healthy indoor air quality, including adequate ventilation, to students, teachers, and other occupants in order to protect occupant health, reduce sick days, and improved student productivity and performance."[43] To do this, the test claim statute adds section 17661(b) to the Education Code to require 'covered schools' (defined to include school districts and county offices of education) to:

> [E]nsure that facilities, including but not limited to, classrooms for students, have HVAC [defined as heating, ventilation, and air conditioning] systems that meet the minimum ventilation rate requirements set forth in Table 120.1-A of Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate.[44]

If a school's existing HVAC system is incapable of meeting the minimum ventilation rate standard in Table 120.1-A of part 6 (commencing with section 100.0) of title 24, then the school district is required to:

> [E]nsure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued . . . [and;];
>
> [D]ocument the HVAC system's inability to meet the current ventilation standards set forth in paragraph (1) [i.e., in the current version of Table 120.1-A of Part 6 of Title 24] in the annual HVAC inspection report required by Section 5142 of Title 8 of the California Code of Regulations, which shall be available to the public upon request.[45]

A covered school is also required by Education Code section 17661(c) to:

> [I]nstall filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school.
>
> If . . . it is determined that the existing HVAC system is not designed to achieve MERV levels of 13 or higher, a covered school shall install filtration that achieves the highest MERV level that the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system.[46]

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[43] Education Code section 17660 (Stats 2022, ch. 777).

[44] Education Code section 17661(b)(1) (Stats 2022, ch. 777). The incorporation by reference of a table in "Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations" refers to California's Building Standards Code. Part 2 of title 24 is known as the "Building Code."

[45] Education Code section 17661(b)(2) (Stats 2022, ch. 777).

[46] Education Code section 17661(c) (Stats 2022, ch. 777). MERV is the minimum efficiency reporting value as determined by ASHRAE [American Society of Heating, Refrigerating, and Air Conditioning Engineers] Standard 52.2 Method of Testing

The test claim was timely filed on November 17, 2023.[47] This filing date establishes reimbursement eligibility for the 2022-2023 fiscal year,[48] but because the test claim statute became effective on January 1, 2023, the potential period of reimbursement begins January 1, 2023.

The Commission finds Education Code sections 17660 (which states the Legislature's findings and declarations) and 17661(a), (d), and (e), as well as uncodified section 1 of the test claim statute, impose no requirements on school districts so they do not constitute a state-mandated program.

The Commission further finds Education Code section 17661(b) does not impose a reimbursable state-mandated program because:

- The requirement in Education Code section 17661(b)(2), requiring schools to inspect to "[e]nsure that its HVAC system meets the minimum ventilation rates *in effect at the time the building permit for installation of that HVAC system was issued*" is *not* new and does not impose a new program or higher level of service. Since 1987, section 5142(b) of the title 8 regulations has required employers, including school districts, to conduct annual workplace inspections to ensure compliance with the minimum ventilation rate requirements in effect at the time the building permit was issued, with inspections and maintenance to be documented in writing.[49]
- The requirements in Education Code section 17661(b)(1) and (b)(2), to inspect HVAC systems to ensure compliance with the *current* minimum ventilation rates set forth in Table 120.1-A of part 6 of Title 24 of the California Code of Regulations, as adopted in 2022, and to document the system's inability to meet the *current* ventilation standards in the annual inspection report required by section 5142 of Title 8 of the California Code of Regulations, are *not* new and do

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General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. (Cal. Code Regs., tit. 23, pt. 6, § 100.1(b).)

[47] Exhibit A, Test Claim, filed November 17, 2023, page 1.

[48] Government Code section 17557(e) requires a test claim be submitted on or before June 30 following a given fiscal year to establish eligibility for that fiscal year.

[49] California Code of Regulations, title 8, section 5142 (Register 87, No. 2). Section 5142 is a general industrial safety order (see Cal. Code Regs., tit. 8, § 3200 et. seq.). GISOs apply to ". . . all employments and places of employment in California as defined by Labor Code Section 6303. . . " See also, the Leroy F. Greene School Facilities Act of 1998 and the State School Building Lease Purchase Law of 1976, which require school construction project plans for "major maintenance, repair and replacement," to keep school facilities in "good repair," including heating and cooling systems. (Ed. Code §§ 17002(d)(1)(B), 17014(c), 17075(a), 17070.77(a)-(b); Exhibit X (9), Office of Public School Construction, Facility Inspection Tool, revised April 2022, https://www.dgs.ca.gov/-/media/Divisions/OPSC/Forms/Facility-Inspection-Tool---SAB-Approved-04-27-2022.pdf (accessed on May 1, 2024).)

not impose a new program or higher level of service for school districts that received a permit or equivalent approval for HVAC installation under the 2019 or 2022 Energy Codes (for HVAC systems approved *on or after* January 1, 2020).

Under existing law, schools were already required to conduct annual inspections to ensure the HVAC system provides "at least the quantity of outdoor air required by . . . Title 24, . . . in effect at the time the building permit was issued" and to document that inspection in writing.[50] Since Table 120.1-A in the 2019 and 2022 Energy Codes are the same, the requirements in the test claim statute to perform the same activities are not new.[51]

- Regarding the requirements in Education Code section 17661(b)(1) and (b)(2), for school districts that received a permit or equivalent approval for an HVAC installation under the 2016 or earlier Energy Code (approved *before* January 1, 2020), to inspect HVAC systems to ensure compliance with the *current* minimum ventilation rates set forth in Table 120.1-A of part 6 of Title 24 of the California Code of Regulations, as adopted in 2022, and to document the system's inability to meet the *current* ventilation standards in the annual inspection report required by section 5142 of Title 8 of the California Code of Regulations, there is no evidence of increased costs mandated by the state to comply with these activities in accordance with Government Code section 17514 and section 1183.1(e) of the Commission's regulations. The claimant identifies no costs in the Test Claim or the attached declaration to comply with the section 17661(b) requirements to inspect the HVAC systems for compliance with current standards and document the system's inability to meet current standards.[52]

The Commission further finds reimbursement is not required to comply with Education Code section 17661(c), which requires school districts to install MERV 13 or the highest filtration the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system. Under prior law, the 2016 Energy Code did not require filters rated at MERV 13 or higher.[53] The 2019 amendment to the Energy Code (eff. Jan. 1, 2020) set the minimum requirement to MERV 13.[54] However, reimbursement under article XIII B, section 6 is not required because:

- The MERV 13 requirement in Education Code section 17661(c) is *not* new to the extent a school received a permit or equivalent approval to install a new HVAC system under the 2019 or 2022 Energy Code (i.e., on or after Jan. 1, 2020)

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[50] California Code of Regulations, title 8, section 5142. Emphasis added.

[51] California Code of Regulations, title 24, part 6, section 120.1(h), Table 120.1-A. In the 2019 code, Table 120.1-A is at section 120.1(g).

[52] Exhibit A, Test Claim, filed November 17, 2023, page 13, 18-19 (Landon Declaration).

[53] Exhibit X (3), California Energy Commission, 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings, page 241.

[54] Exhibit X (8), International Code Council, *Significant Changes to the California Energy Code*, 2019 Edition, May 2021, pages 91-92.

because those Codes already required the HVAC system to have filters with a designated efficiency equal to or greater than MERV 13.[55] Prior law also required these filters be replaced or cleaned regularly.[56]

- In addition, the MERV 13 requirement is *not* new if there was a COVID-19 outbreak in the school. At the time the test claim statute became effective on January 1, 2023, MERV 13 filters were required for schools that had a COVID-19 outbreak (meaning three or more *employee* COVID-19 cases within an exposed group, as defined, who visited the worksite during their infectious period any time during a 14-day period).[57] Under these circumstances, existing regulations required the school to comply with the same filtration requirements as the test claim statute.[58]
- Therefore, the requirement in Education Code section 17661(c) is new only for schools with HVAC systems approved for installation *before* January 1, 2020 (under the 2016 or earlier Energy Code), and only to the extent these schools did *not* have a COVID-19 outbreak as defined in the title 8 regulations.[59] Although the claimant alleges the test claim statute requires school districts to replace the MERV 13 filters more often and every three months,[60] the requirement imposed by Education Code section 17661(c) is a *one-time* requirement to purchase and install the required filters since prior law already required employers, including school districts, to regularly replace or clean filters, regardless of the filter efficiency level.[61] On-going filter purchase and installation is not new.[62]

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[55] California Code of Regulations, title 24, part 6, section 120.1(c)(1)(B). The citation is the same under both the 2019 and 2022 Energy Codes.

[56] California Code of Regulations, title 8, section 5143(d)(3) (Register 2003, No. 24).

[57] California Code of Regulations, title 8, section 3205.1(a)(1) (Register 2022, No. 18, eff. May 5, 2022).

[58] California Code of Regulations, title 8, section 3205.1(f) (Register 2022, No. 18, eff. May 5, 2022).

[59] California Code of Regulations, title 8, section 3205.1(f) (Register 2022, No. 18, eff. May 5, 2022).

[60] Exhibit A, Test Claim, filed November 17, 2023, page 13.

[61] California Code of Regulations, title 8, section 5143 (as last amended by Register 2003, No. 24.)

[62] Even if purchasing and installing MERV 13 filters is more costly, as asserted by the claimant, increased costs alone do not establish the right to reimbursement under article XIII B, section 6 of the California Constitution. (*County of Los Angeles v. State of California* (1987) 43 Cal.3d 46, 54; *Department of Finance v. Commission on State Mandates* (*Kern High School Dist.*) (2003) 30 Cal.4th 727, 735; *San Diego Unified School Dist. v. Commission on State Mandates* (2004) 33 Cal.4th 859, 876-877.)

> However, there is no evidence of increased costs mandated by the state in accordance with Government Code section 17514 and section 1183.1(e) of the Commission's regulations. The Test Claim does not acknowledge any prior law requirements to install MERV 13 filters when a new HVAC system is approved for installation under the 2019 or 2022 Energy Code or when a COVID outbreak occurs, or the existing requirement to regularly replace or clean these filters. Instead, the Test Claim alleges increased costs, supported by a declaration from the claimant's Deputy Superintendent of Business Services, for the costs to install MERV 13 filters in *all* of its schools' HVAC systems since January 1, 2023.[63]

The Declaration submitted by the claimant also identifies revenues received under the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) that provides funding to Local Education Agencies through the Elementary and Secondary School Emergency Relief (ESSER) Fund to address the impact of COVID-19 on elementary and secondary schools. The claimant used these funds to *replace* HVAC systems, beginning in June 2021, and to purchase MERV 13 filters.[64] What this evidence shows is the claimant has schools *not* subject to the new mandated requirement since any new HVAC installation approved beginning in June 2021 would have been approved under the 2019 and 2022 Energy Codes. As indicated above, the MERV 13 requirement in Education Code section 17661(c) is *not* new and does not mandate a new program or higher level of service to the extent a school received a permit or equivalent approval to install a new HVAC system after January 1, 2020 (under the 2019 or 2022 Energy Code) because those Codes already required the HVAC system to have filters with a designated efficiency equal to or greater than MERV 13.[65]

However, there is *no* evidence in the record the claimant has incurred any increased costs mandated by the state to perform the one-time activity to install filtration that achieves MERV levels of 13 or higher or install filtration that achieves the highest MERV level that the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system, in schools with HVAC systems approved for installation *before* January 1, 2020 (under the 2016 or earlier Energy Code), and only to the extent these schools did *not* have a COVID-19 outbreak as defined in section 3205.1 of the title 8 regulations. The Commission cannot make a finding of increased costs mandated by the state without evidence in the record.[66]

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[63] Exhibit A, Test Claim, filed November 17, 2023, pages 13, 14, 18-19 (Landon Declaration); Exhibit C, Claimant's Rebuttal Comments, filed March 14, 2024, pages 2, 5 (Landon Declaration).

[64] Exhibit A, Test Claim, filed November 17, 2023, page 20 (Landon Declaration).

[65] California Code of Regulations, title 24, part 6, section 120.1(c)(1)(B). The citation is the same under both the 2019 and 2022 Energy Codes.

[66] Government Code section 17514; California Code of Regulations, title 2, section 1183.1(e).

Accordingly, the Commission finds the test claim statute does not impose a reimbursable state-mandated program within the meaning of article XIII B, section 6 of the California Constitution and Government Code section 17514 and denies this Test Claim.

COMMISSION FINDINGS

I. Chronology

09/29/2022	Statutes 2022, chapter 777 was enacted.
11/17/2023	The claimant filed the Test Claim.[67]
02/15/2024	The Department of Finance (Finance) filed comments on the Test Claim.[68]
03/14/2024	The claimant filed rebuttal comments.[69]
09/03/2024	Commission staff issued the Draft Proposed Decision.[70]

II. Background

A. <u>The Test Claim Statute (Stats. 2022, ch. 777)</u>

The test claim statute, effective January 1, 2023, seeks to further the declared "policy of the state that school facilities provide healthy indoor air quality, including adequate ventilation, to students, teachers, and other occupants in order to protect occupant health, reduce sick days, and improved student productivity and performance."[71]

In doing so, the test claim statute adds section 17661(b) to the Education Code to require 'covered schools' (defined as "a school district, a county office of education, a charter school, a private school, the California Community Colleges, or the California State University")[72] to:

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[67] Exhibit A, Test Claim, filed November 17, 2023.

[68] Exhibit B, Finance Comments, filed February 15, 2024.

[69] Exhibit C, Claimant's Rebuttal Comments, filed March 14, 2024.

[70] Exhibit D, Draft Proposed Decision, issued September 3, 2024.

[71] Education Code section 17660 (Stats 2022, ch. 777).

[72] Under Government Code section 17514, "school districts" are eligible to seek reimbursement for state-mandated new programs or higher levels of service within the meaning of article XIII B, section 6 of the California Constitution. Government Code section 17519 defines "school district," as "any school district. . . , or county superintendent of schools." The county superintendent of schools is the executive officer of the county office of education. (Ed. Code, § 1010.) County offices of education provide alternative educational programs for pupils attending county community schools who have been expelled from school, referred as a condition of probation, or who are homeless. (Ed. Code, § 1981, 1984, 48852.7, 48859.) Thus, this

> [E]nsure that facilities, including but not limited to, classrooms for students, have HVAC systems that meet the minimum ventilation rate requirements set forth in Table 120.1-A of Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate.[73]

If a school's existing HVAC system is incapable of meeting the minimum ventilation rate standard in Table 120.1-A of part 6 (commencing with section 100.0) of title 24 of the California Code of Regulations, then the school district is required to:

> [E]nsure its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued . . . [and;]
>
> [D]ocument the HVAC system's inability to meet the current ventilation standards set forth in paragraph (1) (i.e., in the current version of Table 120.1-A of Part 6 of Title 24) in the annual HVAC inspection report required by Section 5142 of Title 8 of the California Code of Regulations, which shall be available to the public upon request.[74]

A covered school is also required by Education Code section 17661(c) to:

- [I]nstall filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school
- If . . . it is determined that the existing HVAC system is not designed to achieve MERV levels of 13 or higher, a covered school shall install filtration that achieves the highest MERV level that the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system.[75]

Decision applies to K-12 school districts and county offices of education, referred to as "school districts."

The definition of "covered schools" in section 17661(a)(1) also includes the California Community Colleges. A test claim has not been filed by a community college district. Therefore, the Commission makes no findings with respect to community college districts.

[73] Education Code section 17661(b)(1) (Stats 2022, ch. 777). The incorporation by reference of a table in "Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations" refers to California's Building Standards Code. Part 2 of title 24 is known as the "Building Code."

[74] Education Code section 17661(b)(2) (Stats 2022, ch. 777).

[75] Education Code section 17661(c) (Stats 2022, ch. 777). MERV is the minimum efficiency reporting value as determined by ASHRAE [American Society of Heating, Refrigerating, and Air Conditioning Engineers] Standard 52.2 Method of Testing

Finally, the test claim statute requires the California Building Standards Commission and the Division of the State Architect to research, develop, and propose for adoption mandatory standards for carbon dioxide monitors in classrooms of a covered school and the University of California on the next triennial update of the California Building Standards Code (title 24 of the California Code of Regulations).[76]

The test claim statute was enacted because "despite "laws requiring schools to maintain functional HVAC systems to supply adequate ventilation and safe indoor air quality, poor indoor air quality remains an extensive problem."[77] As described in the statute's legislative findings and declarations below, studies and reports indicate the minimum ventilation rates in classrooms were not being met:

> (b) In November 2003, the State Air Resources Board and the State Department of Health Care Services issued a report to the Legislature detailing the adverse impact that poor indoor air quality is having on California schools. The report found significant indoor air quality problems, including problems with ventilation, temperature, humidity, air pollutants, floor dust contaminants, moisture, mold, noise, and lighting. The report found that ventilation with outdoor air was inadequate during 40 percent of classroom hours and seriously deficient during 10 percent of classroom hours in both portable classrooms and traditional classrooms.
>
> (c) In February 2005, the State Air Resources Board approved an indoor air quality report that cites proven health and economic benefits to reducing indoor air pollution, which is estimated to cost California $45 billion per year. The report noted that children are particularly vulnerable to poor indoor air quality. According to the report, children under 12 years of age spend about 86 percent of their time indoors with 21 percent of the time being spent in schools.
>
> (d) A 2019 report by the University of California, Davis, Western Cooling Efficiency Center and the Indoor Environment Group of the Lawrence Berkeley National Laboratory identifies numerous studies finding that underventilation of classrooms is common and negatively impacts student health and learning. Improved heating, ventilation, and air conditioning (HVAC) system performance improves student and teacher health and attendance, student productivity, and the performance of mental tasks, such as better concentration and recall. The report found that students in classrooms with higher ventilation rates have a significantly higher percentage of students—13 to 14

General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. (Cal. Code Regs., tit. 23, pt. 6, § 100.1(b)).

[76] Education Code section 17661(d) (Stats 2022, ch. 777).

[77] Exhibit X (11), Senate Rules Committee, Office of Senate Floor Analyses, Third Reading Analysis of AB 2232, as amended June 28, 2022, page 3.

percent—scoring satisfactorily on mathematics and reading tests than students in classrooms with lower outdoor air ventilation rates.

(e) A 2018 report in the Environment International Journal found that short-term carbon dioxide exposure beginning at 1,000 parts per million (ppm) negatively affects cognitive performances, including decisionmaking and problem resolution. The Wisconsin Department of Health Services states that carbon dioxide levels between 1,000 and 2,000 ppm are associated with drowsiness and attention issues. Carbon dioxide levels above 2,000 ppm affect concentration and cause headaches, increased heart rate, and nausea.

(f) The California Building Energy Efficiency Standards set minimum ventilation rates for classrooms. Sections 17002 and 17070.75 of the Education Code require school districts to ensure schools are maintained in good repair, including HVAC systems that are functional, supply adequate ventilation to classrooms, and maintain interior temperatures within acceptable ranges. Regulations adopted pursuant to Section 142.3 of the Labor Code require that HVAC systems be maintained and operated to provide at least the quantity of outdoor air required by the California Building Standards Code (Title 24 of the California Code of Regulations) in effect at the time the building permit was issued. Despite these requirements, poorly performing HVAC systems and underventilation of classrooms continue to be a significant problem in California.

(g) The 2019 report by the University of California, Davis, Western Cooling Efficiency Center and the Indoor Environment Group of the Lawrence Berkeley National Laboratory found that over one-half of new HVAC systems in schools had significant problems within three years of installation and that the vast majority of classrooms in California, including 95 percent of the classrooms studied in the central valley, continue to fail to meet minimum ventilation rates. Some classrooms were found to have carbon dioxide concentrations above 2,000 ppm for substantial periods of the day. The study recommended periodic testing of HVAC systems and continuous real-time carbon dioxide monitoring to detect and correct these problems.

(h) Monitoring levels of carbon dioxide in classrooms will help ensure that California students' school environment is healthy and conducive to learning and performing well on tests.

(i) A March 2021 study found that proper ventilation in classrooms could reduce COVID-19 infection risk by over 80 percent compared to classrooms without ventilation.

(j) The Centers for Disease Control and Prevention and the American Society of Heating, Refrigerating and Air-Conditioning Engineers recommend that schools, buildings, and homes combine filters and air cleaners to achieve minimum efficiency reporting values (MERV) levels of performance for air cleaning of 13 or higher.[78]

The legislative history indicates that to comply with the test claim statute, there would be "unknown potentially significant costs for school districts . . . to inspect and ensure that their HVAC systems meet the minimum ventilation rate requirements" and "it is unclear how many school . . . districts statewide need to install new filtration as a result of the inspections."[79]

B. Existing Law Requires School District HVAC Systems to be Maintained and Operated to Provide at Least the Quantity of Outdoor Air Required by Title 24 in Effect When the Building Permit was Issued.

Existing law provides "On or after January 1, 1979, no governmental agency shall commence construction on any new structure unless the new structure complies with Title 24 Standards."[80] The standards encompass those adopted by the Energy Commission for nonresidential buildings, including schools.[81]

The test claim statute incorporates by reference a table in "Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations."[82] Part 6 of title 24 of the California Code of Regulations refers to the Energy Code adopted by the California Energy Commission which, like all parts of the building regulations in title 24, is revised and published every three years.[83] All of the indoor air quality regulations in part 6 apply to new construction, alterations, and repairs of existing buildings.[84] The Code also contains an enforcement provision requiring a building inspection agency "shall not issue a building permit for any construction unless the enforcement agency determines in writing that the construction is designed to comply with the requirements of Part 6 that are in effect on the date the building permit was applied for."[85] Table 120.1-A of part 6, (commencing with section 100.0) of the title 24 regulations establishes minimum ventilation rates for HVAC systems for non-residential buildings, including schools. For public schools, the State's Division of State Architect in the Department of General

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[78] Statutes 2022, chapter 777, section 1 (AB 2232). Exhibit A, Test Claim, filed November 17, 2023, pages 99-100.

[79] Exhibit X (10), Senate Appropriations Committee, Analysis of AB 2232, as amended June 28, 2022, page 1.

[80] Public Resources Code section 25493; Education Code section 17280(a).

[81] Public Resources Code section 25488.

[82] Education Code section 17661(b)(1) (Stats 2022, ch. 777). The reference is to table 120.1-A of part 6, commencing with section 100.0) of the title 24 regulations, which establishes minimum outside air ventilation rates for HVAC systems and filtering requirements for non-residential buildings, including schools.

[83] Health and Safety Code section 18942(a).

[84] California Code of Regulations, title 24, Part 6, sections 120, 141.

[85] California Code of Regulations, title 24, Part 1, section 10-103(d)(1).

Services is the "enforcement agency" supervising the design and construction of school buildings to ensure compliance with title 24, including inspections during installation.[86]

The test claim statute also references "regulations adopted pursuant to Section 142.3 of the Labor Code."[87] These CalOSHA regulations in title 8 of the California Code of Regulations impose General Industry Safety Orders (GISOs) on employers, including school districts.[88] Since 1987, section 5142 of title 8 has required workplace HVAC systems to be maintained and operated to provide at least the quantity of outdoor air required by title 24 in effect when the building permit was issued.[89] Section 5142 also requires the HVAC system to be inspected at least annually and any problems found during the inspections to be corrected within a reasonable time.[90] The employer is required to document in writing the name of the individual inspecting or maintaining the system, the date of the inspection or maintenance or both, and the specific findings and actions taken. The records shall be retained for at least five years and made available for examination and copying within 48 hours of a request to the Division of Occupational Safety and Health, any employee of the employer, and to any designated representative of employees.[91]

In addition, and as more fully explained below, as a condition of receiving funds for new construction or modernization projects under the Leroy F. Greene School Facilities Act of 1998 and the State School Building Lease Purchase Law of 1976, schools are required to keep facilities in good repair, including HVAC systems that are functional and unobstructed, supply adequate ventilation to classrooms, and maintain interior temperatures within acceptable ranges.[92]

Finally, during the COVID-19 pandemic, the Legislature enacted the School Energy Efficiency Stimulus Program,[93] which includes the School Reopening Ventilation and Energy Efficiency Verification and Repair Program (SRVEVR).[94] This Energy

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[86] Education Code section 172809(a) references the Department of General Services that is over the Division of State Architect. *Hall v. City of Taft* (1956) 47 Cal.2d, 177. Regarding inspections, see Education Code sections 17311(a), 17280; See also California Code of Regulations, title 21, section 2.

[87] Statutes 2022, chapter 777, section 1(f).

[88] Public schools are "employers" for purposes of the Labor Code (Lab. Code, §§ 6304, 3300). Labor Code section 142.3 authorizes adoption of "safety and health standards" published in title 8 (see Labor Code, § 142.3(a)(1), (a)(4)(D)).

[89] California Code of Regulations, title 8, section 5142(a)(1).

[90] California Code of Regulations, title 8, section 5142(b).

[91] California Code of Regulations, title 8, section 5142(b).

[92] Education Code sections 17002, 17070.75.

[93] Public Utilities Code section 1600 et seq. (AB 841, Stats. 2020, ch. 372).

[94] Public Utilities Code section 1620 et seq. SRVEVR is the acronym defined in the bill. See Public Utilities Code section 1601(b) (Stats. 2020, ch. 372).

Commission grant program uses ratepayer-funded energy efficiency incentives to fund HVAC upgrades for school districts.[95] School districts that receive grants must, among other requirements, install filtration with a minimum MERV 13 or better where feasible, and have qualified testing personnel review system capacity and airflow to determine the highest MERV filtration that can be installed without adversely impacting the equipment, replace or upgrade filters where needed, and verify that those filters are installed correctly.[96] Also, qualified testing personnel must verify the ventilation rates in the classrooms, auditoriums, gymnasiums, nurses offices, restrooms, and other occupied areas to assess whether they meet the minimum ventilation rate requirements in Table 120.1-A of part 6 (commencing with Section 100.0) of title 24 California Code of Regulations in accordance with specific assessment criteria.[97] If the HVAC system does not meet the minimum ventilation rate requirements in Table 120.1-A, a licensed professional or qualified adjusting personnel shall review the system airflow and capacity to determine if additional ventilation can be provided without adversely impacting equipment performance and building indoor environmental quality. If additional ventilation can be provided, a qualified adjusting personnel shall adjust ventilation rates to meet the minimum ventilation rate requirements in Table 120.1-A to the extent feasible. If the minimum ventilation rate requirements in Table 120.1-A cannot be met, the deficiency shall be reported in the assessment report addressed by a licensed professional as required.[98] Upon completion of grant-funded work under the SRVEVR, the district must prepare an HVAC verification report.[99] The School Energy Efficiency Stimulus Program and SRVEVR Program are repealed as of January 1, 2027.[100]

In addition, the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) provided funding to Local Education Agencies through the Elementary and Secondary School Emergency Relief (ESSER) Fund to address the impact of COVID-19 on elementary and secondary schools, which can be used for HVAC improvements.[101]

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[95] The statute uses “local educational agency” but defines it as school districts, charter schools granted charters pursuant to Part 26.8 of the Education Code, and regional occupation centers established under section 52301 of the Education Code. Public Utilities Code section 1601(a) (Stats. 2020, ch. 372).

[96] Public Utilities Code section 1623(a)(1) (Stats. 2020, ch. 372).

[97] Public Utilities Code section 1623(b)(1) (Stats. 2020, ch. 372).

[98] Public Utilities Code section 1623(b)(2) (Stats. 2020, ch. 372). The assessment report requirements are in section 1626.

[99] Public Utilities Code section 1627 (Stats. 2020, ch. 372).

[100] Public Utilities Code section 1640 (Stats. 2020, ch. 372).

[101] Public Law No. 116-136 (Mar. 27, 2020) 134 Stat. 281.

III. Positions of the Parties

A. Hesperia Unified School District

The claimant maintains the test claim statute imposes a reimbursable state mandate. According to the Test Claim:

> Claimant incurred new activities and costs to ensure that facilities have heating, ventilation, and air conditioning (HVAC) systems that meet specified minimum ventilation rate requirements, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate, in which to ensure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued. Additionally, schools are required to install filtration that achieves specified minimum efficiency reporting values (MERV) levels, determined by the school to be feasible with the existing HVAC system, as provided. The new activities and costs incurred by the Claimant includes the purchasing and installation of new filters . . ..[102]

The claimant alleges the test claim statute requires schools to provide a healthy indoor environment by requiring their HVAC systems meet "the minimum ventilation rate requirements" unless the system is incapable of safely and efficiently providing the minimum ventilation rate.[103] According to the claimant, "To achieve this requirement Claimant is required to perform the new activity to install filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school."[104] The claimant describes the process to replace its MERV 9 air filters with new MERV 13 air filters, which the claimant alleges are more difficult to store, have a shorter life span, require the indoor coil to be cleaned more frequently, and require more maintenance and higher labor costs than its former filters.[105]

The claimant argues the required activities are new and "the good repair, working order, and condition[al] requirements of the Leroy F. Greene School Facilities Act of 1998 and its predecessor program" do not include the test claim statute's requirement for public schools to install MERV 13 filtration or filtration the school determines to be feasible with the existing HVAC system.[106]

The claimant alleges its increased costs exceed the $1,000 minimum amount specified in Government Code section 17564(a). The claimant also states there is "no evidence

[102] Exhibit A, Test Claim, filed November 17, 2023, pages 7, 18 (Landon Declaration).

[103] Exhibit A, Test Claim, filed November 17, 2023, pages 11-13.

[104] Exhibit A, Test Claim, filed November 17, 2023, page 13.

[105] Exhibit A, Test Claim, filed November 17, 2023, page 13, 18-19 (Landon Declaration).

[106] Exhibit C, Claimant's Rebuttal Comments, filed March 14, 2024, page 3.

that additional on-going revenue has been appropriated" to fund the costs of the mandated activities, so Government Code section 17556(e) does not apply.[107] The claimant also asserts its claim was timely filed.[108]

In addition to listing the following labor and filter costs, the claimant alleges it hired two employees to replace and install the MERV 13 air filters every three months:[109]

Year	Costs
January 1, 2023, to June 30, 2023	$27,443.12 labor to install filters $66,236.22, for MERV 13 filters.[110]
July 1, 2023, to June 30, 2024	$81,669.06 estimated labor to install filters $100,119.04 estimated for MERV 13 filters[111]
July 1, 2024, to June 30, 2025	$120,624.56 estimated labor to install filters $151,920.32 estimated for MERV 13 filters.[112]

The claimant also estimates statewide costs of $10 million.[113]

In rebuttal comments, the claimant notes it provided documented evidence with the test claim supporting the labor hours needed to replace the MERV 13 filters.[114] Further, the claimant asserts it provided documentation showing it has 22 school sites with 830 rooftop HVAC units and 614 wall (portable) HVAC units and it submitted work orders (duty statements) for the employee positions to install and replace the MERV filters, and its Ventilation Maintenance Policy and Procedure and checklist for Indoor Air Quality.[115]

Regarding available funds, the claimant cites the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) that provides funding to Local Education Agencies through the Elementary and Secondary School Emergency Relief (ESSER) Fund to address the impact of COVID-19 on elementary and secondary schools. The claimant admits receiving ESSER II funds of $26,295,815 distributed from June 2021 to August 2023, to use towards the districtwide HVAC project to remove and replace HVAC systems at

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107 Exhibit A, Test Claim, filed November 17, 2023, page 9.

108 Exhibit A, Test Claim, filed November 17, 2023, page 10.

109 Exhibit A, Test Claim, filed November 17, 2023, page 14, 19 (Landon Declaration). In rebuttal comments, the claimant states it replaces its HVAC rooftop units every six months and portable wall units every three months. Exhibit C, Claimant's Rebuttal Comments, filed March 14, 2024, pages 2, 5 (Landon Declaration).

110 Exhibit A, Test Claim, filed November 17, 2023, pages 14, 19 (Landon Declaration).

111 Exhibit A, Test Claim, filed November 17, 2023, pages 14, 19 (Landon Declaration).

112 Exhibit A, Test Claim, filed November 17, 2023, pages 15, 20 (Landon Declaration).

113 Exhibit A, Test Claim, filed November 17, 2023, pages 15, 21 (Landon Declaration).

114 Exhibit C, Claimant's Rebuttal Comments, filed March 14, 2024, page 2.

115 Exhibit C, Claimant's Rebuttal Comments, filed March 14, 2024, page 3.

elementary, middle, and high schools.[116] Prior to January 1, 2023, ESSER funds were used to purchase MERV 13 filters for new HVAC systems.[117] The claimant states it also received ESSER III funds of $58,852,535, of which it allocated $13 million to the districtwide HVAC project to remove and replace HVAC systems at elementary, middle, and high schools, with the difference due to having other spending priorities for the remaining ESSER III funds.[118] The claimant says it has until September 30, 2024, to spend this allocation, and there will be no additional ESSER funds.[119] The claimant identifies no other state or federal funds, or offsetting fee authority, available for this program.[120]

Finally, the claimant points out Finance submitted no evidence supporting its concerns with the costs identified in the test claim, and Finance failed to submit its representations of fact under oath or affirmation and signed under penalty of perjury, as required by the Commission's regulations.[121]

B. Department of Finance

Finance states "to the extent that AB 2232 establishes new responsibilities, it appears that activities and claimed costs are overstated in the test claim."[122] Finance notes the test claim statute does not require schools to hire additional staff and the claimant must provide sufficient justification for those costs. And it is unclear if the additional staff would be responsible for duties unrelated to the test claim statute, especially when four established positions already cover HVAC maintenance.[123] Further, schools that opt to receive school construction funds under the Leroy F. Greene School Facilities Act or its predecessor are already required to keep facilities at all times in good repair. Finance states the claimant should provide the following information to justify the claimed costs:

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[116] Exhibit A, Test Claim, filed November 17, 2023, page 15, 20 (Landon Declaration).

[117] Exhibit A, Test Claim, filed November 17, 2023, page 15, 20 (Landon Declaration).

[118] Exhibit A, Test Claim, filed November 17, 2023, page 15, 20 (Landon Declaration).

[119] Exhibit A, Test Claim, filed November 17, 2023, pages 15-16, 20 (Landon Declaration).

[120] Exhibit A, Test Claim, filed November 17, 2023, page 16, 20 (Landon Declaration).

[121] Exhibit C, Claimant's Rebuttal Comments, filed March 14, 2024, pages 3-4. Section 1183.1(e) of the Commission's regulations requires "[a]ll representations of fact shall be supported by documentary or testimonial evidence in accordance with section 1187.5 of the Commission's regulations." However, the determination whether a statute or executive order imposes a reimbursable state-mandated program is a question of law. *County of San Diego v. State of California* (1997) 15 Cal.4th 68, 109.

[122] Exhibit B, Finance's Comments on the Test Claim, filed February 15, 2024, page 1.

[123] Exhibit B, Finance's Comments on the Test Claim, filed February 15, 2024, page 2.

- Documented evidence of the labor hours needed to replace the MERV 13 filter, which would be part of the annual HVAC inspection report required by Section 5142 of Title 8 of the California Code of Regulations.
- The total number of HVAC systems within its district.
- Duty Statements for the existing positions and the two additional positions that highlight any extra duties these positions are expected to perform, in addition to maintaining the MERV 13 filters.
- Documentation that the identified facilities are not already subject to the good repair, working order, and condition requirements of the Leroy F. Greene School Facilities Act of 1998 or its predecessor program, the State School Building Lease-Purchase Law of 1976.[124]

Additionally, Finance points out the claimant provided a receipt for multiple Ply Panels, which is not aligned with the requirements of AB 2232 and is not required by the plain language of the test claim statute nor is reasonably necessary to implement it, so reimbursement for these costs should be denied.[125]

IV. Discussion

Article XIII B, section 6 of the California Constitution provides in relevant part the following:

> Whenever the Legislature or any state agency mandates a new program or higher level of service on any local government, the state shall provide a subvention of funds to reimburse such local government for the costs of such programs or increased level of service…

The purpose of article XIII B, section 6 is to "preclude the state from shifting financial responsibility for carrying out governmental functions to local agencies, which are 'ill equipped' to assume increased financial responsibilities because of the taxing and spending limitations that articles XIII A and XIII B impose."[126] Thus, the subvention requirement of section 6 is "directed to state-mandated increases in the services provided by [local government] …"[127]

Reimbursement under article XIII B, section 6 is required when the following elements are met:

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[124] Exhibit B, Finance's Comments on the Test Claim, filed February 15, 2024, page 2.

[125] Exhibit B, Finance's Comments on the Test Claim, filed February 15, 2024, pages 2-3.

[126] *County of San Diego v. State of California* (1997) 15 Cal.4th 68, 81.

[127] *County of Los Angeles v. State of California* (1987) 43 Cal.3d 46, 56.

1. A state statute or executive order requires or "mandates" local agencies or school districts to perform an activity.[128]
2. The mandated activity constitutes a "program" that either:
   a. Carries out the governmental function of providing a service to the public; or
   b. Imposes unique requirements on local agencies or school districts and does not apply generally to all residents and entities in the state.[129]
3. The mandated activity is new when compared with the legal requirements in effect immediately before the enactment of the test claim statute or executive order and it increases the level of service provided to the public.[130]
4. The mandated activity results in the local agency or school district incurring increased costs, within the meaning of section 17514. Increased costs, however, are not reimbursable if an exception identified in Government Code section 17556 applies to the activity.[131]

The Commission is vested with the exclusive authority to adjudicate disputes over the existence of state-mandated programs within the meaning of article XIII B, section 6 of the California Constitution.[132] The determination whether a statute or executive order imposes a reimbursable state-mandated program is a question of law.[133] In making its decisions, the Commission must strictly construe article XIII B, section 6 of the California Constitution, and not apply it as an "equitable remedy to cure the perceived unfairness resulting from political decisions on funding priorities."[134]

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[128] *San Diego Unified School Dist. v. Commission on State Mandates* (2004) 33 Cal.4th 859, 874.

[129] *San Diego Unified School Dist. v. Commission on State Mandates* (2004) 33 Cal.4th 859, 874-875 (reaffirming the test in *County of Los Angeles* (1987) 43 Cal.3d 46, 56).

[130] *San Diego Unified School Dist.* (2004) 33 Cal.4th 859, 874-875, 878; *Lucia Mar Unified School District v. Honig* (1988) 44 Cal3d 830, 835.

[131] *County of Fresno v. State of California* (1991) 53 Cal.3d 482, 487; *County of Sonoma v. Commission on State Mandates* (2000) 84 Cal.App.4th 1265, 1284; Government Code sections 17514 and 17556.

[132] *Kinlaw v. State of California* (1991) 54 Cal.3d 326, 335.

[133] *County of San Diego v. State of California* (1997) 15 Cal.4th 68, 109.

[134] *County of Sonoma v. Commission on State Mandates* (2000) 84 Cal.App.4th 1265, 1280 [citing *City of San Jose v. State of California* (1996) 45 Cal.App.4th 1802, 1817].

A. <u>The Test Claim Was Timely Filed and the Potential Period of Reimbursement Begins January 1, 2023.</u>

Government Code section 17551(c) requires test claims "be filed not later than 12 months following the effective date of a statute or executive order, or within 12 months of incurring increased costs as a result of a statute or executive order, whichever is later." Section 1183.1(c) of the Commission's regulations defines "12 months" as 365 days.[135]

The test claim statute became effective on January 1, 2023.[136] The Test Claim was filed on November 17, 2023,[137] within 12 months of the effective date of the test claim statute, so the Test Claim was timely filed.

Government Code section 17557(e) requires a test claim be submitted on or before June 30 following a given fiscal year to establish eligibility for that fiscal year. The November 17, 2023 filing date establishes reimbursement eligibility for the 2022-2023 fiscal year, but because the test claim statute became effective on January 1, 2023, the potential period of reimbursement begins January 1, 2023.

B. <u>The Uncodified Language in Section 1 of the Test Claim Statute and Education Code Section 17660 as Added by the Test Claim Statute Describe the Legislature's Findings, But Do Not Impose any Requirements on School Districts and Therefore Do Not Constitute a State-Mandated Program.</u>

Reimbursement under article XIII B, section 6 is required if a state statute or executive order requires or "mandates" local agencies or school districts to perform an activity.[138]

Education Code section 17660, added by the test claim statute, does not impose any requirements on school districts, but provides "The Legislature finds and declares that it is the policy of the state that school facilities provide healthy indoor air quality, including adequate ventilation, to students, teachers, and other occupants in order to protect occupant health, reduce sick days, and improve student productivity and performance."[139]

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[135] California Code of Regulations, title 2, section 1183.1(c), Register 2018, No. 18 (eff. April 1, 2018).

[136] Statutes 2022, chapter 777. Exhibit A, Test Claim, filed November 17, 2023, page 98.

[137] Exhibit A, Test Claim, filed November 17, 2023, page 1.

[138] *San Diego Unified School Dist. v. Commission on State Mandates* (2004) 33 Cal.4th 859, 874.

[139] Education Code section 17660 (Stats 2022, ch. 777).

Similarly, uncodified section 1 of the test claim statute contains legislative findings and declarations and cites four studies or reports on the adverse effects of poor indoor quality on school-age children but imposes no requirements on school districts.[140]

Accordingly, the uncodified language in section 1 of the test claim statute and Education Code section 17660, as added by the test claim statute, do not impose a state-mandated program.

C. <u>Education Code Section 17661, as Added by the Test Claim Statute, Does Not Impose a Reimbursable State-Mandated Program.</u>

1. Education Code Section 17661(a), (d), and (e) Do Not Impose Any Requirements on School Districts.

Education Code section 17661(a) defines "covered school," "HVAC," and "MERV" as used in the test claim statute, but does not impose any requirements on school districts.

Education Code section 17661(d) requires the California Building Standards Commission and the Division of the State Architect to research, develop, and propose for adoption mandatory standards for carbon dioxide monitors in classrooms of a covered school and the University of California on the next triennial update of the California Building Standards Code (title 24 of the California Code of Regulations).[141]

Education Code section 17661(e) states: "This section shall apply to the University of California only to the extent that the Regents of the University of California, by resolution, make it applicable."

Education Code section 17661(a), (d) and (e) as added by the test claim statute, do not impose any requirements on school districts and, therefore, there is no state-mandated program imposed by these subdivisions.

2. The Requirement in Education Code Section 17661(b)(2), to Inspect the HVAC Systems to Ensure They Meet the Minimum Ventilation Rates *in Effect When the Building Permit for HVAC Installation Was Issued* Is Not New and Does Not Impose a New Program or Higher Level of Service. Although the Requirements in Sections 17661(b)(1) and (b)(2) to Inspect HVAC Systems to Ensure Compliance with the *Current* Minimum Ventilation Rates in Table 120.1-A of Part 6 of the Title 24 Regulations and Document in the Annual Inspection Report the System's Inability to Meet *Current* Ventilation Standards in Table 120.1-A Is New for School Districts with HVAC Systems Approved for Installation *Before* January 1, 2020, There Is No Evidence of Increased Costs Mandate by the State to Comply with the Requirements.

Education Code section 17661(b) requires school districts to:

> [E]nsure that facilities, including but not limited to, classrooms for students, have HVAC [defined as heating, ventilation, and air conditioning]

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[140] Statutes 2022, chapter 777, section 1.

[141] Education Code section 17661(d) (Stats 2022, ch. 777).

> systems *that meet the minimum ventilation rate requirements set forth in Table 120.1-A of Part 6* (commencing with Section 100.0) of Title 24 of the California Code of Regulations, *unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate*.[142]

Section 17661(b)(2) requires a school incapable of meeting the minimum ventilation rates in Table 120.1-A of title 24 to:

- [E]nsure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued. . . [and;]
- [D]ocument the HVAC system's inability to meet the current ventilation standards set forth in paragraph (1) in the annual HVAC inspection report required by Section 5142 of Title 8 of the California Code of Regulations, which shall be available to the public upon request.[143]

As indicated in the Background, title 24, including the Energy Code in part 6, is revised and published every three years.[144] The test claim statute and the 2022 Energy Code (published July 1, 2022 and eff. Jan. 1, 2023) both became effective on January 1, 2023.[145] Thus, the requirement in section 17661(b)(1) to "[e]nsure that facilities . . . have HVAC systems that meet the minimum ventilation rate requirements set forth in Table 120.1-A of Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations" refers to the *current* Energy Code. If a school HVAC system is incapable of meeting the minimum ventilation rates in the current Energy Code, Education Code section 17661(b)(2) requires the school to "[e]nsure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued."[146]

Table 120.1-A of part 6 of the title 24 regulations identifies the "Minimum Ventilation Rates" for HVAC systems, including the total outdoor air rate, the minimum ventilation rates for systems with DCV (demand control ventilation) devices, and the air class applicable to "educational facilities," including classrooms. To understand these terms, a summary of the requirements in part 6 is necessary. Part 6 of the title 24 regulations currently requires occupiable spaces in nonresidential buildings, including school facilities, to meet specified air filtration requirements (which are discussed in the next section) and the requirements for naturally ventilated spaces or mechanically ventilated

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142 Education Code section 17661(b)(1) (Stats 2022, ch. 777). Emphasis added.

143 Education Code section 17661(b)(2) (Stats 2022, ch. 777). Emphasis added.

144 Health and Safety Code section 18942(a).

145 Exhibit X (1), Building Standards Commission, California Building Standards Code, https://www.dgs.ca.gov/BSC/Codes#:~:text=Code%20Regs.%2C%20Title%2024),date%20of%20January%201%2C%202023 (accessed on Aug. 12, 2024).

146 Emphasis added.

spaces, depending on the HVAC system the school uses.[147] Some mechanically ventilated systems have demand control ventilation (DCV) devices, which vary the rate at which outdoor air is delivered based on carbon dioxide (CO_2) and occupancy levels in the room.[148] DCV devices are required for spaces with a design occupant density of greater than or equal to 25 people per 1,000 square feet and the system has an air economizer, a modulating outside air control, or a design outdoor air rate of greater than 3000 cfm.[149] All systems are required to meet the minimum outside air ventilation rates for each occupied area based on the anticipated occupancy and the minimum required ventilation rate per occupant in Table 120.1-A.[150]

The regulations also provide "[a]ir classification and recirculation limitations of air shall be based on the air classification as listed in Table 120.1-A,"[151] which are also identified ASHRAE 62.1 (the standards of the American Society of Heating, Refrigerating and Air-Conditioning Engineers). Two air classifications are relevant to school facilities.[152] Class 1 air can be recirculated to any space type and is typical of the air in a classroom. Class 2 air is moderately contaminated or odorous with mild sensory irritation intensity, is restricted in its recirculation, and is typical of a science laboratory or art classroom.[153]

Thus, Table 120.1-A identifies the following "Minimum Ventilation Rates" for schools:[154]

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[147] California Code of Regulations, title 24, part 6, section 120.1(c). Section 120.1(c)(2) also requires naturally ventilated spaces include a mechanical ventilation system designed in accordance with certain specifications.

[148] California Code of Regulations, title 24, part 6, section 120.1(d); Exhibit X (5), California Energy Commission, Installer and Inspector Quick-Reference: 2022 NRCA-MCH-06-A Demand Control Ventilation (DCV) Systems, 2022, https://www.energy.ca.gov/filebrowser/download/4953 (accessed on Aug. 15, 2024), page 1; Exhibit X (2), California Department of Public Health, Ventilation and Filtration to Reduce Long-Range Airborne Transmission of COVID-19 and Other Respiratory Infections: Considerations for Reopened Schools, California Department of Public Health, July 2021, https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/CDPH%20Document%20Library/School_ventilation_and_filtration_ADA.pdf (accessed on Aug. 23, 2024), page 18.

[149] California Code of Regulations, title 24, part 6, section 120.1(d)(3);

[150] California Code of Regulations, title 24, part 6, sections 120.1(c), 120.1(c)(3), 120.1(d), and 120.l(f).

[151] California Code of Regulations, title 24, part 6, sections 120.1(g).

[152] California Code of Regulations, title 24, part 6, section 120.1(g).

[153] California Code of Regulations, title 24, part 6, section 120.1(g)(1)-(g)(2).

[154] California Code of Regulations, title 24, part 6, section 120.1.

Occupancy Category	Total Outdoor Air Rate R_t (cfm/ft^2)	Min. Ventilation Air Rate for DCV R_a (cfm/ft^2)	Air Class	Notes
Classrooms (ages 5-8)	0.38	0.15	1	
Classrooms (age 9-18)	0.38	0.15	1	
Art Classrooms	0.15	-	2	
Science Laboratories	0.15	-	2	

The table indicates the total outdoor air rate for classrooms is 38 cubic feet per unit area, and the minimum ventilation air rate for systems with demand control ventilation devices is 15 cubic feet per minute of outdoor air flow per person.[155] Table 120.1-A also identifies the minimum ventilation rates for other school facilities such as lecture halls; multi-use assembly rooms; wood and metal shops; computer labs; media centers; and music, theater, and dance rooms.

The test claim statute itself does not define what it means to "ensure" compliance with the minimum ventilation rate requirements. According to the author of the bill, "AB 2232 will require comprehensive HVAC *inspections* . . . in classrooms *to ensure* the wellbeing and learning of California students are protected from the harmful effects of poor air quality."[156] Thus, Education Code section 17661(b)(1) requires school districts *to inspect* their HVAC systems to ensure they meet the current minimum ventilation rate requirements in Table 120.1-A above, and if their systems do not, section 17661(b)(2) requires the schools to ensure the systems meet the minimum ventilation rates in the Energy Code at the time their permit was issued for installation of the HVAC system and document the HVAC system's inability to meet the current ventilation standards in the annual HVAC inspection report required by section 5142 of title 8 of the California Code of Regulations.

However, existing law already requires school districts to inspect, maintain, and ensure their installed HVAC systems are running and in good repair, and provide at least the quantity of outdoor air required by title 24 *at the time their building or installation permit (or equivalent approval) was obtained*. Since 1987, section 5142(b) of the title 8 regulations has required annual inspections of HVAC systems in workplaces, with inspections and maintenance to be documented in writing.[157] Title 8 includes the General Industry Safety Orders (GISOs) for employers,[158] which apply to school

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[155] California Code of Regulations, title 24, part 6, section 120.1(c)(3).

[156] Exhibit X (11), Senate Rules Committee, Office of Senate Floor Analyses, Third Reading Analysis of AB 2232, as amended June 28, 2022, page 3. Emphasis added.

[157] California Code of Regulations, title 8, section 5142 (Register 87, No. 2). Section 5142 is a general industrial safety order (see Cal. Code Regs., tit. 8, § 3200 et. seq.). GISOs apply to ". . . all employments and places of employment in California as defined by Labor Code Section 6303. . . "

[158] California Code of Regulations, title 8, section 3200 et seq.. The General Industrial Safety Orders are "to make full provision for securing safety in places of employment, . .

districts.[159] The GISO in section 5142 of title 8, entitled "Mechanically Driven Heating, Ventilating and Air Conditioning (HVAC) Systems to Provide Minimum Building Ventilation," expressly requires annual workplace inspections to ensure compliance with the minimum ventilation rate requirements in effect at the time the building permit was issued so the HVAC system operates properly each year after installation, as it states:

> (a) Operation:
>
> (1) The HVAC system shall be maintained and operated to provide at least the quantity of outdoor air required by the State Building Standards Code, Title 24, Part 2, California Administrative Code, in effect at the time the building permit was issued.[160]
>
> [¶] . . . [¶]
>
> (b) Inspection and Maintenance:
>
> (1) The HVAC system shall be inspected at least annually, and problems found during these inspections shall be corrected within a reasonable time.
>
> (2) Inspections and maintenance of the HVAC system shall be documented in writing. The employer shall record the name of the individual(s) inspecting and/or maintaining the system, the date of the inspection and/or maintenance, and the specific findings and actions taken. The employer shall ensure that such records are retained for at least five years.
>
> (3) The employer shall make all records required by this section available for examination and copying, within 48 hours of a request, to any authorized representative of the Division (as defined in Section 3207), to any employee of the employer affected by this section, and to any designated representative of said employee of the employer affected by this section.

Similarly, Education Code sections 17002 and 17070.75, in the Leroy F. Greene School Facilities Act of 1998 and the State School Building Lease Purchase Law of 1976, require school construction project plans for "major maintenance, repair and replacement," to keep school facilities in "good repair," including heating and cooling

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. [and] are promulgated for the guidance of employers and employees alike." (Cal. Code Regs., tit. 8, § 3200).

[159] Public schools are "employers" for purposes of the Labor Code (Lab. Code, §§ 6304, 3300), which the title 8 regulations implement.

[160] It is inconsequential that section 5142 references "part 2" of title 24 rather than part 6. At the time the title 8 regulation was adopted in 1987, the energy regulations were in part 2. Energy regulations were not codified into part 6 until 1992. Exhibit X (6), California Energy Commission, *The 1992 Efficiency Standards for New Residential and Non-Residential Buildings*, July 1, 1992, footnote 1.

systems.[161] As a condition of receiving funds for new construction or modernization projects, schools are required to provide for ongoing and major maintenance of school buildings.[162] Education Code section 17002(d),[163] states “good repair” means:

> [T]he facility is maintained in a manner that assures that it is clean, safe, and functional as determined pursuant to a *school facility inspection and evaluation instrument* developed by the Office of Public School Construction and approved by the board or a local evaluation instrument that meets the same criteria.[164]

The “evaluation instrument” used to determine good repair is the Facility Inspection Tool (FIT), developed by the Office of Public School Construction.[165] Section 17002(d) requires the FIT to include the following minimum criteria for mechanical and HVAC systems: “(i) functional and unobstructed; (ii) appear to supply adequate amount of air to all classrooms, work spaces, and facilities; and (iii) maintain interior temperatures within normally acceptable ranges.”[166] Consistent with these criteria in section 17002(d), the FIT as revised in April 2022 states:

> *Heating, ventilation, and air conditioning systems (HVAC) as applicable are functional and unobstructed. Examples include but are not limited to the following:*
>
> a. The HVAC system is operable.
>
> b. The facilities are ventilated (via mechanical or natural ventilation)
>
> c. The ventilation units are unobstructed and vents and grills are without evidence of excessive dirt or dust.
>
> d. There appears to be an adequate air supply to all classrooms, work spaces, and facilities (i.e. no strong odor is present, air is not stuffy)
>
> e. Interior temperatures appear to be maintained within normally accepted ranges.
>
> f. The ventilation units are not generating any excessive noise or vibrations.
>
> [¶] . . . [¶]

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[161] Education Code sections 17014(c), 17070.77(a) – (b).

[162] Education Code section 17075(a).

[163] See also Education Code, section 17070.75, which addresses facilities maintenance and incorporates by reference the definition of ‘good repair’ in section 17002(d).

[164] Education Code section 17002(d)(1). Emphasis added.

[165] Exhibit X (9), Office of Public School Construction, Facility Inspection Tool, revised April 2022, https://www.dgs.ca.gov/-/media/Divisions/OPSC/Forms/Facility-Inspection-Tool---SAB-Approved-04-27-2022.pdf (accessed on May 1, 2024).

[166] Education Code section 17002(d)(1)(B).

> [and] Surfaces (including floors, ceilings, walls, window casings, HVAC grills) appear to be free of mildew, mold odor and visible mold.[167]

The FIT is intended to assist county superintendents of schools in their statutory duty to annually visit their schools and to assess or inspect for:

> The accuracy of data reported on the school accountability report card with respect to the availability of sufficient textbooks and instructional materials, as defined by Section 60119, *and the safety, cleanliness, and adequacy of school facilities, including good repair,* as required by Sections 17014, 17032.5, 17070.75, and 17089.[168]

Thus, the requirement in section 17661(b)(2), for a school to "[e]nsure that its HVAC system meets the minimum ventilation rates *in effect at the time the building permit for installation of that HVAC system was issued*" is not new and does not impose a new program or higher level of service on school districts.[169]

However, the requirements imposed by Education Code section 17661(b)(1) and (2) to inspect the HVAC systems to ensure compliance with the *current* minimum ventilation rates in Table 120.1-A of part 6, and if the existing HVAC system is "not capable of safely and efficiently providing the minimum ventilation rate" to document the system's inability to meet the *current* standards, goes beyond the scope of the existing requirements and is new for some school districts.

Table 120.1-A in the 2019 Energy Code is the same as Table 120.1-A in the 2022 Energy Code, so the requirements to inspect the system to ensure compliance with *current* minimum ventilation rates and document the inspection in writing is *not* new to the extent a school district received a permit or equivalent approval for an HVAC installation beginning with the 2019 Energy Code, effective January 1, 2020.[170] Under existing law, schools were already required to conduct annual inspections to ensure the HVAC system provides "at least the quantity of outdoor air required by . . . Title 24, . . . *in effect at the time the building permit was issued"* and to document that inspection in writing.[171] Since Table 120.1-A in the 2019 and 2022 Energy Codes are the same, the requirements in the test claim statute to perform the same activities are not new and do

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[167] Exhibit X (9), Office of Public School Construction, Facility Inspection Tool, revised April 2022, https://www.dgs.ca.gov/-/media/Divisions/OPSC/Forms/Facility-Inspection-Tool---SAB-Approved-04-27-2022.pdf (accessed on May 1, 2024), pages 3, 4.

[168] Education Code section 1240(c)(2)(E)(iii). Emphasis added. Also see Exhibit X (9), Office of Public School Construction, Facility Inspection Tool, revised April 2022, https://www.dgs.ca.gov/-/media/Divisions/OPSC/Forms/Facility-Inspection-Tool---SAB-Approved-04-27-2022.pdf (accessed on May 1, 2024), page 1.

[169] Emphasis added.

[170] California Code of Regulations, title 24, part 6, section 120.1(h), Table 120.1-A. In the 2019 code, Table 120.1-A is at section 120.1(g).

[171] California Code of Regulations, title 8, section 5142. Emphasis added.

not increase the level of service for HVAC systems approved for installation on or after January 1, 2020.

Unlike the 2019 and 2022 versions, Table 120.1-A in the 2016 Energy Code only identifies the minimum ventilation rates per square foot of conditioned floor area and does not identify the minimum ventilation air rate for systems with demand control ventilation devices or the air class.[172] Discussing the difference between Table 120.1-A in the 2019 Energy Code and earlier (2016 and before) Energy Codes, one publication explained:

> New minimum ventilation rate calculations have been added to Table 120.1-A. The table includes significantly more information, reducing the need to cross reference between the Building or and [sic] Energy Code to determine the minimum ventilation rates. It includes many additional space types (occupancy categories) and identifies the "air classifications" referenced by §120.1(g).[173]
>
> [¶] . . . [¶]
>
> This change [to section 120.1(g)] adds air classifications and recirculation limits for ventilation air. Previously, the Energy Code did not give direction on these two concepts, although they may have a significant impact on indoor air quality. They are present in ASHRAE standards that were incorporated by reference but not directly stated in the Energy Code.[174]

In addition, the 2016 and earlier versions of Table 120.1-A do not contain DCV standards because, as stated in the 2016 Energy Code: "Classrooms . . with occupant density greater than 2.5 people per 1000 ft^2. . . are not required to have demand control ventilation."[175] According to the 2016 Nonresidential Compliance Manual, classrooms and other spaces "are exempted either due to concerns about equipment maintenance practices (schools and public buildings) or concerns about high levels of pathogens (social service buildings, medical buildings, healthcare facilities and to some extent

[172] The 2016 version of California Code of Regulations, title 24, part 6, section 120.1(e), Table 120.1-A lists a minimum ventilation rate of "CFM per square foot of conditioned floor area" for "all other" types of use at .15. There is nothing in the 2016 version of Table 120.1-A specifically applicable to school occupancy.

[173] Exhibit X (8), International Code Council, *Significant Changes to the California Energy Code*, 2019 Edition, May 2021, page 97.

[174] Exhibit X (8), International Code Council, *Significant Changes to the California Energy Code*, 2019 Edition, May 2021, page 105.

[175] California Code of Regulations, title 24, part 6, section 120.1(c)(3), effective January 1, 2016.

classrooms)."[176] However, the 2016 exception for classrooms was removed in the 2019 Energy Code.[177]

Thus, Table 120.1-A changed since the 2016 Energy Code and the requirements in Education Code section 17661(b)(1) and (2) to ensure compliance with *current* minimum ventilation rates and to "document the HVAC system's inability to meet the *current* ventilation standards set forth in paragraph (1) in the annual HVAC inspection report required by section 5142 of title 8 of the California Code of Regulations" goes beyond the scope of prior law for schools that received a permit or equivalent approval for an HVAC installation under the 2016 or earlier Energy Code (i.e., *before* January 1, 2020).

However, the claimant has not requested reimbursement for these activities and there is no evidence in the record school districts incurred any costs mandated by the state to comply with these requirements. Government Code section 17514 defines "costs mandated by the state" as any increased cost a local agency or school district incurs as a result of any statute or executive order that mandates a new program or higher level of service. Government Code section 17564(a) further requires no claim nor any payment shall be made unless the claim exceeds $1,000. Section 1183.1(e) of the Commission's regulations requires "[a]ll representations of fact shall be supported by documentary or testimonial evidence in accordance with section 1187.5 of the Commission's regulations." The Test Claim and the only declaration in the record describe the process to replace MERV 9 air filters with new MERV 13 air filters, which the claimant alleges is required to comply with the test claim statute.[178] Although installing MERV 13 filters is addressed in Education Code section 17661(c), which is discussed below, it is not a requirement imposed by section 17661(b). The claimant identifies no costs in the Test Claim or the attached declaration to comply with the section 17661(b) requirements to inspect the HVAC systems for compliance with current standards and document the system's inability to meet current standards.

Therefore, the Commission finds Education Code section 17661(b) does not impose a reimbursable state-mandated program because:

- The requirement in Education Code section 17661(b)(2), for a school inspection to "[e]nsure that its HVAC system meets the minimum ventilation rates *in effect at the time the building permit for installation of that HVAC system was issued*" is *not* new and does not impose a new program or higher level of service.
- The requirements in Education Code section 17661(b)(1) and (b)(2), to inspect HVAC systems to ensure compliance with the *current* minimum ventilation rates

[176] Exhibit X (4), California Energy Commission, 2016 Nonresidential Compliance Manual, page 4-45.

[177] Exhibit X (8), International Code Council, *Significant Changes to the California Energy Code*, 2019 Edition, May 2021, page 101.

[178] Exhibit A, Test Claim, filed November 17, 2023, page 13, 18-19 (Landon Declaration).

in Table 120.1-A of part 6 of title 24 of the California Code of Regulations, as adopted in 2022, and to document the system's inability to meet the *current* ventilation standards in the annual inspection report required by section 5142 of title 8 of the California Code of Regulations, are *not* new and do not impose a new program or higher level of service for school districts that received a permit or equivalent approval for an HVAC installation under the 2019 or 2022 Energy Codes (for HVAC systems approved *on or after* January 1, 2020).

- Regarding the requirements in Education Code section 17661(b)(1) and (b)(2), for school districts that received a permit or equivalent approval for an HVAC installation under the 2016 or earlier Energy Code (approved *before* January 1, 2020), to inspect HVAC systems to ensure compliance with the *current* minimum ventilation rates in Table 120.1-A of part 6 of title 24 of the California Code of Regulations, as adopted in 2022, and to document the system's inability to meet the *current* ventilation standards in the annual inspection report required by section 5142 of title 8 of the California Code of Regulations, there is no evidence of increased costs mandated by the state to comply with these requirements in accordance with Government Code section 17514 and section 1183.1(e) of the Commission's regulations.

3. Reimbursement Is Not Required to Comply with Education Code Section 17661(c) Because There Is No Evidence in the Record of Increased Costs Mandated by the State to Comply with the One-Time New Requirement to Install MERV 13 Filtration, or the Highest MERV Filtration Feasible, *Only* at Schools with HVAC Systems Approved for Installation *Before* January 1, 2020 and Only to the Extent the District's Schools Did *Not* Have a COVID-19 Outbreak.

Education Code section 17661(c), as added by the test claim statute, requires school districts to install MERV 13 air filtration or the highest filtration feasible in their HVAC systems:

- [I]nstall filtration that achieves "MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school.
- If . . . it is determined that the existing HVAC system is not designed to achieve MERV levels of 13 or higher, a covered school shall . . . install filtration that achieves the highest MERV level that the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system.[179]

[179] Education Code section 17661(c) (Stats 2022, ch. 777).

As indicated above, MERV is an acronym for minimum efficiency reporting value.[180] MERV air filtration was explained as follows in an Energy Commission publication:

> Air filtration is used in forced air systems to protect the equipment from dust accumulation that could reduce the capacity or efficiency of the system. Preventing dust buildup may also prevent the system from becoming a host to biological contaminants such as mold, especially if dust is deposited on cooling coils that become wet from water condensation during comfort cooling operation. Air filter efficiencies of Minimum Efficiency Reporting Value (MERV) 6 to MERV 8 are sufficient for protection from these large airborne dust particles. Air filter efficiencies of at least MERV 13 are needed to protect occupants from exposure to the smaller airborne particles that are known to adversely affect respiratory health. These smaller particles are often referred to as PM 2.5 which refers to particulate matter of 2.5 microns. PM2.5 is produced from combustion such as that resulting from cooking in the kitchen and from exhaust from motor vehicles that enters a dwelling through ventilation openings and infiltration.[181]

As described below, the Commission finds reimbursement is not required to comply with Education Code section 17661(c) because there is no evidence in the record of increased costs mandated by the state to comply with the one-time new requirement mandated by the state to install MERV 13 or the highest filtration feasible *only* at schools with HVAC systems approved for installation *before* January 1, 2020, and only to the extent the district's schools did *not* have a COVID-19 outbreak.

a. Education Code section 17661(c) imposes a *one-time* new requirement to install filtration that achieves MERV levels of 13 or higher, or install filtration that achieves the highest MERV level feasible without reducing the lifespan of the existing HVAC system, *only* for schools with HVAC systems approved for installation before January 1, 2020 (under the 2016 or earlier Energy Code) and only to the extent the district's schools did not have a COVID-19 outbreak as defined.

The current Energy Code requires filters shall have a designated efficiency equal to or greater than MERV 13.[182] The same requirement is in the 2019 Energy Code (eff.

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[180] Education Code section 17661(a)(3) (Stats 2022, ch. 777). MERV is the minimum efficiency reporting value as determined by ASHRAE [American Society of Heating, Refrigerating, and Air Conditioning Engineers] Standard 52.2 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. (Cal. Code Regs., tit. 23, pt. 6, § 100.1(b)).

[181] Exhibit X (7), California Energy Commission, 2022 Residential Compliance Manual, https://www.energy.ca.gov/filebrowser/download/5126 (accessed on May 2, 2024), pages 4-39 to 4-40.

[182] California Code of Regulations, title 24, part 6, section 120.1(c)(1)(B) (eff. Jan. 1, 2023).

Jan. 1, 2020).[183] But the 2016 Energy Code (eff. Jan. 1, 2017) did not require filters rated at MERV 13 or higher.[184] The 2019 amendment to title 24 increased the minimum requirement to MERV 13 as explained below:

> The extensive changes to Section 120.1 address outdoor air ventilation and indoor air quality (IAQ) with new requirements for air filtration and system designs. Subsection (c) applies to the occupiable spaces in high-rise [and] nonresidential buildings, and hotels/motels. Subsection (c)1 addresses air filtration. It specifies the types of mechanical systems that must have air filters, air filter efficiency, and sizes. The 2019 Energy Code ensures that HVAC systems are designed to accommodate higher MERV filters so that occupants can improve filtration without inadvertently harming the energy efficiency, lifespan, or overall performance of their HVAC system.
>
> [¶] . . . [¶]
>
> To improve indoor air quality, the air filtration particle size efficiency requirement has increased from MERV 6 to MERV 13. A MERV 13 filter effectively filters out fine particulate matter (PM 2.5).[185]

Therefore, the MERV 13 requirement in Education Code section 17661(c) is *not* new to the extent a school received a permit or equivalent approval to install a new HVAC system under the 2019 or 2022 Energy Code (i.e., on or after Jan. 1, 2020) because those Codes already required the HVAC system to have filters with a designated efficiency equal to or greater than MERV 13.[186] Prior law also required these filters be replaced or cleaned regularly. Section 5143(d)(3) of the title 8 regulations states:

> Where the air supply is filtered, the filters shall be replaced or cleaned regularly to prevent significant reductions in airflow. A pressure gauge shall be installed to show the pressure drop across the filters. This gauge shall be marked to show the pressure drop at which filters require cleaning or replacement.

As indicated above, this title 8 regulation applies to employers, including school districts.[187]

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[183] California Code of Regulations, title 24, part 6, section 120.1(c)(1)(B) (eff. Jan. 1, 2020).

[184] Exhibit X (3), California Energy Commission, 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings, page 241.

[185] Exhibit X (8), International Code Council, *Significant Changes to the California Energy Code*, 2019 Edition, May 2021, pages 91-92.

[186] California Code of Regulations, title 24, part 6, section 120.1(c)(1)(B).

[187] Public schools are “employers” for purposes of the Labor Code (Lab. Code, §§ 6304, 3300), which the title 8 regulations implement.

In addition, the MERV 13 requirement is *not* new if there was a COVID-19 outbreak in the school. At the time the test claim statute became effective on January 1, 2023, MERV 13 filters were required for schools that had a COVID-19 outbreak (meaning three or more *employee* COVID-19 cases within an exposed group, as defined, who visited the worksite during their infectious period any time during a 14-day period).[188] Under these circumstances, existing regulations in section 3205.1(f) of title 8 required the school to comply with the same filtration requirements as the test claim statute:

> (f) In buildings or structures with mechanical ventilation, employers shall filter recirculated air with Minimum Efficiency Reporting Value (MERV) 13 or higher efficiency filters if compatible with the ventilation system. If MERV-13 or higher filters are not compatible with the ventilation system, employers shall use filters with the highest compatible filtering efficiency. . . .[189]

Although this title 8 regulation expires by its own terms on February 3, 2025, the ventilation requirements in subdivision (f) continue pursuant to section 3205(h)(4) in title 8 that states; "A place of employment subject to section 3205.1 after February 3, 2023 shall continue to comply with the ventilation requirements of subsection 3205.1(f) even after the outbreak has passed and section 3205.1 is no longer applicable."[190] And, as

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[188] See California Code of Regulations, title 8, section 3205.1(a)(1). (Register 2022, No. 18.) Section 3205(b)(7) of title 8 defines "exposed group" to mean "all employees at a work location, working area, or a common area at work, within employer-provided transportation covered by section 3205.3, or residing within housing covered by section 3205.2, where an employee COVID-19 case was present at any time during the infectious period. A common area at work includes bathrooms, walkways, hallways, aisles, break or eating areas, and waiting areas. The following exceptions apply:

(A) For the purpose of determining the exposed group, a place where persons momentarily pass through, without congregating, is not a work location, working area, or a common area at work.

(B) If the COVID-19 case was part of a distinct group of employees who are not present at the workplace at the same time as other employees, for instance a work crew or shift that does not overlap with another work crew or shift, only employees within that distinct group are part of the exposed group.

(C) If the COVID-19 case visited a work location, working area, or a common area at work for less than 15 minutes during the infectious period, and the COVID-19 case was wearing a face covering during the entire visit, other people at the work location, working area, or common area are not part of the exposed group.

[189] California Code of Regulations, title 8, section 3205.1(f) (Register 2022, No. 18, eff. May 5, 2022.)

[190] California Code of Regulations, title 8, sections 3205(h)(4) (Register 2023, No. 29, eff. Feb. 2, 2023), 3205.1(a) (Register 2023, No. 29, eff. Feb. 2, 2023.)

stated above, schools were required by prior law to regularly replace or clean these filters.[191]

Therefore, the requirement in Education Code section 17661(c) to install filtration that achieves MERV levels of 13 or higher, or install filtration that achieves the highest MERV level the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system, is new only for schools with HVAC systems approved for installation *before* January 1, 2020 (under the 2016 or earlier Energy Code), and only to the extent these schools did *not* have a COVID-19 outbreak as defined in section 3205.1 of the title 8 regulations. Although the claimant alleges the test claim statute requires school districts to replace the MERV 13 filters more often and every three months,[192] the requirement imposed by Education Code section 17661(c) is a <u>*one-time*</u> requirement to purchase and install the required filters since prior law already required employers, including school districts, to regularly replace or clean filters, regardless of the filter efficiency level.[193] On-going filter purchase and installation is not new.[194]

b. <u>The one-time new requirement imposed by Education Code section 17661(c) is mandated by the state.</u>

The California Supreme Court has made it clear a state-mandated requirement exists when a statute or executive order uses mandatory language that 'require[s]' or 'command[s]' a local entity to participate in a program or service"; in other words, local government "has the legally enforceable duty to obey."[195] Education Code section 17661(c) states: "a covered school *shall*, . . . install filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system." According to Education Code section 75: ""Shall" is mandatory and "may" is permissive."

Therefore, the new one-time requirement imposed by Education Code section 17661(c) is mandated by the state only on school districts with HVAC systems approved for installation in their schools before January 1, 2020 (under the 2016 or earlier Energy

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191 California Code of Regulations, title 8, section 5143(d)(3) (as last amended by Register 2003, No. 24.)

192 Exhibit A, Test Claim, filed November 17, 2023, page 13.

193 California Code of Regulations, title 8, section 5143 (as last amended by Register 2003, No. 24.)

194 Even if installing MERV 13 filters is more costly, as asserted by the claimant, increased costs alone do not establish the right to reimbursement under article XIII B, section 6 of the California Constitution. (*County of Los Angeles v. State of California* (1987) 43 Cal.3d 46, 54; *Department of Finance v. Commission on State Mandates* (*Kern High School Dist.*) (2003) 30 Cal.4th 727, 735; *San Diego Unified School Dist. v. Commission on State Mandates* (2004) 33 Cal.4th 859, 876-877.)

195 *Coast Community College Dist. v. Commission on State Mandates* (2022) 13 Cal.5th 800, 815.

Code) and only to the extent these district's schools did *not* have a COVID-19 outbreak as defined in section 3205.1 of the title 8 regulations, to install filtration that achieves MERV levels of 13 or higher or install filtration that achieves the highest MERV level the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system.

This finding also applies to school districts that applied for grant funding under the School Energy Efficiency Stimulus Program,[196] which includes the School Reopening Ventilation and Energy Efficiency Verification and Repair Program (SRVEVR).[197] As described in the Background, school districts, as a condition of receiving grant funds, are required to install filtration with a minimum MERV 13 or better where feasible, and have qualified testing personnel review system capacity and airflow to determine the highest MERV filtration that can be installed without adversely impacting the equipment, replace or upgrade filters where needed, and verify those filters are installed correctly.[198] Participating in that grant program is not mandated by state law, but is optional. Government Code section 17565 states "If a local agency or a school district, at its option, has been incurring costs which are subsequently mandated by the state, the state shall reimburse the local agency or school district for those costs incurred after the operative date of the mandate."[199]

Thus, the one-time new requirement imposed by Education Code section 17661(c) is mandated by the state as described above.

c. <u>The one-time new requirement imposed by Education Code section 17661(c) constitutes a new program or higher level of service.</u>

The one-time mandated activity imposed by section 17661(c) must also constitute a new program or higher level of service within the meaning of article XIII B, section 6. "New program or higher level of service" is defined as "programs that carry out the governmental function of providing services to the public, or laws which, to implement a state policy, impose unique requirements on local governments and do not apply

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[196] Public Utilities Code section 1600 et seq. (AB 841, Stats. 2020, ch. 372).

[197] Public Utilities Code section 1620 et seq. SRVEVR is the acronym defined in the bill. See Public Utilities Code section 1601(b) (Stats. 2020, ch. 372).

[198] Public Utilities Code section 1623(a)(1) (Stats. 2020, ch. 372).

[199] However, any grant funding received under the program would have to be identified as offsetting revenues and the claimant would be required to show, with evidence in the record, it incurred increased costs mandated by the state of its proceeds of taxes above and beyond the use of the grant funds. (*County of Fresno v. State of California* (1991) 53 Cal.3d 482, 487.) Reimbursement under article XIII B, section 6 is only required when a mandated new program or higher level of service forces local government to incur "increased actual expenditures of limited tax proceeds that are counted against the local government's spending limit." (*County of Sonoma v. Commission on State Mandates* (2000) 84 Cal.App.4th 1264, 1283; *County of Los Angeles v. Commission on State Mandates* (2003) 110 Cal.App.4th 1176, 1185.)

generally to all residents and entities in the state."[200] Only one of these alternatives is required to establish a new program or higher level of service.[201] Courts have found a reimbursable "higher level of service" concerning an existing "program" when a state law or executive order mandates not merely some change that increases the cost of providing services, but an increase in the actual level or quality of governmental services provided.[202]

Here, school districts have purchased and installed MERV filters before the enactment of the test claim statute, based on the Energy Code requirements in effect at the time their permits were approved. However, as stated above, the test claim statute imposes a newly mandated requirement to increase the MERV efficiency level, by installing a higher rated filter if feasible without significantly reducing the lifespan or performance of the existing HVAC system, for schools with HVAC systems approved for installation before January 1, 2020, that did *not* have a COVID-19 outbreak. The intent of the test claim statute is for "school facilities [to] provide healthy indoor air quality, including adequate ventilation, to students, teachers, and other occupants in order to protect occupant health, reduce sick days, and improve student productivity and performance."[203] Filters with higher MERV ratings are generally better, as they can capture smaller particles.[204] Protecting the health and improving the productivity and performance of pupils are governmental services to the public, and the increase in the MERV efficiency increases the level or quality of service provided. That the test claim statute also applies to private schools does not change this conclusion. As the courts have said, "although numerous private schools exist, education in our society is considered to be a peculiarly governmental function."[205]

Thus, the one-time new requirement imposed by Education Code section 17661(c) constitutes a new program or higher level of service within the meaning of article XIII B, section 6.

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[200] *Carmel Valley Fire Protection Dist. v. State of California* (1987) 190 Cal.App.3d 521, 537; *Department of Finance v. Commission on State Mandates* (2021) 59 Cal.App.5th 546, 557.

[201] *Carmel Valley Fire Protection Dist. v. State of California* (1987) 190 Cal.App.3d 521, 537; *Department of Finance v. Commission on State Mandates* (2021) 59 Cal.App.5th 546, 557.

[202] *San Diego Unified School Dist. v. Commission on State Mandates* (2004) 33 Cal.App.4th 859, 877.

[203] Education Code section 17660 (Stats. 2022, ch. 777).

[204] Exhibit X (7), California Energy Commission, 2022 Residential Compliance Manual, https://www.energy.ca.gov/filebrowser/download/5126 (accessed on May 2, 2024), pages 4-39 to 4-40.

[205] *Long Beach Unified School Dist. v. State of California* (1990) 225 Cal.App.3d. 155, 172.

d. <u>There is no evidence in the record the claimant has incurred any increased costs mandated by the state to comply with the new state-mandated activity.</u>

The last issue is whether the new activity mandated by Education Code section 17661(c) results in increased costs mandated by the state. Government Code section 17514 defines "costs mandated by the state" as any increased cost a local agency or school district incurs as a result of any statute or executive order that mandates a new program or higher level of service. Government Code section 17564(a) further requires no claim nor any payment shall be made unless the claim exceeds $1,000. All representations of fact shall be supported by documentary or testimonial evidence in accordance with section 1187.5 of the Commission's regulations.[206] In addition, a finding of costs mandated by the state means none of the exceptions in Government Code section 17556 apply to deny the claim.

The Test Claim does not acknowledge any prior law requirements to install MERV 13 filters when a new HVAC system is approved for installation under the 2019 or 2022 Energy Code or when a COVID outbreak occurs, or the existing requirement to regularly replace or clean these filters. Instead the Test Claim alleges increased costs, supported by a declaration from the claimant's Deputy Superintendent of Business Services, for the following costs to install MERV 13 filters in *all* of its schools' HVAC systems.[207] The claimant also alleges it hired two employees to replace and install the MERV 13 air filters every three months.[208]

Year	Costs
January 1, 2023, to June 30, 2023	$27,443.12 labor to install filters $66,236.22, for MERV 13 filters.[209]
July 1, 2023, to June 30, 2024	$81,669.06 estimated labor to install filters $100,119.04 estimated for MERV 13 filters[210]
July 1, 2024, to June 30, 2025	$120,624.56 estimated labor to install filters $151,920.32 estimated for MERV 13 filters.[211]

The Declaration submitted by the claimant also identifies revenues received under the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) that provides funding

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206 California Code of Regulations, title 2, section 1183.1(e).

207 Exhibit A, Test Claim, filed November 17, 2023, pages 13, 18-19 (Landon Declaration).

208 Exhibit A, Test Claim, filed November 17, 2023, pages 14, 19 (Landon Declaration). In rebuttal comments, the claimant states it replaces its HVAC rooftop units every six months and portable wall units every three months. Exhibit C, Claimant's Rebuttal Comments, filed March 14, 2024, pages 2, 5 (Landon Declaration).

209 Exhibit A, Test Claim, filed November 17, 2023, pages 14, 19 (Landon Declaration).

210 Exhibit A, Test Claim, filed November 17, 2023, pages 14, 19 (Landon Declaration).

211 Exhibit A, Test Claim, filed November 17, 2023, pages 15, 20 (Landon Declaration).

to Local Education Agencies through the Elementary and Secondary School Emergency Relief (ESSER) Fund to address the impact of COVID-19 on elementary and secondary schools. The claimant used these funds to *replace* HVAC systems, beginning in June 2021, and to purchase MERV 13 filters as follows:

> 14. The Claimant received Elementary and Secondary School Emergency Relief (ESSER) II funds in the amount of $26,295,815. These funds were distributed from June 2021 to August 2023 towards the Districtwide HVAC project to remove and replace HVAC systems at elementary, middle, and high schools. Prior to January 1, 2023, ESSER funds were used to purchase MERV 13 filters in the initial implementation of the new HVAC systems.
>
> 15. The Claimant received Elementary and Secondary School Emergency Relief (ESSER) III funds in the amount of $58,852,535. The Claimant allocated $13 million towards the Districtwide HVAC project to remove and replace HVAC systems at elementary, middle, and high schools. The difference is due to the Claimant having other priorities in spending the remainder of ESSER III funds. The Claimant has until September 30, 2024, to spend this allocation. There will be no additional allocations of ESSER funds. Attached are Department of General Services, Division of the State Architect approval plans for the replacement of the District's HVAC.[212]

What this evidence shows is the claimant has schools *not* subject to the new mandated requirement since any new HVAC installation approved beginning in June 2021 would have been approved under the 2019 and 2022 Energy Codes. As indicated above, the MERV 13 requirement in Education Code section 17661(c) is *not* new and does not mandate a new program or higher level of service to the extent a school received a permit or equivalent approval to install a new HVAC system after January 1, 2020 (under the 2019 or 2022 Energy Code) because those Codes already required the HVAC system to have filters with a designated efficiency equal to or greater than MERV 13.[213]

However, there is *no* evidence in the record the claimant has incurred any increased costs mandated by the state to perform the mandated new program or higher level of service. As stated above, the mandated activity is the one-time installation of MERV 13 or higher filters or installing filtration that achieves the highest MERV level the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system, in schools with HVAC systems that were approved for installation *before* January 1, 2020 (under the 2016 or earlier Energy Code), and only to the extent these district's schools did *not* have a COVID-19 outbreak as defined in

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[212] Exhibit A, Test Claim, filed November 17, 2023, page 20 (Landon Declaration).

[213] California Code of Regulations, title 24, part 6, section 120.1(c)(1)(B). The citation is the same under both the 2019 and 2022 Energy Codes.

section 3205.1 of the title 8 regulations. The Commission cannot make a finding of increased costs mandated by the state without evidence in the record.[214]

Therefore, the Commission finds there is no evidence of increased costs mandated by the state within the meaning of Government Code section 17514 to perform the mandated new activity imposed by Education Code section 17661(c).

V. Conclusion

Accordingly, the Commission finds the test claim statute does not impose a reimbursable state-mandated program within the meaning of article XIII B, section 6 of the California Constitution and Government Code section 17514 and denies this Test Claim.

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[214] Government Code section 17514; California Code of Regulations, title 2, section 1183.1(e).

DECLARATION OF SERVICE BY EMAIL

I, the undersigned, declare as follows:

I am a resident of the County of Sacramento and I am over the age of 18 years, and not a party to the within action. My place of employment is 980 Ninth Street, Suite 300, Sacramento, California 95814.

On September 3, 2024, I served the:

- **Current Mailing List dated September 3, 2024**
- **Draft Proposed Decision, Schedule for Comments, and Notice of Hearing issued September 3, 2024**

  Heating, Ventilation, and Air Conditioning (HVAC) Program, 23-TC-01
  Statutes 2022, Chapter 777, Sections 1, 2 (AB 2232);
  Education Code Sections 17660, 17661, Effective January 1, 2023
  Hesperia Unified School District, Claimant

by making it available on the Commission's website and providing notice of how to locate it to the email addresses provided on the attached mailing list.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that this declaration was executed on September 3, 2024 at Sacramento, California.

Jill Magee

Jill Magee
Commission on State Mandates
980 Ninth Street, Suite 300
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COMMISSION ON STATE MANDATES

Mailing List

Last Updated: 9/3/24

Claim Number: 23-TC-01

Matter: Heating, Ventilation, and Air Conditioning (HVAC) Program

Claimant: Hesperia Unified School District

TO ALL PARTIES, INTERESTED PARTIES, AND INTERESTED PERSONS:

Each commission mailing list is continuously updated as requests are received to include or remove any party or person on the mailing list. A current mailing list is provided with commission correspondence, and a copy of the current mailing list is available upon request at any time. Except as provided otherwise by commission rule, when a party or interested party files any written material with the commission concerning a claim, it shall simultaneously serve a copy of the written material on the parties and interested parties to the claim identified on the mailing list provided by the commission. (Cal. Code Regs., tit. 2, § 1181.3.)

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Exhibit E

RECEIVED
September 23, 2024
Commission on State Mandates

September 24, 2024

Heather Halsey
Executive Director
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Re: *Comments to Draft Proposed Decision*
Heating, Ventilation, and Air Conditioning (HVAC) Program, 23-TC-01
Statutes 2022, Chapter 777, Sections 1, 2 (AB 2232); Education Code Sections 17660, 17661, Effective January 1, 2023
Hesperia Unified School District, Claimant

Dear Ms. Halsey:

Hesperia Union School District ("Claimant") provides the following comments on the Draft Proposed Decision ("DPD").

A. Introduction

Test Claim 23-TC-01, Heating, Ventilation, and Air Conditioning (HVAC) Program addresses new legislation that includes Education Code Section 17660 and 17661 requiring schools in the State to ensure that facilities have heating, ventilation, and air conditioning (HVAC) systems that meet specified minimum ventilation rate requirements, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate, requiring a public school to ensure its HVAC system meets the minimum ventilation rates.

Assembly Bill 2232 also requires public schools to install filtration that achieves specified minimum efficiency reporting values (MERV) levels, determined by the school to be feasible with the existing HVAC system, as provided. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Sections 1, 2, Education Code Sections 17660, 17661, Enacted on September 29, 2022, Effective Date: January 1, 2023.)

The Draft Proposed Decision concluded the test claim was filed timely.

1. *Education Code section 17661(c) imposes a reimbursable state mandated program*.[1]

AB 2232, School facilities: heating, ventilation, and air conditioning systems states:

> This bill would require a covered school, defined as a school district, a county office of education, a charter school, a private school, the California Community Colleges, or the California State University, and would request the University of California, to ensure that facilities have heating, ventilation, and air conditioning (HVAC) systems that meet specified minimum ventilation rate requirements, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate, in which case the bill would require a covered school, and request the University of California, to ensure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued. The bill would also require a covered school, and request the University of California, to install filtration that achieves specified minimum efficiency reporting values (MERV) levels, determined by the school to be feasible with the existing HVAC system, as provided.

(AB 2232 Legislative Counsel Digest)

AB 2232 legislative enacted on September 22, 2022, added Education Code Section 17661 that required the following: "(c) (1) Subject to paragraph (2), a covered school shall, and the University of California is requested to, install filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school." Attached is a declaration supporting the initial (one-time) costs incurred by the claimant for the purchase and installation of the MERV 13 filters.

It was not until AB 2232, that California schools were explicitly required to install MERV 13 or higher filters in their HVAC systems. AB 2232 set new ventilation standards and formalized the requirement for MERV 13 filters to be used, specifically to address both indoor air quality and public health concerns related to the spread of airborne pathogens. AB 2232 was

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[1] Claimant agrees with the DPD recommendation Education Code section 17660 and uncodified section 1, as added by the test claim statute does not impose a reimbursable state mandate as it does not require school districts to perform any activities.

Claimant agrees with the DPD recommendation Education Code section 17661 (a), (d), and (e), as added by the test claim statute does not impose a reimbursable state mandate since it does not require school districts to perform any activities.

enacted to deal with poor air quality in classrooms that is a pervasive problem that negatively impacts student health and learning.

AB 2232 and Education Code Section 17661(c) for the first time required schools to use MERV 13 filters. California Code of Regulations, title 24, part 6, section 120.1(c)(1)(B) requirements for ventilation and indoor air quality are applicable to "All occupiable spaces in hotel/motel buildings, and nonresidential buildings other than healthcare facilities shall comply with the applicable requirements of Section 120.1(a) through 120.1(g). (DPD Footnote 13; page 5) Healthcare facilities shall be ventilated in accordance with Chapter 4 of the California Mechanical Code." [2] This requirement did not include schools.

This is further supported by Education Code section 17661 that states:

> A covered school shall, and the University of California is requested to, ensure that facilities, including, but not limited to, classrooms for students, have HVAC systems that meet the minimum ventilation rate requirements set forth in Table 120.1-A of Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations, unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate.

(Education Code section 17661(b)(1).)

California Code of Regulations, title 8, section 5143(d)(3). (Register 2003, No. 24.) (DPD Footnote 14; page 5) is under the Labor Code with the Occupational Safety and Health Standards Board (Board) authorized to develop health and safety requirements for the protection of workers. Regulations adopted by the Board (Title 8, Section 5142) require HVAC systems to be maintained and operated in accordance with the State Building Standards Code and continuously functioning during working hours with some exceptions (e.g., during scheduled maintenance)

2. *Prior law did not require schools to have MERV 13 ventilation*.

Prior to the enactment of AB 2232 (effective from January 1, 2023), California Education Code Section 17661 pertained to the general authorization for school districts to enter into contracts and agreements for the construction, reconstruction, or alteration of school buildings or other facilities. The section provided general guidelines on the responsibilities of school districts in relation to the acquisition, lease, and maintenance of school properties. It did not yet

[2] SECTION 120.1 – REQUIREMENTS FOR VENTILATION AND INDOOR AIR QUALITY (a) General Requirements.

1. All occupiable spaces in hotel/motel buildings, and nonresidential buildings other than healthcare facilities shall comply with the applicable requirements of Section 120.1(a) through 120.1(g). Healthcare facilities shall be ventilated in accordance with Chapter 4 of the California Mechanical Code.

incorporate the specific mandates regarding heating, ventilation, and air conditioning (HVAC) systems that AB 2232 introduced.

AB 2232 added specific requirements related to HVAC systems in schools, such as standards for ensuring proper air quality and temperature control, including regular inspections, maintenance, and reporting to ensure safe and healthy conditions in classrooms.

Prior to Assembly Bill 2232, MERV 13 filters were not required for all California schools. Although Assembly Bill 841 (passed in 2020) encouraged the use of MERV 13 filters in schools' HVAC systems and provided funding for ventilation upgrades, it did not make the use of these filters a statewide mandate. (https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201920200AB841)

Title 8 of the California Code of Regulations generally deals with workplace safety, governed by Cal/OSHA (California Occupational Safety and Health Administration). Section 3205, along with its subsections like 3205.1 requirements due to the COVID-19 Outbreaks to install MERV 13 filters sunsets on February 3, 2025. [3] Claimant will continue to be required to comply with the requirements of Education Code Section 17661(c).

Certification

I certify by my signature below, under penalty of perjury under the laws of the State of California, that the statements made in this document are true and complete to the best of my own personal knowledge or based on information and belief and that I am authorized and competent to do so.

September 23, 2024

Arthur Palkowitz
Arthur M. Palkowitz
Representative for the Claimant

[3] COVID-19 Outbreaks California Code of Regulations, title 8, section 3205.1(a)(1)(Register 2022, No. 18, eff. May 5, 2022) and California Code of Regulations, title 8, section 3205.1(f) (Register 2022, No. 18, eff. May 5, 2022) are in effect until February 3, 2025.

Hesperia Unified School District

School	Rooftop Labor Hours	Portable Labor Hours	Total Labor Hours for Rooftop and Portables	Senior Maintenance Worker Hourly Rate with Statutories	Total Labor Cost
Carmel	8	2	10	$ 41.33	$ 371.97
Cottonwood	8	2	44	$ 41.33	$ 1,074.58
Hollyvale	8	2	44	$ 41.33	$ 1,074.58
Joshua Circle	10	4	64	$ 41.33	$ 1,529.21
Juniper	8	2	44	$ 41.33	$ 1,074.58
Kingston	10	4	64	$ 41.33	$ 1,529.21
Lime Street	8	4	56	$ 41.33	$ 1,322.56
Maple	8	3	50	$ 41.33	$ 1,198.57
Mesa Grande	10	4	64	$ 41.33	$ 1,529.21
Mesquite Trails	8	2	44	$ 41.33	$ 1,074.58
Cedar Middle	12	5	78	$ 41.33	$ 1,859.85
Hesperia Jr	12	6	84	$ 41.33	$ 1,983.84
Mojave	12	8	96	$ 41.33	$ 2,231.82
Shadow Ridge	8	0	32	$ 41.33	$ 826.60
Total					$ 18,681.16

Hesperia Unified School District

MERV 13 Filters

Size of Filters

School	20x30x2	Cost Per Filter	Cost	16x25x2	Cost per Filter	Cost	16x20x2	Cost per Filter	Cost	20x20x2	Cost per Filter	Cost	Total MERV 13 Filter Cost
Carmel	16	$ 18.04	$ 288.64	56	$ 11.51	$ 644.56	2	$ 9.95	$ 19.90	12	$ 11.51	$ 138.12	$ 1,022.16
Cottonwood	23	$ 18.04	$ 414.92	54	$ 11.51	$ 621.54	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,099.28
Hollyvale	8	$ 18.04	$ 144.32	58	$ 11.51	$ 667.58	8	$ 9.95	$ 79.60	8	$ 11.51	$ 92.08	$ 937.54
Joshua Circle	28	$ 18.04	$ 505.12	44	$ 11.51	$ 506.44	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,074.38
Juniper	32	$ 18.04	$ 577.28	44	$ 11.51	$ 506.44	4	$ 9.95	$ 39.80	4	$ 11.51	$ 46.04	$ 1,146.54
Kingston	30	$ 18.04	$ 541.20	54	$ 11.51	$ 621.54	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,202.54
Lime Street	21	$ 18.04	$ 378.84	62	$ 11.51	$ 713.62	16	$ 9.95	$ 159.20	2	$ 11.51	$ 23.02	$ 1,263.17
Maple	24	$ 18.04	$ 432.96	54	$ 11.51	$ 621.54	8	$ 9.95	$ 79.60	-	$ 11.51	$ -	$ 1,134.10
Mesa Grande	24	$ 18.04	$ 432.96	58	$ 11.51	$ 667.58	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,140.34
Mesquite Trails	22	$ 18.04	$ 396.88	54	$ 11.51	$ 621.54	2	$ 9.95	$ 19.90	12	$ 11.51	$ 138.12	$ 1,107.38
													$ -
Cedar Middle	64	$ 18.04	$ 1,154.56	28	$ 11.51	$ 322.28	4	$ 9.95	$ 39.80	26	$ 11.51	$ 299.26	$ 1,666.27
Hesperia Jr	46	$ 18.04	$ 829.84	100	$ 11.51	$ 1,151.00	34	$ 9.95	$ 338.30	16	$ 11.51	$ 184.16	$ 2,411.22
													$ -
													$ -
Mojave	40	$ 18.04	$ 721.60	34	$ 11.51	$ 391.34	4	$ 9.95	$ 39.80	-	$ 11.51	$ -	$ 1,152.74
IT	6	$ 18.04	$ 108.24	0	$ 11.51	$ -	3	$ 9.95	$ 29.85	11	$ 11.51	$ 126.61	$ 201.40
Total			$ 6,927.36			$ 8,057.00			$ 1,004.95			$ 1,139.49	$ 16,559.06

Test Claim: Heating, Ventilation, and Air Conditioning (HVAC)
Claimant: Hesperia Unified School District
Section: 6 Declaration- Dr. George Landon, Deputy Superintendent, Business Service, Hesperia Unified School District

SECTION NUMBER: 6
Heading: DECLARATION

I, Dr. George Landon, Deputy Superintendent, Business Service, Hesperia Unified School District (Claimant) declare as follows:

1. I am currently employed with the Claimant, and I have been employed with the Claimant since July 1, 2016.

2. I have personal knowledge of the actual and estimated costs incurred by the Claimant for the School Facilities: Heating, Ventilation, and Air Conditioning ("HVAC") Systems commencing on January 1, 2023. The information contained in my declaration is from preparing and reviewing Claimant's business records, my personal knowledge and my information or belief pertaining to the Claimant's HVAC Systems.

3. The new requirements included in test claim statute Assembly Bill No. 2232, Statutes 2022, Chapter 777, Education Code Section 17661, Enacted on September 29, 2022, Effective January 1, 2023, include the activities of purchasing and installing MERV 13 air filters in the Claimant's facilities HVAC Systems.

4. The procedure for receiving and installing the MERV 13 air filters is as follows. MERV 13 air filters are delivered to different staging areas. They are delivered by the vendor and unloaded by our staff. The process was very easy with the previous MERV 9 1" air filters. The MERV 13 filters are 2" requiring more storage space. The filters are loaded and transported to the school facility site that may require multiple trips and additional labor hours.

5. Every school site has roof top units. Claimant uses a rope to lift the roof top units on to the roof. The filter changers use cordless drill motors and hand tools to remove and replace the filters. The coils are covered with the new box filters that takes additional time and multiple trips. There is triple the number of boxes because of the larger filters. The units are closed and the old filters are disposed of. There is a significant increase in labor due to the additional work involved in maintaining the units.

6. I have submitted documentation (HVAC 105-HVAC 106) stating the following: List of District Schools (22); Total Units (830); Total Roof Tops Replaced (815); Total Roof Tops Not Replaced (15); Total Wall Mounts (614); Total Wall Units Replaced (517); Total Roof Tops Not Replaced (97).

7. The Claimant first incurred increased one-time labor costs to replace and install the MERV 13 air filters on about January 1, 2023 in the amount of **$18,681.16.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

8. The Claimant first incurred increased one-time costs on about January 1, 2023 for purchasing the MERV 13 air filters in the amount of **$16,559.06.** (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Section 2, Education Code Section 17661(c)(1)).

9. The Claimant's General funds are the funding sources for the initial purchasing of the MERV 13 air filter costs and the labor of replacing and installing the MERV 13 air filters.

10. The good repair, working order, and condition requirements of the Leroy F. Greene School Facilities Act of 1998 or its predecessor program, the State School Building Lease-Purchase Law of 1976 does not include Assembly Bill 2232 requiring public schools to install filtration that achieves specified minimum efficiency reporting values (MERV) levels, determined by the school to be feasible with the existing HVAC system. (Assembly Bill No. 2232, Statutes 2022, Chapter 777, Sections 1, 2, Education Code Sections 17660, 17661, Enacted on September 29, 2022, Effective Date: January 1, 2023)

11. I am unaware of any local, state, or federal funds or fee authority that may be used to offset the increased costs that will be incurred by claimant to implement the alleged mandate, including direct and indirect costs. This declaration is intended to provide additional information to my previous declarations.

I certify by my signature below, under penalty of perjury under the laws of the State of California, that the statements made in this document are true and complete to the best of my own personal knowledge or information and belief and I am authorized and competent to do so.

Dated: September 23, 2024

DR. GEORGE LANDON, DEPUTY
SUPERINTENDENT, BUSINESS SERVICE
HERSPERIA UNIFIED SCHOOL DISTRICT

DECLARATION OF SERVICE BY EMAIL

I, the undersigned, declare as follows:

I am a resident of the County of Sacramento and I am over the age of 18 years, and not a party to the within action. My place of employment is 980 Ninth Street, Suite 300, Sacramento, California 95814.

On September 23, 2024, I served the:

- **Current Mailing List dated September 4, 2024**
- **Claimant's Comments on the Draft Proposed Decision filed September 23, 2024**

  Heating, Ventilation, and Air Conditioning (HVAC) Program, 23-TC-01
  Statutes 2022, Chapter 777, Sections 1, 2 (AB 2232);
  Education Code Sections 17660, 17661, Effective January 1, 2023
  Hesperia Unified School District, Claimant

by making it available on the Commission's website and providing notice of how to locate it to the email addresses provided on the attached mailing list.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that this declaration was executed on September 23, 2024 at Sacramento, California.

David Chavez

David Chavez
Commission on State Mandates
980 Ninth Street, Suite 300
Sacramento, CA 95814
(916) 323-3562

COMMISSION ON STATE MANDATES

Mailing List

Last Updated: 9/4/24

Claim Number: 23-TC-01

Matter: Heating, Ventilation, and Air Conditioning (HVAC) Program

Claimant: Hesperia Unified School District

TO ALL PARTIES, INTERESTED PARTIES, AND INTERESTED PERSONS:

Each commission mailing list is continuously updated as requests are received to include or remove any party or person on the mailing list. A current mailing list is provided with commission correspondence, and a copy of the current mailing list is available upon request at any time. Except as provided otherwise by commission rule, when a party or interested party files any written material with the commission concerning a claim, it shall simultaneously serve a copy of the written material on the parties and interested parties to the claim identified on the mailing list provided by the commission. (Cal. Code Regs., tit. 2, § 1181.3.)

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Exhibit F

(http://www.ca.gov)

(mailto:?subject=Codes&body=%0ahttps%3A%2F%2Fwww.dgs.ca.gov%2FBSC%2FCodes%0a%0a)

Translate

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Codes

CALIFORNIA BUILDING STANDARDS CODE

Expand All

2022 TRIENNIAL EDITION OF TITLE 24

The 2022 California Building Standards Code (Cal. Code Regs., Title 24) will be published July 1, 2022, with an effective date of January 1, 2023. Summaries of the code changes (/BSC/Resources/2022-Title-24-California-Code-Changes) in this edition and the supplements are available under the Resources (/BSC/Resources)tab of the CBSC website.

The active links below will take you to each publisher's website. Please contact CBSC at cbsc@dgs.ca.gov (mailto:cbsc@dgs.ca.gov) if you have difficulty accessing the codes.

PART 1 – CALIFORNIA ADMINISTRATIVE CODE (https://codes.iccsafe.org/content/CAAC2022P1)

- Supplement — Part 1 (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-California-Administrative-Code-Part-1-Errata-eff.-July-2024_COMPLETE.pdf) Check history note appendices to determine effective date of each change.

PART 2 – [CALIFORNIA BUILDING CODE (https://codes.iccsafe.org/content/CABC2022P1)] — Volumes 1 & 2

- Errata — Part 2, Volume 1 (non-substantive corrections) (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-California-Building-Code-Part-2-Vol-1-Errata-eff.-January-2023-5520S221.pdf) Effective January 1, 2023
- Supplement — Part 2 Volume 1 (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-CA_Bldg-Vol-1_July24-Supp_COMPLETE.pdf) Effective July 1, 2024
- Errata — Part 2, Volume 2 (non-substantive corrections) (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-California-Building-Code-Part-2-Vol-2-Errata-eff.-January-2023-5520S221.pdf) Effective January 1, 2023
- Supplement — Part 2 Volume 2 (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-CA_Bldg-Vol-2_July24-Supp_COMPLETE.pdf) Effective July 1, 2024

PART 2.5 – CALIFORNIA RESIDENTIAL CODE (https://codes.iccsafe.org/content/CARC2022P1)

- Errata — Part 2.5 (non-substantive corrections) (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-California-Residential-Code-Part-2.5-Errata-eff.-January-2023-5525S221.pdf)Effective January 1, 2023
- Supplement — Part 2.5 (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-California-Residential-Code-Part-2.5-Errata-eff.-July-2024_COMPLETE.pdf) Effective July 1, 2024

PART 3 – CALIFORNIA ELECTRICAL CODE (https://link.nfpa.org/free-access/publications/70/2022California)

NOTE*: NFPA requires creation of a user login to view its free online resources.*

PART 4 – CALIFORNIA MECHANICAL CODE (https://epubs.iapmo.org/2022/CMC/index.html)

- Supplement — Part 4 (https://www.iapmo.org/media/31991/2022-cmc-supplement-packet-effective-07-01-24.pdf) Effective July 1, 2024

PART 5 – CALIFORNIA PLUMBING CODE (https://epubs.iapmo.org/2022/CPC/)

- Errata — Part 5 (non-substantive corrections) Effective January 1, 2023 (https://www.iapmo.org/media/30783/2022-cpc-errata-effective-01012023.pdf)
- Supplement — Part 5 (https://www.iapmo.org/media/31990/2022-cpc-supplement-packet-effective-07-01-24.pdf) Effective July 1, 2024

PART 6 – CALIFORNIA ENERGY CODE (https://codes.iccsafe.org/content/CAEC2022P1)

- Errata — Part 6 (non-substantive corrections) (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-California-Energy-Code-Part-6-Errata-eff.-January-2023-5560S221-1.pdf) Effective January 1, 2023
- Supplement — Part 6 (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-CA_Energy_July24-Supp_COMPLETE.pdf) Effective July 1, 2024

PART 7 – Vacant - formerly California Elevator Safety Construction Code (see Cal. Code Regs., Title 8)

PART 8* – CALIFORNIA HISTORICAL BUILDING CODE (https://codes.iccsafe.org/content/CAHBC2022P1)

PART 9 – CALIFORNIA FIRE CODE (https://codes.iccsafe.org/content/CAFC2022P1)

- Errata — Part 9 (non-substantive corrections) (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-California-Fire-Code-Part-9-Errata-eff.-January-2023-5590S221.pdf) Effective January 1, 2023
- Supplement — Part 9 (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-CA_Fire_July24-Supp_COMPLETE-reduced.pdf) Effective July 1, 2024

PART 10* – CALIFORNIA EXISTING BUILDING CODE (https://codes.iccsafe.org/content/CAEBC2022P1)

- Supplement — Part 10 (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-CA_Exist_July24-Supp_COMPLETE.pdf) Effective July 1, 2024

PART 11 – CALIFORNIA GREEN BUILDING STANDARDS CODE (https://codes.iccsafe.org/content/CAGBC2022P1) also referred to as ***CALGreen***

- Errata — Part 11 (non-substantive corrections) (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-California-Green-Code-Part-11-Errata-eff.-January-2023-5570S221.pdf)Effective January 1, 2023
- Supplement — Part 11 (https://www.iccsafe.org/wp-content/uploads/errata_central/2022-CA_Green_July24-Supp_COMPLETE.pdf) Effective July 1, 2024

PART 12* – CALIFORNIA REFERENCED STANDARDS CODE (https://codes.iccsafe.org/content/CARSC2022P1)

**The printed versions of Parts 8, 10, and 12 are located in a shared binder featuring Part 10.*

2019 TRIENNIAL EDITION OF TITLE 24

2016 TRIENNIAL EDITION OF TITLE 24

2013 TRIENNIAL EDITION OF TITLE 24

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The California Building Standards Code (Cal. Code Regs., Title 24) is available for purchase from the following publishers or is viewable at no cost through several State Document Depository Libraries (http://www.library.ca.gov/government-publications/state-document-depository-program/depositories).

International Code Council (ICC) (https://shop.iccsafe.org/)
Parts 1, 2, 2.5, 6, 8, 9, 10, 11 and 12
(800) 786-4452

International Association of Plumbing and Mechanical Officials (IAPMO) (https://iapmomembership.org/store/)
Parts 4 and 5
(909) 472-4208

National Fire Protection Association (NFPA) (https://catalog.nfpa.org/NFPA-70-National-Electrical-Code-with-California-Amendments-P17223.aspx)
Part 3 - 2019 +
(800) 344-3555

BNi Building News (https://www.bnibooks.com/)

Part 3 - 2016

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CALIFORNIA BUILDING STANDARDS CODE (CALIFORNIA CODE OF REGULATIONS, TITLE 24)

The California Building Standards Code is a compilation of three types of building standards from three different origins:

- Building standards that have been adopted by state agencies without change from building standards contained in national model codes;
- Building standards that have been adopted and adapted from national model codes to address California's ever-changing conditions; and

- Building standards, authorized by the California legislature, that constitute amendments not covered by national model codes, that have been created and adopted to address particular California concerns.

All occupancies in California are subject to national model codes adopted into Title 24, and occupancies are further subject to amendments adopted by state agencies and ordinances implemented by local jurisdictions' governing bodies.

State Agency Adoptions and Matrix Adoption Tables

About Title 24

About Title 24 - Educational Video

2023-24 CALENDAR

Contact us and we'll send you a printable version of our 2023-24 calendar commemorating the publication and effective dates of the supplements to the 2022 edition of Title 24.

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Ventilation and Filtration to Reduce Long-Range Airborne Transmission of COVID-19 and Other Respiratory Infections: Considerations for Reopened Schools

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Indoor Air Quality Section
Environmental Health Laboratory Branch
Center for Healthy Communities
California Department of Public Health

July, 2021

Table of Contents

Introduction

The Centers for Disease Control and Prevention (CDC) has included ventilation in the multiple layered strategies to reduce exposures to SARS-CoV-2.[1] In recognition of the importance of proper ventilation in indoor environments to reduce the spread of COVID-19, the California Department of Public Health (CDPH), together with the Office of Statewide Health Planning and Development (OSHPD) and the California Division of Occupational Safety and Health (Cal/OSHA), has recently issued *Interim Guidance for Ventilation, Filtration, and Air Quality in Indoor Environments* for non-healthcare organizations in general, including schools.[2]

This document on ventilation and filtration is intended to supplement the above State interim ventilation guidance by providing a road map, with simple flow charts, focused on the practical steps that schools can take to assess and improve classroom ventilation and air filtration. Appendix A lists the units of measure, acronyms, and abbreviations used in this guide. Because many other information resources are now available on best practices in schools during the COVID pandemic, this guide refers to such resources whenever appropriate for details on specific measures or actions.

The primary audience for this document on ventilation and filtration includes school facility managers (operations and maintenance) and testing personnel or IAQ/industrial hygiene consultants that schools hire to check the ventilation system. Persons with an interest in the safe reopening of schools as well as improving IAQ in the long term (e.g., school district officials, teachers, parents, and students) may also use this document for an overview on checking school ventilation and air filtration to protect against infectious agents and other airborne hazards.

Ventilation and Filtration Considerations

Schools vary widely in the design, complexity, flexibility, and age of their HVAC equipment, systems, and controls. Schools also include a variety of space types with different VR design requirements (e.g., classrooms, cafeterias, and multi-use assembly areas). For each occupiable space, it is always important to first:

- Determine the floor area (in m^2 or ft^2), the maximum number of occupants, and the occupancy schedule.
- Check if the space is naturally ventilated with openable windows only or has a mechanical ventilation system.

Naturally ventilated spaces

If a space has no mechanical ventilation (i.e., it relies solely on openable windows and doors for outdoor air), employers must follow Cal/OSHA's COVID-19 Emergency Temporary Standard (ETS) and evaluate how to maximize ventilation (fully opening all windows and openings) with outdoor air.[3] To do this, schools can use use the following flow chart (**Figure 1**) to check the space. Additionally, Appendix B provides a Do-it-yourself (DIY) inspection checklist to determine the *area of openable windows* in classrooms.

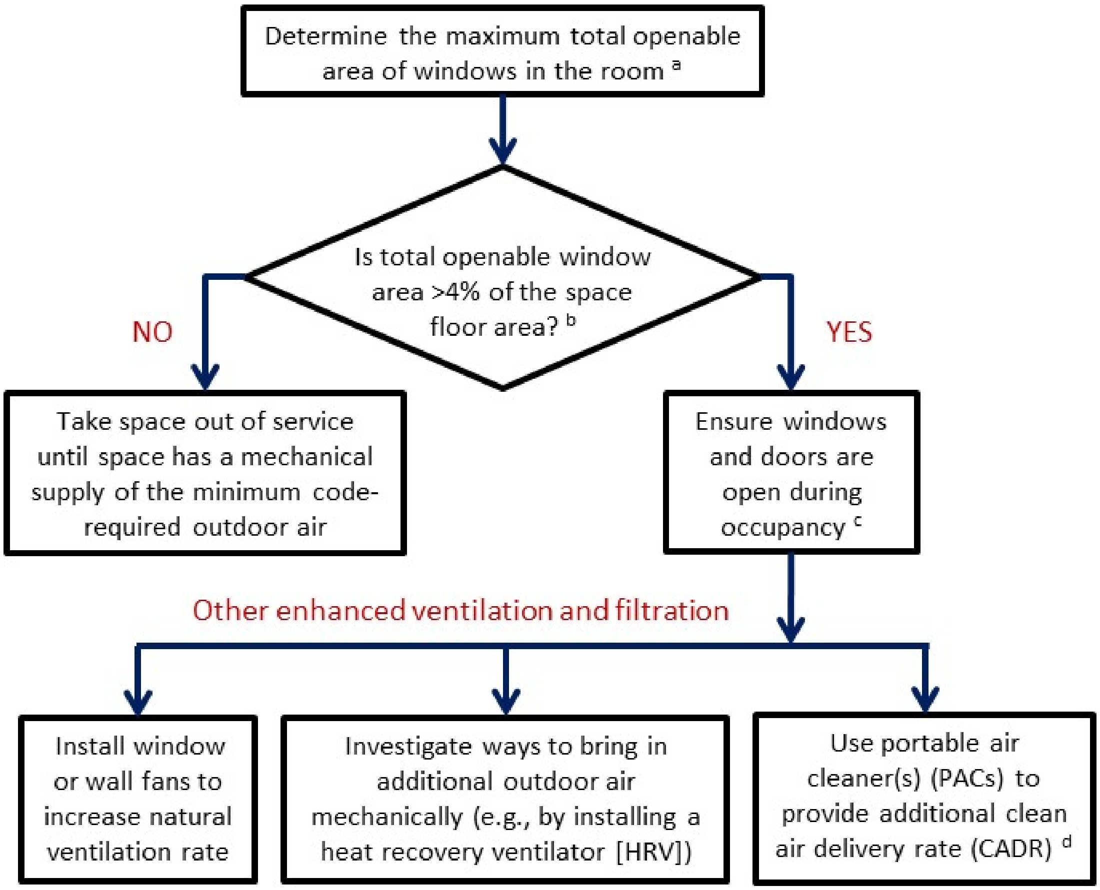

Figure 1. Flow chart for checking spaces without mechanical ventilation.

[a] See Appendix B for a DIY inspection checklist to determine the area of openable windows.

[b] The California Building Standards Code (Title 24)—in both Part 4 of the California Mechanical Code (CMC) and Part 6 of the California Energy Code (CEC)—requires that buildings with no mechanical supply of outdoor air have windows with a total openable area of at least 4 percent of the floor area.[4,5]

[c] When weather conditions allow, opening windows and doors can provide fresh outdoor air. Ensure that windows are fully open. See Appendix C for background information on VRs for naturally ventilated classrooms.

[d] Schools can refer to the SF DPH web page FAQs: Portable Air Cleaners for detailed instructions on how to properly size and select PACs.[6]

Mechanically ventilated spaces

If the space is mechanically ventilated, employers must comply with Cal/OSHA's ETS to maximize the quantity of outside air provided to the extent feasible and can use the following flow chart (**Figure 2**) to check the space. (Note: even with mechanical ventilation, windows and doors should be opened to provide additional outdoor air ventilation.)

In addition to Figure 2, several Appendices are relevant to mechanical ventilation systems. Appendix C provides background information on common types of ventilation and filtration in schools and minimum VR requirements. Appendix D provides a simplified, DIY checklist for operation inspection of classroom HVAC systems. Appendix E describes how to use carbon dioxide (CO_2) decay to measure outdoor air VR. For more complete HVAC checklists and operation guidance, schools are encouraged to read the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) guideline on *Reopening Schools and Universities* [7] and the California Coalition for Adequate School Housing (CASH) Maintenance Network's guidebook on *Healthy Schools: Cleaning, Disinfecting, Healthy Air Quality, Scheduling and Social Distancing*.[8]

Several guidance documents recommend a target minimum VR of 6 air changes per hour (ACH) in non-healthcare environments to reduce the spread of airborne SARS-CoV-2.[6,9] The metric "ACH" is considered preferable to airflow rate (e.g., in cubic feet per minute, cfm) to describe VRs used to control indoor air contaminants, because it scales with room volume (i.e., larger rooms need more airflow rates). ACH can be calculated from airflow rate and room volume, using the following equation:

$$\text{ACH} = \text{airflow rate } (\text{m}^3/\text{h})/\text{room volume } (\text{m}^3) \quad \text{(using International System of Units [SI] units), or} \qquad (1a)$$

$$\text{ACH} = \text{airflow rate (cfm)} \times 60/\text{room volume } (\text{ft}^3) \quad \text{(using English units)} \qquad (1b)$$

The minimum ventilation requirement of 6 ACH can be traced to the 1970 Centers for Disease Control and Prevention (CDC) recommendations for infection control *Isolation Techniques for use in Hospitals*.[10] *Current recommendations* are to provide at least 6 ACH in existing healthcare facilities and 12 ACH in new ones and those undergoing renovation.[11] In addition, if it is not possible to exhaust air from a room directly to the outside, the air may be returned to the air-handling system or adjacent spaces if all air is directed through high-efficiency particulate air (HEPA) filters. Although devised for healthcare settings, these ventilation recommendations can provide a good reference for other workplaces and public spaces where persons with aerosol transmissible infections, such as SARS-CoV-2, may be present.

In addition to outdoor air ventilation, the removal of airborne virus-containing particles from indoor air by HVAC system filters and PACs can be included in calculation of the above-mentioned minimum ACH. However, because the HVAC filters used in general building environments are not true HEPA filters, they only remove a portion of airborne viruses. The total ACH for SARS-CoV-2 removal, ACH_{Total}, including the combination of outdoor air ventilation, HVAC system filtration, and PAC rates, can be calculated using Equation (2).

$$ACH_{Total} = ACH_{OA} + ACH_{HVAC\text{-}Filtration} + ACH_{PAC} \qquad (2)$$

where:

ACH_{OA} = outdoor air VR
$ACH_{HVAC\text{-}Filtration}$ = SARS-CoV-2 removal rate by HVAC system filtration

ACH_{PAC} = SARS-CoV-2 removal rate by PAC.

This calculation function has been implemented as an output spreadsheet in the Interactive Model of CDPH IAQ's modeling paper (Appendix 3).[12] See Appendix F for an example calculation. A more user-friendly online tool based on similar methodology is available on the Harvard T.H. Chan School of Public Health's (HSPH) web page COVID-19 TOOLS.[13]

Opening windows and doors can further increase outdoor air ventilation for classrooms with mechanical ventilation. See Appendix B for how to determine the area of openable windows in classrooms.

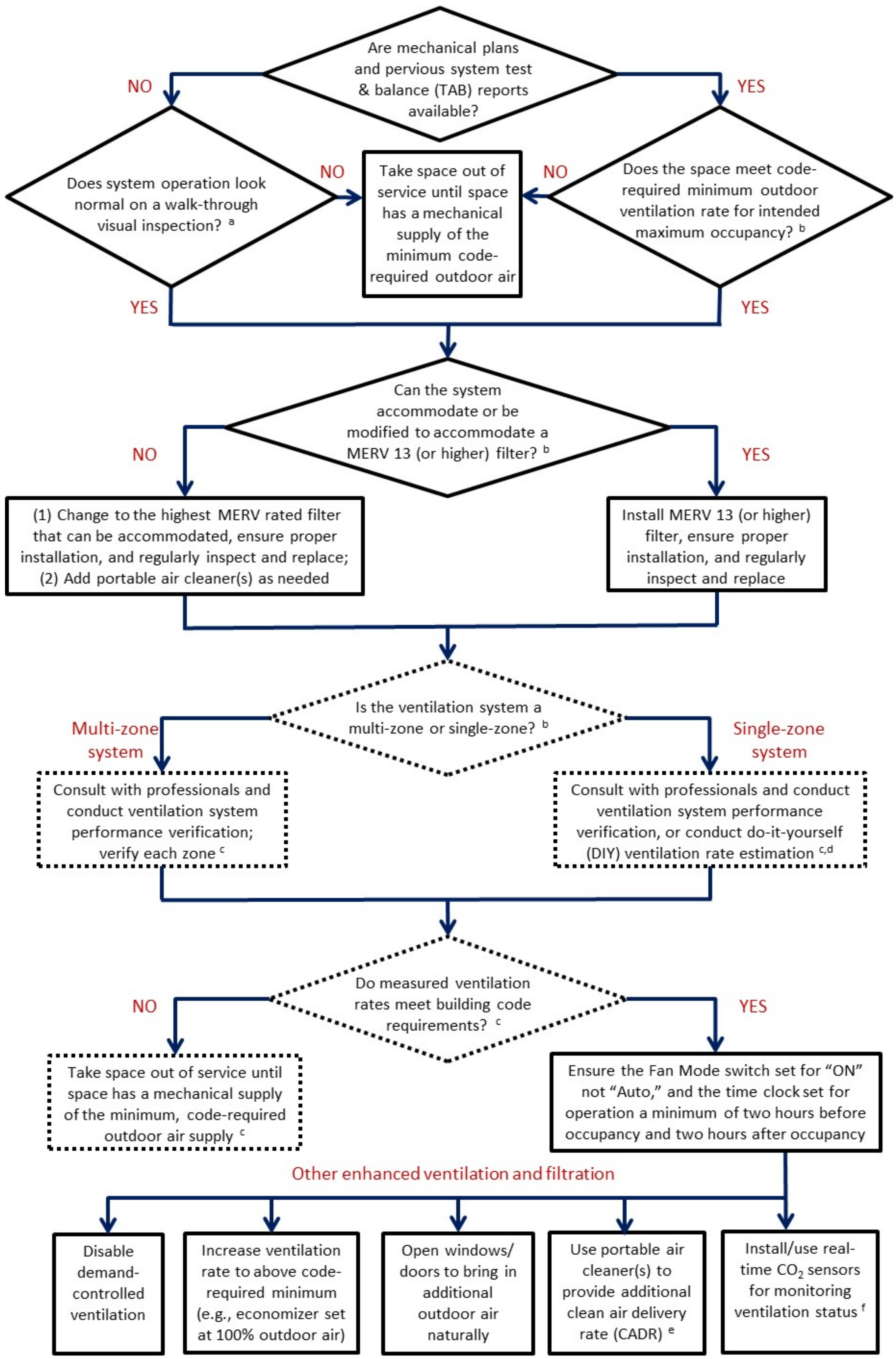

Figure 2. Flow chart for checking spaces with mechanical ventilation.

[a] See Appendix D for a DIY checklist for initial operation inspection of classroom HVAC systems; see the Environmental Protection Agency (EPA)'s web page Indoor Air Quality Tools for Schools Action Kit for a more complete ventilation checklist.[14]

[b] See Appendix C for background information on common types of ventilation and filtration in schools and minimum VR requirements.

[c] Unless otherwise required, VR measurement and verification are optional as they may not be feasible prior to school reopening.

[d] DIY VR measurement can be done using a CO_2 decay method (Appendix E), a steady-state CO_2 method, or a balometer; see the Harvard T.H. Chan School of Public Health's (HSPH) web page 5 Step Guide to Checking Ventilation Rates in Classrooms for detailed instructions.[9]

[e] Schools can refer to the SF DPH web page FAQs: Portable Air Cleaners for detailed instructions on how to properly size and select PACs.[6]

[f] Real-time CO_2 monitoring can be helpful to determine the outdoor air ventilation status in classrooms, especially in more densely occupied classrooms; see HSPH web page COVID-19 TOOLS for a maximum classroom CO_2 concentration calculator.[13] It should be noted that the measurement of CO_2 levels does not reflect the additional air cleaning benefit from the use of filters (or portable air cleaners). It is possible to exceed target CO_2 concentrations and still be meeting targets for clean air through filtration.

Appendix A. List of Units of Measure, Acronyms, and Abbreviations of Measure

Symbol	Name
cfm	cubic foot per minute
ft^2	square foot
ft^3	cubic foot
H	hour
In	inch
L	Liter
lb	pound
lbs	pounds
L/s-occupant	liter per second per occupant
m/s	meter per second
m^2	square meter
m^3	cubic meter
min	minute
ppm	part per million

Acronym	Group or program
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
Cal/OSHA	California Division of Occupational Safety and Health
CASH	California Coalition for Adequate School Housing Maintenance Network
CCR	California Code of Regulations
CDC	Centers for Disease Control and Prevention
CDPH	California Department of Public Health
CEC	California Energy Code
CMC	California Mechanical Code
EPA	Environmental Protection Agency
HSPH	Harvard T.H. Chan School of Public Health
IAQS	Indoor Air Quality Section
LEED	Leadership in Energy and Environmental Design
OSHPD	Office of Statewide Health Planning and Development
SF DPH	San Francisco Department of Public Health

Abbreviation	Meaning
ACH [a]	air changes per hour (also called air change rate)
CADR [b]	clean air delivery rate
CO_2	carbon dioxide
COVID-19	the disease caused by SARS-CoV-2; CO stands for coronavirus, VI for virus, D for disease, and -19 for the year 2019[15]
DCV	demand control ventilation
DIY	do-it-yourself
DOAS	dedicated outdoor air system
ERV	energy recovery ventilator
ETS	Cal/OSHA's COVID-19 Emergency Temporary Standard
FCU	fan coil unit
HEPA	high-efficiency particulate air
HRV	heat recovery ventilator
HVAC	heating, ventilation, and air-conditioning
IAQ	indoor air quality
MERV [c]	minimum efficiency reporting value
PAC	portable air cleaner
RTU	rooftop unit
SARS	severe acute respiratory syndrome due to SARS-CoV or SARS-CoV-1
SARS-CoV-2	severe acute respiratory syndrome due to SARS-CoV-2, the virus that causes COVID-19; previously referred to as the "2019 novel coronavirus" or "2019-nCoV"
SI	international system of units of measure
Title 24	California Building Standards Code
VAV	variable air volume
VR	ventilation rate

[a] **ACH** is a calculated value that allows ventilation standards, guidelines, and comparisons to be made for rooms that have different dimensions or different ventilation systems. It is

considered preferable to airflow rate to describe VRs used to control indoor air contaminants, because it scales with room volume (i.e., larger rooms need more ventilation).

[b] **CADR** measures an air cleaner's effectiveness based on room space and the volume of clean air delivered per minute. Commercially available portable air cleaners often have three CADR ratings certified by the Association of Home Appliance Manufacturers (AHAM).[16] For COVID-19 purposes, use of the CADR rating for "tobacco smoke" (i.e., for particles in the 0.09–1 µm size range) is preferred because research has demonstrated that a significant number of SARS-CoV-2-containing particles could be <0.5 µm.[17] The CADR rating for "tobacco smoke" is typically less than or equal to the CADR for "dust" (i.e., 0.5–3 µm particles.

[c] **MERV** is a measurement and reporting scale to rate the performance of HVAC filters for removing particles in the 0.3–10 µm size range, based on an ASHRAE test standard.[18] MERV values range from 1–16. Higher MERV ratings correspond to a greater percentage of particles captured on each pass through a filter, especially for smaller sized particles (i.e., 0.3–1 µm). For COVID-19 purposes, MERV 13 is the recommended minimum; MERV 14 is preferred.[7]

Appendix B. DIY Inspection for Area of Openable Windows in Classrooms

Purpose: To determine if classrooms windows have operable openings that meet the code-required, minimum openable area (i.e., 4 percent of the room floor area if there is no mechanical ventilation).

Note:

- Title 24 requires that classrooms have windows with a total openable area of at least 4 percent of the floor area or a mechanical ventilation system with an outdoor air VR of at least 15 cfm/occupant or 0.15 cfm/ft^2, whichever is greater. Therefore, this inspection should be conducted in classrooms without mechanical ventilation systems, i.e., those that rely solely on openable windows for ventilation. This inspection may also be conducted in classrooms that have mechanical ventilation, as opening windows can further increase outdoor air ventilation.
- Openable windows can provide a substantial amount of outdoor air depending on how much and often the windows are opened and weather conditions (e.g., wind speed and outdoor air temperature). However, if the window opening is restricted—they cannot be opened at all, openable but the opening is limited (e.g., windows open only partially because of mechanical limiters or because they are stuck), or the windows are obstructed by furniture (e.g., bookshelves, cabinets, or shelving)—then the amount of outdoor air entering a classroom through the windows may be restricted.
- Other alternative ways of providing clean air should be considered when opening windows poses safety risks or other health harzards (e.g., wildfire smoke).
- In this section, we assume that English rather than SI units are employed.

The following is guidance for completing the attached DIY Classroom Openable Area Inspection Datasheet (window datasheet).

What You Need:

- Tape measure or laser distance meter
- Clipboard and the window datasheet

Blank and example window datasheets follow this section and also are available as Excel spread sheets (in both SI and English units).

Procedure for Determining the Area of Openable Windows

1) Measure classroom floor area.

Measure in feet the width and length of the classroom, multiply to determine the floor area, and record on the window datasheet.

Note: If the classroom has an adjacent area, separated by a wall, with permanently unobstructed openings (i.e., no doors), the classroom and adjacent space may be considered one room for purposes of calculating the window open area provided that openings between the rooms have a total area of not less than 8 percent of the adjacent space floor area or 25 ft^2, whichever is greater.[4]

2) Determine if windows are obstructed.

For each window, record whether the windows are obstructed or unobstructed. For example, windows that have an object (e.g., furniture, bookcase, etc.) that is within 3 ft of the window opening and covers any portion of the window opening as determined by line of sight from any occupiable location in the space may be considered obstructed.

3) Calculate the openable window area for each unobstructed window.

For each unobstructed window, open the window to its maximum openable area and record the type of window (e.g., slider, casement, or awning), the opening dimensions, and the maximum openable area (ft^2).

See below for calculation methods for the types of windows commonly found in classrooms.

Sliding windows For windows with vertical sliders (e.g., single- or double-hung windows) and windows with horizontal sliders, measure and record the opening width and height of the opening in inches. Multiply the width by the height and divide by 144, which converts square inches to square feet.

Awning windows For awning windows, which have a section that tilts out along a horizontal hinge, measure and record the window opening width and the swing-open distance, then calculate the openable area as for sliding windows. The swing-open distance is defined as the perpendicular distance from the awning window to the edge of the opening opposite the hinge. Examples of swing-open distances (i.e., the dark line with two end arrows) at different window opening levels are shown in **Figure 3**. Note that the amount that a window opens determines where the measurement should be taken.

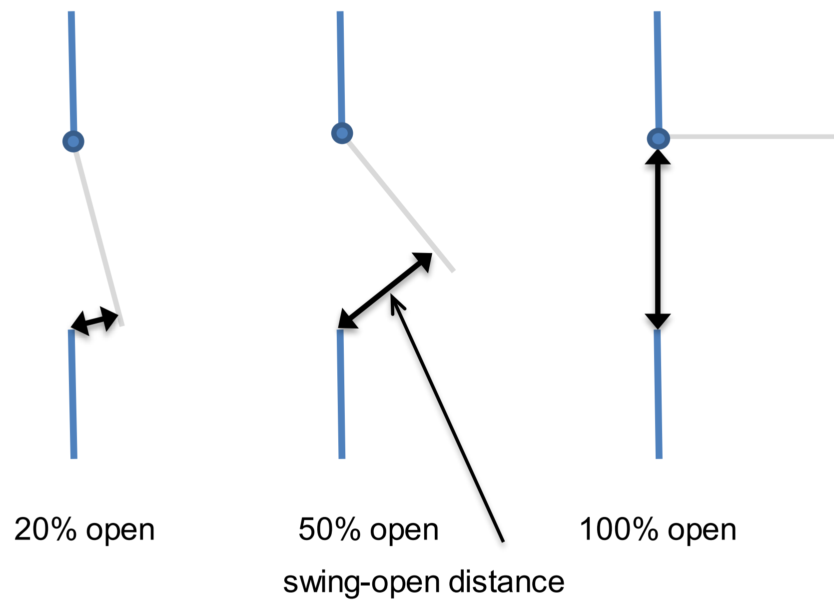

Figure 3. Swing-open distance measurement for casement and awning windows.

<u>Casement windows</u> For casement windows, which have a section that tilts out along a vertical hinge, measure and record the window opening width and the swing-open distance, then calculate the openable area as for sliding windows. The swing-open distance is defined and measured similarly as for awning windows but using the perpendicular distance from the casement window to the edge of the opening opposite the hinge.

4) Calculate the total openable window area.

Sum the openable area from each unobstructed window and record the total openable window area. Divide this total area by the floor area, multiply by 100, and record the total openable window area as a percentage of the floor area.

> Note: If the total area is less than the code-required 4 percent, windows need to be repaired or upgraded to achieve at least the required minimum (e.g., remove obstructions, adjust limiters on window openings, and free stuck windows) or a mechanical supply of at least the code-required minimum outdoor air needs to be provided.

5) Sign and date the window datasheet.

Window Openable Area Inspection Datasheet

Classroom Name: _

Floor Area (ft^2): _____________

Window Maximum Openable Area

Window number	Window obstructed (Yes/No)	Width or swing-open distance (in)	Height or swing-open distance (in)	Openable area (ft^2)
1				
2				
3				
4				
5				
6				
7				
8				

Total openable area for unobstructed windows (ft^2) ___________________

Total openable area (ft^2) as a percentage of floor area (ft^2) _____________________

Does the classroom have a total openable window area of at least 4 percent of the floor area?

☐ Yes—No further action required; open windows fully whenever possible to increase outdoor air ventilation.

☐ NO—Make necessary window repairs or install a mechanical supply of outdoor air if none present.

> **Note:** Title 24 requires that classrooms have windows with a total openable area of at least 4 percent of the floor area or a mechanical ventilation system with an outdoor air VR of at least 15 cfm/occupant or 0.15 cfm/ft^2, whichever is greater.

Inspector's name: _________________________

Date: ___________________

Window Openable Area Inspection Datasheet (EXAMPLE)

Classroom Name: Room 101

Floor Area (ft^2): 960

Window Maximum Openable Area

Window number	Window obstructed (Yes/No)	Width or swing-open distance (in)	Height or swing-open distance (in)	Openable area (ft^2)
1	N	36	34	8.50
2	N	36	33	8.25
3	N	36	32	8.00
4	N	36	33	8.25
5	N	36	34	8.50
6	N	36	34	8.50
7				
8				

Total openable area for unobstructed windows (ft^2) 50

Total openable area (ft^2) as a percentage of floor area (ft^2) 5.2%

Does the classroom have a total openable window area of at least 4 percent of the floor area?

☑ Yes—No further action required; open windows fully whenever possible to increase outdoor air ventilation.

☐ NO—Make necessary window repairs or install a mechanical supply of outdoor air if none present.

> **Note:** Title 24 requires that buildings with no mechanical supply of outdoor air have windows with a total openable area of at least 4 percent of the floor area or a mechanical ventilation system with an outdoor air VR of at least 15 cfm/occupant or 0.15 cfm/ft^2, whichever is greater.

Inspector's name: Luis Martinez

Date: February 10, 2021

Appendix C. Common Ventilation and Filtration Equipment in California Schools and Code-required Minimum VR

This appendix is intended to provide basic background information on common ventilation and filtration equipment and minimum VR requirements in California schools. For details on how to select and operate each type of system, readers should refer to ASHRAE guideline on *Reopening Schools and Universities*[7] and also Cal/OSHA's COVID-19 Emergency Temporary Standard [3] for MERV 13 filter requirements.

Mechanical Ventilation Equipment

The California Code of Regulations (CCR) Title 8 section 5142 requires mechanical ventilation equipment to operate continuously when employees are present.[19] Setting mechanical ventilation equipment to only operate when heating or cooling (sometimes referred to as "auto mode") is prohibited.

Mechanically ventilated classrooms use either "multi-zone" or "single-zone" systems. Multi-zone systems are centralized, relatively large air-handling units that serve multiple classrooms with a remote fan and compressor. In single-zone systems, HVAC units are often either packaged rooftop units (RTUs) or wall-mounted units serving only one or a few classrooms. Wall-mounted units—such as unit ventilators with integrated outdoor air ventilation and filtration, heat pumps with dedicated outdoor air system (DOAS), or fan coil units (FCUs) with DOAS—are used more often in relocatable classrooms. For example, HVAC systems in these classrooms, per a 2004 California study, were typically packaged wall units with teacher-controlled in-room thermostats.[20] A 2020 study of California schools with retrofitted HVAC equipment also reported that relocatable classrooms predominately used wall-mounted, single-package, HVAC systems, while permanent classrooms generally had RTUs.[21] It should be noted that some classrooms have units that only heat or cool the air within a space, with no outdoor air intake (e.g., split systems or FCUs without DOAS). These classrooms do not provide mechanical outdoor air ventilation and rely entirely on openable windows for natural ventilation. Such systems should be discouraged because they are in violation of CCR Title 8 section 5142, which requires outdoor air supply in all mechanically driven HVAC systems.

For all types of HVAC equipment, a fixed position ventilator/damper is the basic control for the mechanical ventilation system, where the position of the outdoor air damper or the size of the opening is fixed so as to provide the indoor space with (at least) the minimum outdoor air VR specified in the design code. Additional features for optimizing both energy efficiency and indoor air quality (IAQ) are often available, either as standard or optional upgrades depending on the product brand and model. Such features include variable air volume (VAV) systems, airside economizers, energy or heat recovery ventilators (ERVs or HRVs), and demand control ventilation (DCV) systems. These are explained further below.

- Variable air volume (VAV) systems: Traditionally, single-zone VAV systems have been used for large, densely occupied zones that have variable cooling loads. However, due to increased focus on energy efficiency, a single-zone VAV currently is used more often in K–12 classrooms, and also is offered in smaller equipment, such as packaged RTUs or direct expansion split systems, fan-coils, classroom unit ventilators, and water-source heat pumps.[22] In contrast with a constant supply airflow rate delivered by a conventional constant air volume system, the supply airflow rate delivered by a VAV system can adjust to demand. With VAV systems, steps need to be taken to ensure that the amount of outdoor air is not reduced below applicable standards when supply air is reduced during part-load conditions.

- Economizer: Economizers use outdoor air to provide free cooling. An airside economizer is now a typical feature in unit ventilators and RTUs. With an economizer, the outdoor air damper can open fully and deliver up to 100 percent outdoor air under favorable weather conditions.
- Energy Recovery Ventilators (ERVs) and Heat Recovery Ventilators (HRVs): An ERV transfers heat and moisture between exhausted room air and incoming outdoor air, thereby reducing the energy required to condition the incoming air. An HRV transfers heat only. An ERV or HRV option is commonly offered in wall-mount units.
- Demand control ventilation (DCV) systems: DCV, using CO_2 sensing, varies the outdoor air supply in response to the indoor CO_2 concentration, to ensure that the maximum concentration remains below a set threshold, generally 1000–1200 ppm. A DCV system always incorporates a minimum outside air setting to dilute building-emitted contaminants during low-occupancy periods. Classroom CO_2 level can be displayed on a monitor (i.e., readily visible to teachers) or directly transmitted to the school's facility energy management system. Both RTU and wall-mount unit manufacturers offer DCV as an add-on feature.

Limited data is available on the prevalence of various ventilation system types in California schools or on trends in changes over the years. Chan et al. recently conducted a survey in 104 mechanically ventilated California classrooms and reported the frequency of occurrence for different types of ventilation equipment, including four commonly used technology types (**Table 1**).[21]

Table 1. Common ventilation equipment found in 104 mechanically ventilated California classrooms with single-zone systems

Technology type	Number (percentage)
ERVs [a]	5 (4.8%)
Fixed position ventilators	19 (18%)
DCVs [b]	25 (24%)
Economizers [c]	74 (71%)

[a] ERVs were all in wall-mount units and not RTUs (although adding an ERV to an RTU is possible).

[b] DCVs were all installed in RTUs

[c] Economizers were common in both RTUs and wall-mount units.

Another factor that may influence the operation of HVAC systems is system noise. Research has found that this is often the most significant source of classroom noise, and cooling system type usually determines the level of overall mechanical noise.[23] Because relocatable classrooms typically have packaged wall units with fans (and sometimes also a compressor) attached outside to one end of the classroom, they can transmit unacceptable ventilation noise and vibration that results in teachers turning off the ventilation system. For example, a 2004 California classroom study found that 60 percent of teachers in relocatable classrooms turned off the mechanical ventilation at times because of the noise (thus providing no outside air, which is a violation of CCR Title 8 section 5142), whereas this occurred less often in traditional classrooms.[20] Some manufacturers of packaged wall units for relocatable classrooms have improved the design of systems manufactured after 2005 to reduce transmission of noise and vibration. The ANSI/Acoustical Society of America [ASA] classroom acoustic standard recommends that the A-weighted sound level measured in an unoccupied classroom with ventilation (mechanical) systems on should not exceed 35 dB(A).[24]

Code-required Minimum VR

For a mechanically ventilated space, Title 24—in both Part 4 of the California Mechanical Code (CMC) and Part 6 of the California Energy Code (CEC)—lists code-required minimum outdoor air VRs for a total of 14 space types in educational facilities.[4,5] However, the two code requirements sometimes differ. For example, the CEC-required outdoor air VRs for classrooms (ages 5–8 and 9 and older) are 15 cfm/occupant or 0.15 cfm/ft^2, whichever is greater. These values are 3 percent higher than the CMC-required rates for classrooms of ages 5–8 and 12 percent higher for classrooms of age 9 and older, using the default occupancies specified in the CMC code. To ensure the recommended minimum 3-ft physical distance between students and a minimum 6-ft physical distancing from employees during the COVID-19 pandemic, actual occupant density may be less than the default value specified in the CMC code. Although VR per occupant is a better indicator of ventilation condition in terms of reducing airborne viral transmission, it should be noted that reducing classroom occupancy does not mean that the code-specified minimum outdoor VR can always be proportionally reduced. This is because the specified minimum is also influenced by floor area (to dilute pollutants of concern emitted from building materials, furniture, and indoor products), and this does not change with reduced occupancy.

HVAC Filters

HVAC filters are available in a variety of Minimum Efficiency Reporting Value (MERV) ratings (i.e., MERV 1 through MERV 16), dimensions (e.g., differing lengths, widths, and 1-, 2-, 4-, 6-, or 12-inch depths), media types (e.g., fiberglass or synthetic media), and design configurations (e.g., panel, pleat, mini-pleat, or bag). In terms of reducing indoor airborne particle concentrations, high-efficiency filters (either installed in a centralized HVAC system to treat recirculated air or included in PACs) can be considered to provide “equivalent” outdoor air ventilation. While outdoor air ventilation equally dilutes the concentration of all gases and all sizes of airborne particles, the “equivalent” clean air provided by filtration for airborne viruses depends on the particle removal efficiency of the filter for the size distribution of the virus-containing particles. It is therefore important to optimize the combination of ventilation and filtration to achieve the desired overall system performance.

During the pandemic, many people have asked about the type of HVAC filtration used in California schools, for those with mechanical ventilation systems. Almost no peer-reviewed information is available on the frequency of use of various MERV filter grades and filter rack depths in California schools. MERV 8 filters in 1- and 2-inch deep filter frames appear to be the most common for classrooms with small RTUs, unit ventilators, heat pumps, and FCUs, while MERV 13 filters appear to be found more frequently in school buildings with larger air handling units and packaged air conditioners. If a school building has been Leadership in Energy and Environmental Design (LEED) or Collaborative for High Performance Schools (CHPS) certified, the filters should already be MERV 13. In California, Title 24-2019 Energy Efficiency Standards now require a MERV 13 or higher filter for schools with mechanical ventilation systems.[5] CASH school reopening guidance also recommend at least a MERV 13 filter,[8] as does ASHRAE guidance if higher efficiency filters do not adversely impact system operation.[7] The Cal/OSHA ETS also requires employers to evaluate how to use the highest level of filtration efficiency compatible with their existing ventilation system.[3] A MERV 13 filter or better will comply with the ETS.

Upgrading to MERV 13 can be relatively inexpensive compared to increasing outdoor air VR to well above the code-required minimum, depending on the current filter rack depth. If the existing filters and filter racks are 2 inch or deeper, replacing a MERV 8 with a MERV 13 filter in most systems will not cause a significant reduction of the supply airflow rate. Many commercially available MERV 13 filters of 2-inches or deeper have pressure drops only slightly higher (i.e., ≤0.1 inches water gauge or ≤25 pascals) than those of MERV 8 filters at air speeds of 300–500 feet per minute (1.5–2.5 m/s). Such a slight increase of pressure drop typically will not cause a significant reduction in the supply airflow rate. The fan performance curve (i.e., design static pressure vs. flow rate) can be checked as needed to verify that there is no significant airflow reduction due to a filter upgrade. However, if the existing filters and filter racks are only 1-inch deep, finding a true 1-inch MERV 13 filter with a low pressure drop can be difficult. This is because commercially available 1-inch MERV 13 filters often use electrostatically charged media, which may lose efficiency quickly after installation. Still, upgrading to a MERV 13 filter may be feasible if a 1-inch rack can be modified to accept a 2-inch filter.

The filter change-out frequency can vary from system to system. It also may vary due to seasonal and atmospheric considerations (e.g., during pollen or wildfire season). As a general rule, it should be established based on one of the following criteria: [25,26]

- The specific or allowable pressure drop (e.g., reaching a pressure drop across the filter that causes the supply air flow rate to drop by 20%)
- Filter manufacturers' recommended final pressure drop

- Values demonstrated by experience (e.g., every three months)
- Values determined by life cycle cost analysis.

Installing a pressure gauge on filter units can assist in determining change frequency. Measuring the pressure drop across a filter provides a quantitative measure of the filter resistance that can be used to determine when to change filters.

> Note: When considering filtration devices, it is best to select only those with MERV (or for PACs, CADR) ratings. Some other types of air cleaning devices, although commercially available and marketed as effective and safe for indoor use in response to the COVID-19 outbreak, have unproven efficacy, and some (i.e., ozone generators and ionization devices) may even produce harmful pollutants.[27]

VRs from Opening Windows for Naturally Ventilated Classrooms

There are two driving forces for natural ventilation: wind pressure and stack (or buoyancy) pressure due to indoor-outdoor air temperature difference. Therefore, the amount of outdoor air entering through windows varies with time and location, depending on the outdoor wind speed and the indoor-outdoor temperature difference. For spaces with standard window and room geometry, if the opening area and height, wind speed, and indoor and outdoor temperature difference are known, the natural VR can be roughly estimated using simplified equations (see Natural Ventilation for Infection Control in Health-Care Settings).[28] As for the actual operational conditions of windows and VRs in naturally ventilated classrooms, currently available information is limited, and more research is needed.

Appendix D. Initial DIY Operation Inspection for Classroom HVAC Systems

Purpose: To determine if HVAC systems are operable and are delivering outdoor and appropriately filtered air to a classroom.

> Caution: This inspection does not ensure that the desired quantity of outdoor air is being delivered to a space. To determine the quantity of delivered outdoor air, HVAC airflow rate measurements (see ASHRAE[7] and HSPH[9] recommendations) or a CO_2 decay test is required (see Appendix E).

The following is guidance for completing the following DIY checklist to assess important aspects of HVAC operation.

What You Need:

- Airflow indicator (e.g., a flexible piece of ribbon or tissue paper)
- Clipboard and the Classroom HVAC System Operation Inspection Checklist.

1) Inspect overall system operation

Identify the HVAC system that serves a classroom

For many classrooms the HVAC system that serves the space will be obvious if there is a dedicated system such as a wall-mounted unit ventilator. For classrooms with a rooftop unit (RTU), the RTU on the roof that is closest to the space is likely the system that serves the space. To confirm that a specific RTU serves a space, turn it on and off while observing if air is coming out of the supply air diffusers.

> Note: Attaching an airflow indicator to a supply air diffuser provides "at a glance" feedback that the HVAC system is operating. The RTU fan typically can be turned on and off at the room thermostat using the fan mode switch "Auto/On." Record the name and location of the HVAC system on the checklist.

Determine if outdoor air is entering the HVAC outdoor air intake

With the HVAC system operating, use an airflow indicator to determine if air is entering the outdoor air intake, and record on the checklist. Typically, the outdoor air intake is in a section of the HVAC system upstream of the filters and often has a sheet metal canopy to protect it from rain. **Figure 4** shows the outdoor air inlet for a typical rooftop HVAC system. If no air is entering, a mechanical contractor will need to inspect and repair the system.

Figure 4. Outdoor air inlet for a typical rooftop HVAC system.

Determine if supply air is coming out of each of the supply air diffusers of the HVAC system

With the HVAC system operating, use an airflow indicator to determine if air is entering from each of the supply air diffuser and record on the checklist. Typically, an RTU has ceiling “supply air” diffusers (often with deflection blades) as well as “return air” inlets (with perforated plates). **Figure 5** shows an airflow indicator to determine that air is being delivered from a supply air diffuser.

If air is not visibly entering a classroom from each of the supply air diffusers, a mechanical contractor will need to inspect and repair the system.

> Note: Seeing that air visibly enters a room simply shows that the system is operating but does not ensure that the desired amount of outdoor air is being supplied (see Appendices D and E).

Figure 5. Checking that air is entering the room from a ceiling supply air diffuser with an airflow indicator.

2) Inspect the HVAC filters

Determine the filter's Minimum Efficiency Reporting Value (MERV) rating and filter condition, and record on the checklist as follows:

- With the HVAC system off, locate and open the filter slot (typically a 1–4-inch deep slot with a removable cover). Remove the filter and record the MERV rating on the checklist. If the MERV rating is not labelled, record the manufacturer and model number and look up the MERV rating online. The recommended minimum efficiency is MERV 13. If the filter slot is ≥2 inches deep, a MERV 13 filter with a low air pressure drop can be installed in most HVAC systems.
- Determine if the filters are installed in the filter rack without significant air bypass around the edges. Replace any missing or damaged filters and seal any gaps in the filter rack, e.g., with a sheet metal spacer.
- Replace the filters if they are visibly overloaded with particulate matter (dust). Checking filters at least every three months is recommended. See Appendix C for more information on how to establish a proper filter change out frequency.

3) Inspect the HVAC fan controls

Single-zone HVAC systems often have a Fan Mode switch integrated with the wall thermostat. The Fan Mode switch can be set for "Auto" or "On." When the switch is set for "Auto," the HVAC fan only operates when the thermostat calls for heating or cooling. To ensure continuous operation of the fan and thus delivery of outdoor and filtered air, ensure that the switch is set for "On" and record on the checklist. Figure 6 shows a thermostat with the fan mode switch set to "On". The fan controls for larger, multi-zone HVAC systems most often are integrated with the Building Automation System, and not located on the wall.

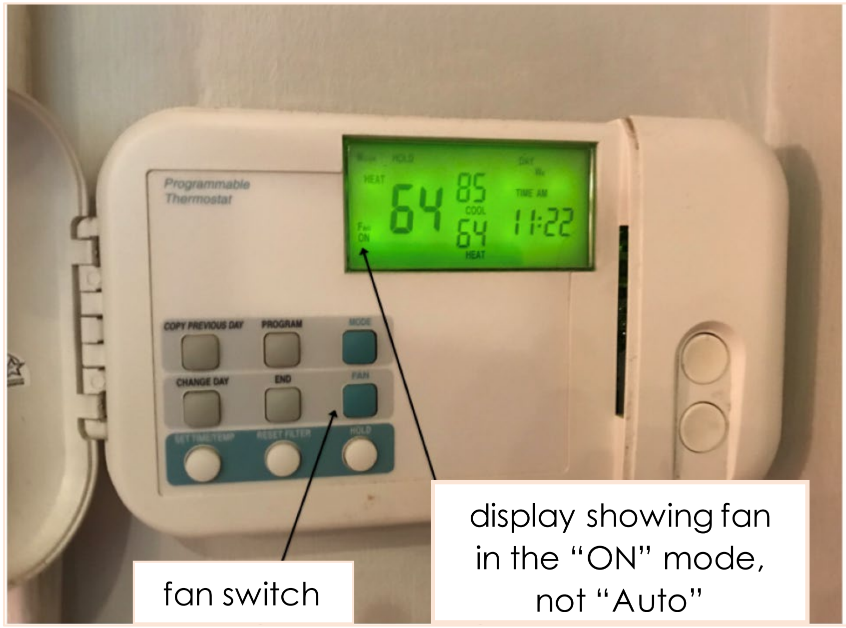

Figure 6. Thermostat with the fan mode switch set to "On."

4) Inspect the HVAC time clock

Single-zone HVAC systems often have a time clock integrated with a wall thermostat that starts and stops them at programmed times. HVAC time clocks for larger, multi-zone HVAC systems most often are integrated with the Building Energy Management System. The time clock should start HVAC operation two hours before and after students, teachers, and custodial staff initially enter and finally leave the room.

Record the normal occupancy start and stop times along with the HVAC time clock start and stop times on the checklist.

5) Sign and date the checklist

Classroom HVAC System Initial Operation Inspection Checklist

Classroom Name: ______________________________

System Operation

Identify HVAC system serving the space. System ID and Location: ______________

Turn system on and determine each of the following:

Yes No

☐ ☐ Outdoor air is entering the HVAC outdoor air intake

☐ ☐ Supply air is coming out each of the HVAC supply air diffusers

Air Filtration—Determine each of the following:

☐ What is the filter MERV rating: ______ (targeting MERV 13 or higher)

☐ ☐ Filters are installed in filter rack without significant air bypass

☐ ☐ Filters are not overloaded with particulate matter (dust)

Fan Control—HVAC system thermostat has the Fan Mode switch set for “ON” not “AUTO”

☐ ☐ Fan Mode switch is set for “ON”

Time Clock

Normal Occupancy Start Time: ________ HVAC Start Time: ________

Normal Occupancy Stop Time: ________ HVAC Stop Time: ________

☐ Time clock is set to start system two hours before occupancy and to stop system two hours after occupancy (including time needed to clean room).

Note: If a box is checked “NO,” conduct necessary repairs before occupancy.

Inspector’s name: ________________________

Date: __________________

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Appendix E. Using CO_2 Decay to Estimate VR—Method Description and Test Procedure

Increasingly, California classrooms are equipped with CO_2 monitoring devices (i.e., display only or also with datalogging capability), due to the increased availability and improved performance of low-cost sensors. This has made real-time, classroom CO_2 measurement more feasible.

There are several ways to estimate VRs using measured indoor CO_2 concentration (occupant generated or from a CO_2 source) and measured (or assumed) outdoor concentration.[29-31] The steady-state method (CO_2 rise to a steady, unchanging concentration) and the concentration decay method (rate of CO_2 decline) are most commonly used. Both methods assume that the measured CO_2 concentration represents the room average (i.e., the room air is well mixed, and the CO_2 concentration is similar throughout). The CO_2 decay method (outlined below) estimates VR more accurately than the steady-state method, because the later depends on assumed occupant CO_2 generation rate (which varies substantially by occupant age, gender, weight, and metabolic activity).[32]

When using exhaled breath as the source, CO_2 decline can be measured over a period of time (e.g., 30 min) after occupants leave (e.g., at the end of school day), and the outdoor air change rate (ACH) can be calculated directly.(HSPH 2020) This rate can then be multiplied by the room air volume to calculate the outdoor airflow rate (cfm or m^3/h). Knowing the airflow rate, maximum occupancy, and floor area, the VR per occupant (cfm or L/s-occupant) and per floor area (cfm/ft^2 or $L/s\text{-}m^2$) can be determined, see following procedure in the section below “Procedure for Measuring Classroom Outdoor Air VR Using a CO_2 Decay Test”. Alternatively, in unoccupied rooms, CO_2 gas can be released (e.g., from a compressed gas cylinder or dry ice) to purposely generate a high initial concentration (e.g., 2000 ppm), and the same measurement and calculation procedure can then be applied.

If a classroom remains occupied (e.g., by a teacher or custodian), the outdoor ACH estimated from CO_2 decay will be less than the true ACH because the method assumes no indoor CO_2 sources. Such deviation due to continued occupancy is influenced mainly by the measurement period, the initial CO_2 concentration, and the actual ACH, and to a lesser extent, by the outdoor CO_2 concentration. For example, in a typical classroom defined in the CDPH IAQS modeling paper (i.e., 27 occupants, 89.3 m^2 floor area, 3 m ceiling, and code-required minimum 2.54 ACH outdoor air),[12] with an initial CO_2 concentration of 1500 ppm and one occupant remaining, the estimated VR will be only ~5 percent lower than the true VR if the final concentration is measured at 30 min. In general, even if an occupant remains, the estimated VR is still a sufficient and conservative approximation of the true ACH.

Procedure for Measuring Classroom Outdoor Air VR Using a CO_2 Decay Test

Purpose: To determine the delivery of outdoor air from a ventilation system.

Caution: This procedure provides a measurement of the outdoor air VR in a single classroom with a single mechanical ventilation system. Spaces with multi-zone HVAC systems that serve more than one classroom require a different test method.

What You Need:

- CO_2 meter
- Cylinder of CO_2 (e.g., a 20-lb aluminum cylinder) or a cooler with dry ice pellets; approximately 1–2 lbs of CO_2 are required for each classroom test.
- Box fan and extension cord
- Tape measure or laser distance meter
- Clipboard, pen, calculator, watch
- Classroom CO_2 Decay Ventilation Measurement Datasheet.

Blank and example CO_2 datasheets follow this section and also are available as excel spread sheets (in both SI and English units).

How to Measure CO_2 Concentration Decay

1. Indoors, close all windows and doors.
2. Determine the maximum classroom occupancy (number of persons), measure and record the room dimensions, and calculate and record the floor area and air volume. If the ceiling is sloped, use the average ceiling height to calculate air volume.
3. Outdoors, turn on the CO_2 meter, place it out of direct sunlight, let equilibrate for 5 min, and record time and the initial outdoor concentration ($C_{outdoor\ initial}$).
4. Indoors, place the CO_2 meter in the center of the room and let equilibrate for 5 min.
5. Place the CO_2 source at one end of the room with the box fan positioned behind the tank or cooler blowing air to the opposite side of the room. Turn the box fan on at high speed.
6. Slowly open the CO_2 tank valve until you hear that gas is flowing. Or, if using dry ice, open the cooler lid. Do <u>not</u> touch dry ice with bare hands, to avoid the risk of burns.
7. When the room CO_2 concentration reaches approximately 2000 ppm, close the tank valve or cooler lid, remove from the room, and leave the box fan running.
8. Record the initial indoor CO_2 concentration ($C_{indoor\ initial}$) and time ($T_{initial}$), then leave the room.
9. After 30 min have elapsed, return to the room and record the final concentration ($C_{indoor\ final}$) and time (T_{final}).
    - Note: If the CO_2 concentration is not recorded at 30 min (e.g., 1 or 2 min before or after 30 min have elapsed), the ACH can still be calculated, just enter the time and use the actual number of minutes that elapsed since the initial concentration measurement.
10. Outdoors, place the CO_2 meter out of direct sunlight, let equilibrate for 5 min, and record time and the final outdoor concentration ($C_{outdoor\ final}$).
11. Calculate and record the average outdoor CO_2 concentration ($C_{outdoor\ average}$): sum the initial and final concentrations and divide by two.

- Note: If occupant-generated CO_2 is used to establish the initial CO_2 concentration, eliminate Steps 5–7 and apply the rest of procedure. To reduce estimation uncertainty, an initial indoor CO_2 concentration >1000 ppm or a shorter measurement end time (e.g., 15 min) is recommended.

How to Calculate the Outdoor Air VR

- Calculate and record the elapsed time (min) between the initial and final indoor concentration measurements.
    - $T_{elapsed} = T_{final} - T_{initial}$
- Calculate and record the initial and final indoor concentrations after subtracting background outdoor concentration ($C_{corrected\ initial}$ and $C_{corrected\ final}$).
    - $C_{corrected\ initial} = C_{indoor\ initial} - C_{outdoor\ average}$
    - $C_{corrected\ final} = C_{indoor\ final} - C_{outdoor\ average}$
- If the elapsed time is 30 min, use the look-up table below in "CO_2 Ventilation Test Look-Up Table" to estimate outdoor ACH from the concentration ratio ($C_{corrected\ final}$) / ($C_{corrected\ initial}$). Otherwise, calculate and record the outdoor ACH.
    - $ACH = Ln\ (C_{corrected\ initial} / C_{corrected\ final}) / (T_{elapsed} / 60)$
- Calculate and record the outdoor airflow rate (cfm).
    - $cfm = ACH \times$ room air volume (ft^3) / 60
- Calculate and record the outdoor air flow rate per occupant (cfm/occupant):
    - cfm/occupant = cfm / maximum number of persons
- Calculate and record the outdoor air flow rate per room floor area (cfm/ft^2):
    - cfm/ft^2 = cfm / room floor area (ft^2).

Note:

- For mechanically ventilated classrooms (including classrooms for both ages 5–8 and 9 and older), the California code-required minimum outdoor air VRs are 15 cfm/occupant or 0.15 cfm/ft^2, whichever is greater.
- If the outdoor CO_2 concentration cannot be measured, assume an outdoor concentration of 400 ppm. This assumption results in a sufficient but conservative estimation of VR (i.e., a calculated VR that is 10–20 percent lower than the true VR), because actual outdoor CO_2 concentrations are usually higher than 400 ppm.[33]

CO_2 Ventilation Test Look-Up Table

Use this table to estimate the outdoor ACH from the ratio of final/initial concentrations.

Note:

- For this table, $C_{indoor\ final}$ must be measured at 30 min following $C_{indoor\ initial}$. If not, use the following equation.
  - $ACH = Ln\ (C_{corrected\ initial} / C_{corrected\ final}) / ((T_{final} - T_{initial}) / 60)$
- If the measured concentration ratio is in between two values of this table, use the average of the corresponding two ACH values.

$(C_{corrected\ final})/(C_{corrected\ initial})$	Outdoor air ACH	$(C_{corrected\ final})/(C_{corrected\ initial})$	Outdoor air ACH
0.88	0.3	0.48	1.5
0.86	0.3	0.46	1.6
0.84	0.3	0.44	1.6
0.82	0.4	0.42	1.7
0.80	0.4	0.40	1.8
0.78	0.5	0.38	1.9
0.76	0.5	0.36	2.0
0.74	0.6	0.34	2.2
0.72	0.7	0.32	2.3
0.70	0.7	0.30	2.4
0.68	0.8	0.28	2.5
0.66	0.8	0.26	2.7
0.64	0.9	0.24	2.9
0.62	1.0	0.22	3.0
0.60	1.0	0.20	3.2
0.58	1.1	0.18	3.4
0.56	1.2	0.16	3.7
0.54	1.2	0.14	3.9
0.52	1.3	0.12	4.2
0.50 (continued)	1.4	0.10	4.6

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Classroom CO_2 Decay Ventilation Measurement Datasheet

Classroom Name: _

Floor Area (ft^2): __

Ceiling Height (ft): _________

Volume (ft^3): _________

Maximum Number of Occupants: _________

Location		Time	CO_2 Concentration (ppm)
Outdoor	$C_{outdoor\ initial}$	_______	__________
	$C_{outdoor\ final}$	_______	__________
Indoor	$C_{indoor\ initial}$		
	$C_{indoor\ final}$	_______	__________

$C_{outdoor\ average}$ __________

$C_{corrected\ initial}$ ($C_{indoor\ initial} - C_{outdoor\ average}$) __________

$C_{corrected\ final}$ ($C_{indoor\ final} - C_{outdoor\ average}$) __________

Concentration Ratio ($C_{corrected\ final}$) / ($C_{corrected\ initial}$) __________

$T_{initial} - T_{final}$ (elapsed minutes) ______

ACH: (ACH = Ln ($C_{corrected\ initial}$ / $C_{corrected\ final}$) / ($T_{elapsed}$ / 60)) ____________________

cfm: (cfm = ACH × room air volume (ft^3) / 60) _________

cfm/occupant: (cfm/occupant = cfm / maximum number of persons) ______________________

cfm/ft^2: (cfm/ft^2 = cfm / room floor area (ft^2)) _______________

Does the classroom meet the California code-required minimum outdoor air VR?

☐ Yes—No further action required.

☐ NO—Make necessary ventilation system checks and repair equipment as required to achieve minimum outdoor air VR.

> **Note:** For mechanically ventilated classrooms, the California code-required minimum outdoor air VRs are 15 cfm/occupant or 0.15 cfm/ft^2, whichever is greater.

Inspector's name: ________________________

Date: __________________

Classroom CO_2 Decay Ventilation Measurement Datasheet (EXAMPLE)

Classroom Name: Room 101

Floor Area (ft^2): 960

Ceiling Height (ft): 9

Volume (ft^3): 8640

Maximum Number of Occupants: 27

Location		Time	CO_2 Concentration (ppm)
Outdoor	$C_{outdoor\ initial}$	10.14	443
	$C_{outdoor\ final}$	11:23	449
Indoor	$C_{indoor\ initial}$	10:37	1063
	$C_{indoor\ final}$	11:07	546
$C_{outdoor\ average}$			441
$C_{corrected\ initial}$ ($C_{indoor\ initial}$ − $C_{outdoor\ average}$)			622
$C_{corrected\ final}$ ($C_{indoor\ final}$ − $C_{outdoor\ average}$)			105
Concentration Ratio ($C_{corrected\ final}$) / ($C_{corrected\ initial}$)			0.17

$T_{initial} - T_{final}$ (elapsed minutes) 30

ACH: (ACH = Ln ($C_{corrected\ initial}$ / $C_{corrected\ final}$) / ($T_{elapsed}$ / 60)) =

Ln (622 / 105) / (30 / 60) = 3.6

cfm: (cfm = ACH × room air volume (ft^3) / 60) =

3.6 × 8640 / 60 = 512

cfm/occupant: (cfm/occupant = cfm / maximum number of persons) =

512 / 27 = 19

cfm/ft^2: (cfm/ft^2 = cfm / room floor area (ft^2)) = 512 / 960 = 0.53

Does the classroom meet the California code-required minimum outdoor air VR?

⍰ Yes—No further action required.

☐ NO—Make necessary ventilation system checks and repair equipment as required to achieve minimum outdoor air VR.

Note: For mechanically ventilated classrooms, the California code-required minimum outdoor air VRs are 15 cfm/occupant or 0.15 cfm/ft^2, whichever is greater.

Inspector's name: Marvin Wong

Date: March 12, 2021

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Appendix F. Example Calculation of Total ACH for Removing Virus-containing Particles

The following is an example calculation for a typical classroom defined in CDPH IAQ's modeling paper (i.e., with 27 occupants, floor area of 89.3 m^2, and ceiling height of 3 m).[12] Appendix 3 in this paper has an interactive spreadsheet that calculates ACH_{Total}, from ACH_{OA}, $ACH_{HVAC\text{-}Filtration}$, and ACH_{PAC}.

For the defined reference case (i.e., with the code-required minimum outdoor air VR, a MERV 8 filter, 6 ACH of supply air, and no PACs),[12] the calculated total ACH for removing virus-containing particles is 4.14 ACH (under the given model assumptions and limitations):

ACH_{OA} = 2.54 ACH (outdoor ventilation airflow rate = 27 occupants × 7 L/s-occupant or 15 cfm/occupant = 680 m^3/h or 405 cfm)

$ACH_{HVAC\text{-}Filtration}$ = 1.60 ACH (MERV 8 removal of SARS-CoV-2 particles)

ACH_{PAC} = 0 ACH

ACH_{Total} = 2.54 +1.60 + 0 = 4.14 ACH

Thus, to achieve a minimum ACH_{Total} of 6 ACH for this classroom scenario, an additional 1.86 ACH, or 498 m^3/h (i.e., 1.86 ACH × 89.3 m^2 × 3 m) or 293 cfm, is required. This additional removal of airborne particles can be provided by increasing the outdoor ventilation airflow rate, improving the HVAC air filtration rate, or adding PACs with total Clean Air Delivery Rates (CADRs) for "tobacco smoke" ≥ 498 m^3/h (or 293 cfm).

Acknowledgements

The project was funded by the U.S. Centers for Disease Control and Prevention (CDC) through a COVID-19 Crisis Response Cooperative Agreement (Grant Number: 6 NU90TP922071-01-03). We thank CDC for providing this support.

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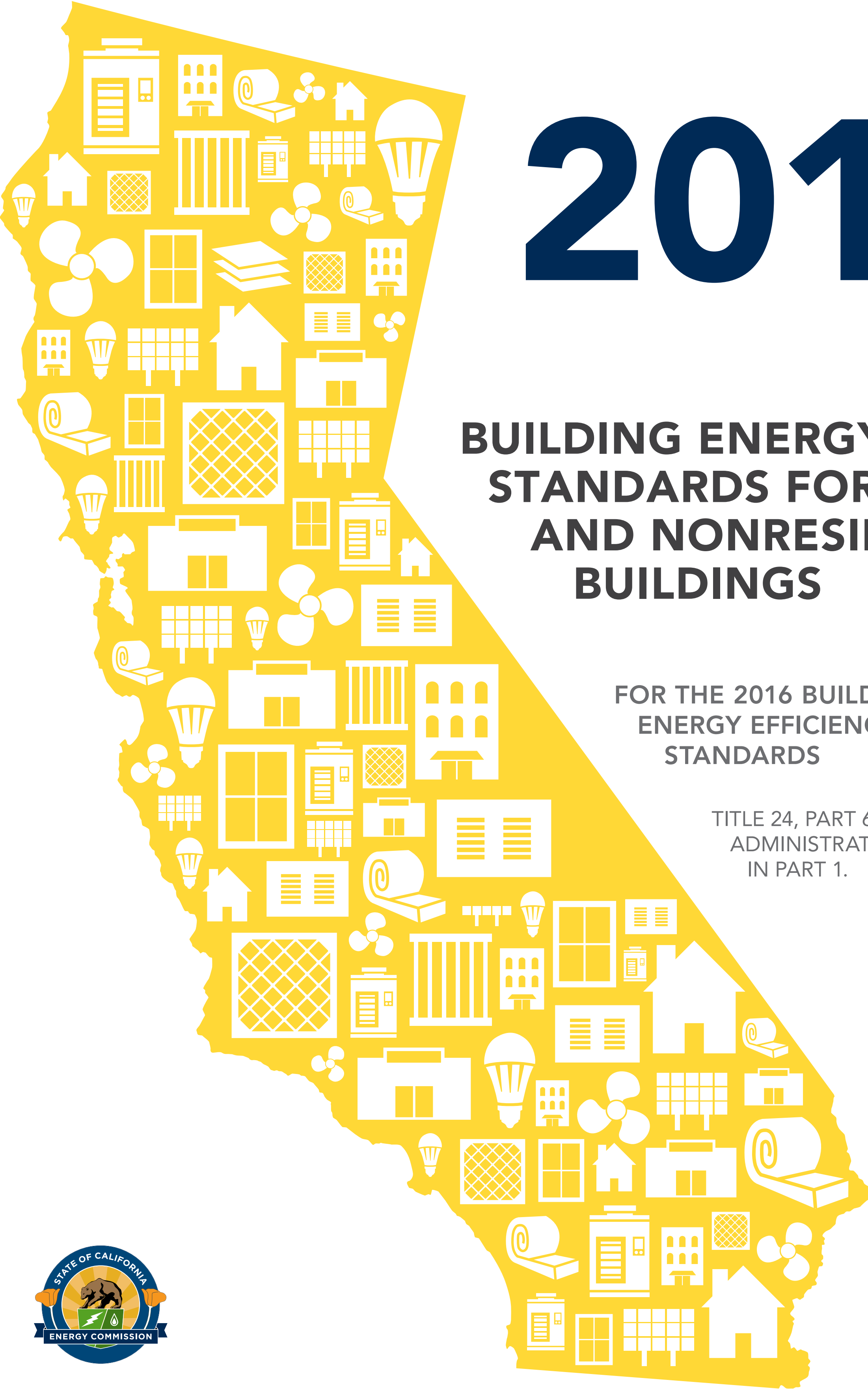

2016

BUILDING ENERGY EFFICIENCY STANDARDS FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS

FOR THE 2016 BUILDING ENERGY EFFICIENCY STANDARDS

TITLE 24, PART 6, AND ASSOCIATED ADMINISTRATIVE REGULATIONS IN PART 1.

JUNE 2015
CEC-400-2015-037-CMF

CALIFORNIA ENERGY COMMISSION
Edmund G. Brown Jr., Governor

CALIFORNIA ENERGY COMMISSION

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ABSTRACT

The Building Energy Efficiency Standards were first adopted in 1976 and have been updated periodically since then as directed by statute. In 1975 the Department of Housing and Community Development adopted rudimentary energy conservation standards under their State Housing Law authority that were a precursor to the first generation of the Standards. However, the Warren-Alquist Act was passed one year earlier with explicit direction to the Energy Commission (formally titled the State Energy Resources Conservation and Development Commission) to adopt and implement the Standards. The Energy Commission's statute created separate authority and specific direction regarding what the Standards are to address, what criteria are to be met in developing the Standards, and what implementation tools, aids, and technical assistance are to be provided.

The Standards contain energy and water efficiency requirements (and indoor air quality requirements) for newly constructed buildings, additions to existing buildings, and alterations to existing buildings. Public Resources Code Sections 25402 subdivisions (a)-(b) and 25402.1 emphasize the importance of building design and construction flexibility by requiring the Energy Commission to establish performance standards, in the form of an "energy budget" in terms of the energy consumption per square foot of floor space. For this reason, the Standards include both a prescriptive option, allowing builders to comply by using methods known to be efficient, and a performance option, allowing builders complete freedom in their designs provided the building achieves the same overall efficiency as an equivalent building using the prescriptive option. Reference Appendices are adopted along with the Standards that contain data and other information that helps builders comply with the Standards.

The 2016 update to the Building Energy Efficiency Standards focuses on several key areas to improve the energy efficiency of newly constructed buildings and additions and alterations to existing buildings. The most significant efficiency improvements to the residential Standards include improvements for attics, walls, water heating, and lighting. The most significant efficiency improvements to the nonresidential Standards include alignment with the ASHRAE 90.1 2013 national standards. New efficiency requirements for elevators and direct digital controls are included in the nonresidential Standards. The 2016 Standards also include changes made throughout all of its sections to improve the clarity, consistency, and readability of the regulatory language.

Public Resources Code Section 25402.1 also requires the Energy Commission to support the performance standards with compliance tools for builders and building designers. The Alternative Calculation Method (ACM) Approval Manual adopted by regulation as an appendix of the Standards establishes requirements for input, output and calculational uniformity in the computer programs used to demonstrate compliance with the Standards. From this, the Energy Commission develops and makes publicly available free, public domain building modeling software in order to enable compliance based on modeling of building efficiency and performance. The ACM Approval Manual also includes provisions for private firms seeking to develop compliance software for approval by the Energy Commission, which further encourages flexibility and innovation.

The Standards are divided into three basic sets. First, there is a basic set of mandatory requirements that apply to all buildings. Second, there is a set of performance standards – the energy budgets – that vary by climate zone (of which there are 16 in California) and building type; thus the Standards are tailored to local conditions. Finally, the third set constitutes an alternative to the performance standards, which is a set of prescriptive packages that are basically a recipe or a checklist compliance approach. A summary outline of the Standards is as follows:

- The administrative regulations for the Standards are in Part 1, Chapter 10.
- Mandatory requirements that apply to all building types are in Part 6, Sections 110.0 – 110.9.
- The requirements for nonresidential buildings, high-rise residential buildings, and hotels/motels are in Part 6, Sections 120.0 to 120.9 and 130.0 to 141.0. Specialized mandatory requirements for such buildings are in Sections 120.0 to 130.5; the performance compliance approach is explained in Section 140.1; nonresidential prescriptive packages are in Sections 140.2 to 140.9; and requirements for additions, alterations, and repairs to existing nonresidential buildings are in Section 141.
- The requirements for low-rise residential buildings are in Part 6, Sections 150.0 to 150.2. Specialized mandatory requirements for these buildings are in Section 150.0; the performance compliance approach is explained in Section 150.1; prescriptive packages are in Section 150.1; and requirements for additions and alterations to existing buildings are in Section 150.2.

- Additional directions adopted to support the Standards in Part 6 are in the Reference Appendices: the Residential Appendices; the Nonresidential Appendices; the Joint Appendices; and the Alternative Calculation Method Approval Manual.

Energy Commission staff completed an Initial Study of the environmental impacts of the 2016 Building Energy Efficiency Standards for residential and nonresidential buildings. In this Initial Study, Energy Commission staff estimated that the implementation of the 2016 Building Energy Efficiency Standards may reduce statewide annual electricity consumption by approximately 281 gigawatt-hours per year, electrical peak demand by 195 megawatts, and natural gas consumption by 16 million therms per year. The potential effect of these energy savings to air quality may be a net reduction in the emission of nitric oxide by approximately 508 tons per year, sulfur oxides by 13 tons per year, carbon monoxide by 41 tons per year and particulate matter less than 2.5 microns in diameter by 13.57 tons per year. Additionally, Energy Commission staff estimated that the implementation of the 2016 Standards may reduce statewide greenhouse gas emissions by 160 thousand metric tons CO_2e per year.

Keywords:

California Energy Commission
California Building Code
California Building Energy Efficiency Standards
Title 24, Part 6
2016 Building Energy Efficiency Standards
Residential
Nonresidential
Newly Constructed
Additions and Alterations to Existing Buildings

Mandatory
Prescriptive
Performance
Time Dependent
Valuation
TDV
Ducts in Conditioned Spaces
High Performance Attics
High Performance Walls
High Efficacy Lighting
Water Heating
Windows

Envelope Insulation
HVAC
Building Commissioning
Process Load
Refrigeration
Data Center
Exhaust
Compressed Air
Acceptance Testing
Data Collection
Cool Roof
On-site Renewable

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ADMINISTRATIVE REGULATIONS
CALIFORNIA CODE OF REGULATIONS
TITLE 24, PART 1

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ARTICLE 1 – ENERGY BUILDING REGULATIONS

10-101 – SCOPE

(a) This article contains administrative regulations relating to the energy building regulations in Title 24, Part 6. This article applies to all residential and nonresidential buildings.

(b) Nothing in this article lessens any necessary qualifications or responsibilities of licensed or registered building professionals or other designers or builders, or the duties of enforcement agencies that exist under state or local law.

(c) If any provision of the regulations in this article or the Building Energy Efficiency Standards, Title 24, Part 6, of the California Code of Regulations is found invalid by a court of competent jurisdiction, the remainder of these regulations shall remain in effect.

NOTE: Authority: Sections 25402 and 25402.1, Public Resources Code. Reference: Sections 25402 and 25402.1, Public Resources Code.

10-102 – DEFINITIONS

In this article the following definitions apply:

ACCEPTANCE REQUIREMENTS are "acceptance requirements for code compliance" as defined in Section 100.1(b) of Part 6.

ACCEPTANCE TEST TECHNICIAN is a Field Technician as defined in Section 10-102 who is certified by an authorized Acceptance Test Technician Certification Provider pursuant to the requirements of Sections 10-103.1 or 10-103.2.

LIGHTING CONTROLS ACCEPTANCE TEST TECHNICIAN is a professional certified by an authorized Lighting Controls Acceptance Test Technician Certification Provider to perform nonresidential lighting controls acceptance tests and complete the documentation required for nonresidential lighting controls acceptance tests as required by the Building Energy Efficiency Standards.

MECHANICAL ACCEPTANCE TEST TECHNICIAN is a professional certified by an authorized Mechanical Acceptance Test Technician Certification Provider to perform nonresidential mechanical acceptance tests and complete the documentation required for nonresidential mechanical acceptance tests as required by the Building Energy Efficiency Standards.

ACCEPTANCE TEST EMPLOYER is a person or entity who employs an Acceptance Test Technician and is certified by an authorized Acceptance Test Technician Certification Provider.

LIGHTING CONTROLS ACCEPTANCE TEST EMPLOYER is a person or entity who is the employer of a Lighting Controls Acceptance Test Technician and certified by an authorized Lighting Controls Acceptance Test Technician Certification Provider.

MECHANICAL ACCEPTANCE TEST EMPLOYER is a person or entity who is the employer of a Mechanical Acceptance Test Technician and certified by an authorized Mechanical Acceptance Test Technician Certification Provider.

ACCEPTANCE TEST TECHNICIAN CERTIFICATION PROVIDER is an agency, organization or entity approved by the Energy Commission to train and certify Acceptance Test Technicians and Acceptance Test Employers according to the requirements of Sections 10-103.1 or 10-103.2.

LIGHTING CONTROLS ACCEPTANCE TEST TECHNICIAN CERTIFICATION PROVIDER is an agency, organization or entity approved by the Energy Commission to train and certify Lighting Controls Acceptance Test Technicians and Lighting Controls Acceptance Test Employers according to the requirements of Section 10-103.1.

MECHANICAL ACCEPTANCE TEST TECHNICIAN CERTIFICATION PROVIDER is an agency, organization or entity approved by the Energy Commission to train and certify Mechanical Acceptance Test Technicians and Mechanical Acceptance Test Employers according to the requirements of Section 10-103.2.

ACM means **ALTERNATIVE CALCULATION METHOD** are compliance software, or alternative component packages, or exceptional methods approved by the Commission under Section 10-109. ACMs are also referred to as Compliance Software.

ACM APPROVAL MANUALS are the documents establishing the requirements for Energy Commission approval of Compliance Software used to demonstrate compliance with the Building Energy Efficiency Standards for Residential and Nonresidential Buildings currently adopted by the Energy Commission.

ACM REFERENCE MANUAL is the document establishing the procedures required to implement Sections 140.1 and 150.1 of Title 24, Part 6 of the California Code of Regulations in Compliance Software.

ALTERNATIVE COMPONENT PACKAGE is a set of building measures whose aggregate calculated energy use is less than or equal to the maximum allowed Energy Budget.

APPLIANCE EFFICIENCY REGULATIONS are the regulations in Title 20, Section 1601 et. seq. of the California Code of Regulations.

APPROVED CALCULATION METHOD is compliance software, or alternative component packages, or exceptional methods approved under Section 10-109.

BUILDING ENERGY EFFICIENCY STANDARDS are those regulations contained in Title 24, Part 6 of the California Code of Regulations.

BUILDING PERMIT is an electrical, plumbing, mechanical, building, or other permit or approval, that is issued by an enforcement agency, and that authorizes any construction that is subject to Part 6.

CALIFORNIA ENERGY COMMISSION is the California State Energy Resources Conservation and Development Commission.

COMMISSION is the California State Energy Resources Conservation and Development Commission.

COMPLEX MECHANICAL SYSTEMS are defined here for the purposes of complying with the Design Phase Review component of Section 10-103(a)1. Complex Mechanical Systems are systems that include 1) fan systems each serving multiple thermostatically controlled zones, or 2) built-up air handler systems (non-unitary or non-packaged HVAC equipment), or 3) hydronic or steam heating systems, or 4) hydronic cooling systems. Complex systems are NOT the following: unitary or packaged equipment listed in Tables 110.2-A, 110.2-B, 110.2-C, and 110.2-E, that each serve one zone, or two-pipe, heating only systems serving one or more zones.

COMPLIANCE APPROACH is any one of the allowable methods by which the design and construction of a building may be demonstrated to be in compliance with Part 6. The compliance approaches are the performance compliance approach and the prescriptive compliance approach. The requirements for each compliance approach are set forth in Section 100.0(e)2 of Part 6.

COMPLIANCE DOCUMENT is any of the documents specified in Section 10-103(a) utilized to demonstrate compliance with Part 6 (i.e., Certificate of Compliance, Certificate of Installation, Certificate of Acceptance, and Certificate of Verification).

COMPLIANCE SOFTWARE is software that has been approved pursuant to Section 10-109 of Part 1.

CONDITIONED FLOOR AREA is the “conditioned floor area” as defined in Section 100.1(b) of Part 6.

CRRC-1 is the Cool Roof Rating Council document titled “Product Rating Program”.

DATA REGISTRY is a web service with a user interface and database maintained by a Registration Provider that complies with the applicable requirements in Reference Joint Appendix JA7, with guidance from the Data Registry Requirements Manual, and provides for registration of residential or nonresidential compliance documentation used for demonstrating compliance with Part 6.

> **RESIDENTIAL DATA REGISTRY** is a data registry that is maintained by a HERS Provider that provides for registration, when required by Part 6 of all residential compliance documentation and the nonresidential Certificate of Verification.
>
> **NONRESIDENTIAL DATA REGISTRY** is a data registry that is maintained by a Registration Provider approved by the Commission that provides for registration, when required by Part 6 of all nonresidential compliance documentation. However, nonresidential data registries may not provide for registration of nonresidential Certificates of Verification.

DATA REGISTRY REQUIREMENTS MANUAL is a document that provides additional detailed guidance regarding the functional and technical aspects of the data registry requirements given in Joint Appendix JA7.

DOCUMENTATION AUTHOR is a person who prepares a Title 24 Part 6 compliance document that must subsequently be reviewed and signed by a responsible person in order to certify compliance with Part 6.

ENERGY BUDGET is the “energy budget” as defined in Section 100.1(b) of Part 6.

ENERGY COMMISSION is the California State Energy Resources Conservation and Development Commission.

ENFORCEMENT AGENCY is the city, county, or state agency responsible for issuing a building permit.

EXCEPTIONAL METHOD is a method for estimating the energy performance of building features that cannot be adequately modeled using existing Compliance Software and that is approved by the Executive Director.

EXECUTIVE DIRECTOR is the executive director of the Commission.

FIELD TECHNICIAN is a person who performs acceptance tests in accordance with the specifications in Reference Joint Appendix NA7, and reports the results of the acceptance tests on the Certificate of Acceptance in accordance with the requirements of Section 10-103(a)4.

HERS is the California Home Energy Rating System as described in Title 20, Chapter 4, Article 8, Section 1670.

HERS PROVIDER is an organization that administers a home energy rating system as described in Title 20, Chapter 4, Article 8, Section 1670.

HERS PROVIDER DATA REGISTRY is a data registry maintained by a HERS provider.

HERS RATER is a person who has been trained, tested, and certified by a HERS Provider to perform the field verification and diagnostic testing required for demonstrating compliance with the Part 6 as described in Title 20, Chapter 4, Article 8, Section 1670(i).

HVAC SYSTEM is the “HVAC system” as defined in Section 100.1(b) of Part 6.

MANUFACTURED DEVICE is the “manufactured device” as defined in Section 100.1(b) of Part 6.

NFRC 100 is the National Fenestration Rating Council document titled “NFRC 100: Procedure for Determining Fenestration Product U-factors.” (2011) NFRC 100 includes procedures for the Component Modeling Approach (CMA) and site built fenestration formerly included in a separate document, NFRC 100-SB.

NFRC 200 is the National Fenestration Rating Council document titled “NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence.” (2011),

NFRC 202 is the National Fenestration Rating Council document titled “NFRC 202: Procedures for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence.” (2011).

NFRC 203 is the National Fenestration Rating Council document titled “NFRC 203: Procedure for Determining Visible Transmittance of Tubular Daylighting Devices.” (2012),

NFRC 400 is the National Fenestration Rating Council document titled “NFRC 400: Procedure for Determining Fenestration Product Air Leakage.” (2010).

PART 6 is Title 24, Part 6 of the California Code of Regulations.

PUBLIC ADVISER is the Public Adviser of the Commission.

R-VALUE is the measure of the thermal resistance of insulation or any material or building component expressed in ft^2-hr-°F/Btu.

RECORD DRAWINGS are drawings that document the as installed location and performance data on all lighting and space conditioning system components, devices, appliances and equipment, including but not limited to wiring sequences, control sequences, duct and pipe distribution system layout and sizes, space conditioning system terminal device layout and air flow rates, hydronic system and flow rates, and connections for the space conditioning system. Record drawings are sometimes called “as built.”

REFERENCE APPENDICES are the support document for the Building Energy Efficiency Standards and the ACM Approval Manuals. The document consists of three sections: the Reference Joint Appendices (JA), the Reference Residential Appendices (RA), and the Reference Nonresidential Appendices (NA) currently adopted by the Energy Commission.

REFERENCE JOINT APPENDICES are the Reference Joint Appendices currently adopted by the Energy Commission.

REFERENCE NONRESIDENTIAL APPENDICES are the Reference Nonresidential Appendices currently adopted by the Energy Commission.

REFERENCE RESIDENTIAL APPENDICES are the Reference Residential Appendices currently adopted by the Energy Commission.

REGISTERED DOCUMENT is a document that has been submitted to a residential or nonresidential data registry for retention, and the data registry has assigned a unique registration number to the document.

REGISTRATION PROVIDER is an organization that administers a data registry service that conforms to the requirements in Reference Joint Appendix JA7.

STANDARD DESIGN BUILDING is a "Standard Design Building" as defined in Section 100.1(b) of Part 6.

NOTE: Authority: Sections 25402 and 25402.1, and 25213, Public Resources Code. Reference: Sections 25007, 25402 and 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code.

10-103 – PERMIT, CERTIFICATE, INFORMATIONAL, AND ENFORCEMENT REQUIREMENTS FOR DESIGNERS, INSTALLERS, BUILDERS, MANUFACTURERS, AND SUPPLIERS

(a) **Documentation.** The following documentation is required to demonstrate compliance with Part 6. This documentation shall meet the requirements of Section 10-103(a) or alternatives approved by the Executive Director.

1. **Certificate of Compliance.** For all buildings, the Certificate of Compliance described in Section 10-103 shall be signed by the person who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design (*responsible person*); and submitted in accordance with Sections 10-103(a)1 and 10-103(a)2 to certify conformance with Part 6. If more than one person has responsibility for the building design, each person shall sign the Certificate of Compliance document(s) applicable to that portion of the design for which the person is responsible. Alternatively, the person with chief responsibility for the building design shall prepare and sign the Certificate of Compliance document(s) for the entire building design. Subject to the requirements of Sections 10-103(a)1 and 10-103(a)2, persons who prepare Certificate of Compliance documents (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. In accordance with applicable requirements of 10-103(a)1, the signatures provided by *responsible persons* and *documentation authors* shall be original signatures on paper documents or electronic signatures on electronic documents conforming to the electronic signature specifications in Reference Joint Appendix JA7.

   For all Nonresidential buildings, the Design Review Kickoff Certificate(s) of Compliance and the Construction Document Design Review Checklist Certificate(s) of Compliance shall be reviewed and signed by a licensed professional engineer or licensed architect, or a licensed contractor representing services performed by or under the direct supervision of a licensed engineer or architect, as specified in the provisions of Division 3 of the Business and Professions Code. For buildings less than 10,000 square feet, this signer may be the engineer or architect of record. For buildings greater than 10,000 square feet but less than 50,000 square feet, this signer shall be a qualified in-house engineer or architect with no other project involvement or a third party engineer, architect, or contractor. For buildings greater than 50,000 square feet and all buildings with complex mechanical systems serving more than 10,000 square feet, this signer shall be a third party engineer, architect, or contractor.

   A. All Certificate of Compliance documentation shall conform to a format and informational order and content approved by the Energy Commission.

      These documents shall:

      i. Identify the energy features, performance specifications, materials, components, and manufactured devices required for compliance with Part 6.

      ii. Identify the building project name and location. The building project name and location identification on the Certificate of Compliance shall be consistent with the building project name and location identification given on the other applicable building design plans and specifications submitted to the enforcement agency for approval with the building permit application.

      iii. Display the unique registration number assigned by the data registry if Section 10-103(a)1 requires the document to be registered.

      iv. Include a declaration statement to the effect that the building energy features, performance specifications, materials, components, and manufactured devices for the building design identified on the Certificate of Compliance indicate the building is in compliance with the requirements of Title 24, Parts 1 and 6, and the building design features identified on the Certificate of Compliance are consistent with the building design features identified on the other applicable compliance documents, worksheets, calculations, plans, and specifications submitted to the enforcement agency for approval with the building permit application.

v. Be signed by the *documentation author* to certify the documentation is accurate and complete. When document registration is required by Section 10-103(a)1, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

vi. Be signed by the *responsible person* eligible under Division 3 of the Business and Professions Code to accept responsibility for the design to certify conformance with Part 6. When document registration is required by Section 10-103(a)1, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

B. For all low-rise residential buildings for which compliance requires HERS field verification, the person(s) responsible for the Certificate(s) of Compliance shall submit the Certificate(s) for registration and retention to a HERS provider data registry. The submittals to the HERS provider data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Compliance documents that are registered and retained by a HERS provider data registry shall also be automatically transmitted by the data registry, to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

C. For alterations to existing residential buildings for which HERS field verification is not required, including but not limited to water heater and window replacements, and for additions to existing residential buildings that are less than 300 square feet for which HERS field verification is not required, the enforcement agencies may at their discretion not require any Certificate of Compliance documentation, or may develop simplified Certificate of Compliance documentation for demonstrating compliance with the Standards.

Exemptions from submitting compliance documentation shall not be deemed to grant authorization for any work to be done in any manner in violation of this code or other provisions of law.

D. Contingent upon approval of data registry(s) by the Commission, all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person(s) responsible for the Certificate(s) of Compliance shall submit the Certificate(s) for registration and retention to a data registry approved by the Commission. The submittals to the approved data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Compliance documents that are registered and retained by an approved data registry shall also be automatically transmitted by the data registry to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

2. **Application for a building permit.** Each application for a building permit subject to Part 6 shall contain at least one copy of the documents specified in Sections 10-103(a)2A, 10-103(a)2B, and 10-103(a)2C.

A. For all newly constructed buildings, additions, alterations, or repairs regulated by Part 6 the applicant shall submit the applicable Certificate(s) of Compliance to the enforcement agency for approval. The certificate(s) shall conform to the requirements of Section 10-103(a)1, and shall be approved by the local enforcement agency, in accordance with all applicable requirements of Section 10-103(d), by stamp or authorized signature prior to issuance of a building permit. A copy of the Certificate(s) of Compliance shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).

For alterations to existing residential buildings for which HERS field verification is required, and when the enforcement agency does not require building design plans to be submitted with the application for a building permit, the applicable Certificate of Compliance documentation specified in 10-103(a)1 is not required to be approved by the enforcement agency prior to issuance of a building permit, but shall be approved by the enforcement agency prior to final inspection of the dwelling unit, and shall be made available to the enforcement agency for all applicable inspections, or made available for viewing on an approved data registry.

When the enforcement agency requires building design plans to be submitted with the application for a building permit, the applicable Certificate of Compliance documents shall be incorporated into the building design plans. When Section 10-103(a)1 requires document registration, the certificate(s) that are incorporated into the building design plans shall be copies of the registered Certificate of Compliance documents from a HERS provider data registry, or a data registry approved by the Commission.

B. When the enforcement agency requires building design plans and specifications to be submitted with the application for a building permit, the plans shall conform to the specifications for the features, materials, components, and manufactured devices identified on the Certificate(s) of Compliance, and shall conform to all other applicable requirements of Part 6. Plans and specifications shall be submitted to the enforcement agency for any other feature, material, component, or manufactured device that Part 6 requires be indicated on the building design plans and specifications. Plans and specifications submitted with each application for a building permit for Nonresidential buildings, High-rise Residential buildings and Hotels and Motels shall provide acceptance requirements for code compliance of each feature, material, component or manufactured device when acceptance requirements are required under Part 6. Plans and specifications for Nonresidential buildings, High-rise Residential buildings and Hotels and Motels shall require, and indicate with a prominent note on the plans, that within 90 days after the Enforcement Agency issues a permanent final occupancy permit, record drawings be provided to the building owner.

For all buildings, if the specification for a building design feature, material, component, or manufactured device is changed before final construction or installation, such that the building may no longer comply with Part 6 the building must be brought back into compliance, and so indicated on amended plans, specifications, and Certificate(s) of Compliance that shall be submitted to the enforcement agency for approval. Such characteristics shall include the efficiency (or other characteristic regulated by Part 6) of each building design feature, material, component, or device.

C. The enforcement agency shall have the authority to require submittal of any supportive documentation that was used to generate the Certificate(s) of Compliance, including but not limited to the electronic input file for the compliance software tool that was used to generate performance method Certificate(s) of Compliance; or any other supportive documentation that is necessary to demonstrate that the building design conforms to the requirements of Part 6.

3. **Certificate of Installation.** For all buildings, the person in charge of the construction or installation, who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices regulated by Part 6 or the Appliance Efficiency Regulations (*responsible person*) shall sign and submit Certificate of Installation documentation as specified in Section 10-103(a)3 to certify conformance with Part 6. If more than one person has responsibility for the construction or installation, each person shall sign and submit the Certificate of Installation documentation applicable to the portion of the construction or installation for which they are responsible; alternatively, the person with chief responsibility for the construction or installation shall sign and submit the Certificate of Installation documentation for the entire construction or installation scope of work for the project. Subject to the requirements of Section 10-103(a)3, persons who prepare Certificate of Installation documentation (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. In accordance with applicable requirements of 10-103(a)3, the signatures provided by *responsible persons* and *documentation authors* shall be original signatures on paper documents or electronic signatures on electronic documents conforming to the electronic signature specifications in Reference Joint Appendix JA7.

Delegation of Signature Authority. Except where prohibited by law, including but not limited to any requirements under Division 3 of the Business and Professions Code, the *Responsible Person* may delegate signature authority to third parties (*Authorized Representatives*) provided that there is a written agreement:

i. Between the *Responsible Person* and the person to be designated as the *Authorized Representative*.

ii. Specifying that the *Authorized Representative* may sign Certificates of Installation on behalf of the *Responsible Person*.

iii. Specifying that the legal responsibility for construction or installation in the applicable classification for the scope of work specified on the Certificate of Installation document(s) remains with the Responsible Person.

iv. That is signed by both the *Responsible Person* and the *Authorized Representative*.

v. That is retained by the HERS Provider to which all compliance documents are submitted for the building to which the Certificate of Installation documentation pertains.

vi. That is maintained in the HERS Provider Data Registry such that it is accessible for verification by, included but not limited to, the Energy Commission and enforcement agencies.

A. All Certificate of Installation documentation shall conform to a format and informational order and content approved by the Energy Commission.

These documents shall:

i. Identify the features, materials, components, manufactured devices, and system performance diagnostic results required to demonstrate compliance with Part 6 and the Appliance Efficiency Regulations.

ii. State the number of the building permit under which the construction or installation was performed.

iii Display the unique registration number assigned by the data registry if Section 10-103(a)3 requires the document to be registered.

iv. Include a declaration statement indicating that the constructed or installed features, materials, components or manufactured devices (the installation) identified on the Certificate of Installation conforms to all applicable codes and regulations, and the installation conforms to the requirements given on the plans and specifications approved by the enforcement agency.

v. Be signed by the *documentation author* to certify the documentation is accurate and complete. When document registration is required by Section 10-103(a)3, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

vi. Be signed by the *Responsible Person* eligible under Division 3 of the Business and Professions Code to accept responsibility for construction or installation in the applicable classification for the scope of work specified on the Certificate of Installation document(s), or shall be signed by their *Authorized Representative*. When document registration is required by Section 10-103(a)3, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

B. For all low-rise residential buildings, the person(s) responsible for the Certificate(s) of Installation , or their *Authorized Representative(s),* shall submit the following Certificate of Installation documentation that is applicable to the building to a HERS provider data registry for registration and retention in accordance with procedures specified in Reference Residential Appendix RA2:

i. All Certificates of Installation for which compliance requires HERS field verification.

ii. All other Certificates of Installation, except those exempted by the Energy Commission.

The submittals to the HERS provider data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Installation documents that are registered and retained by a HERS provider data registry shall also be automatically transmitted by the data registry to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

C. For alterations to existing residential buildings for which HERS field verification is not required, including but not limited to water heater and window replacements, and for additions to existing residential buildings that are less than 300 square feet for which HERS field verification is not required, the enforcement agencies may, at their discretion, not require any Certificate of Installation documentation, or may develop simplified Certificate of Installation documentation for demonstrating compliance with the Standards.

Exemptions from submitting compliance documentation shall not be deemed to grant authorization for any work to be done in any manner in violation of this code or other provisions of law.

D. Contingent upon approval of data registry(s) by the Commission, all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person(s) responsible for the Certificate(s) of Installation, except those documents exempted by the Energy Commission, shall submit the Certificate(s) for registration and retention to a data registry approved by the Commission. The submittals to the approved data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Installation documents that are registered and retained by an approved data registry shall also be automatically transmitted by the data registry to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

E. For all buildings, a copy of the Certificate(s) of Installation shall be posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and shall be made available to the enforcement agency for all applicable inspections. When document registration is required by Section 10-103(a)3, registered copies of the Certificate(s) of Installation from a HERS provider data registry or a data registry approved by the Commission shall be posted or made available with the building permit(s) issued for the building, and shall be made available to the enforcement agency for all applicable inspections. If construction on any portion of the building subject to Part 6 will be impossible to inspect because of subsequent construction, the enforcement agency may require the Certificate(s) of Installation to be posted upon completion of that portion. A copy of the Certificate(s) of Installation shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).

4. **Certificate of Acceptance.** For all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person in charge of the acceptance testing, who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the applicable scope of system design, or construction, or installation of features, materials, components, or manufactured devices regulated by Part 6 or the Appliance Efficiency Regulations (*responsible person*), shall sign and submit all applicable Certificate of Acceptance documentation in accordance with Section 10-103(a)4 and Nonresidential Appendix NA7 to certify conformance with Part 6. If more than one person has responsibility for the acceptance testing, each person shall sign and submit the Certificate of Acceptance documentation applicable to the portion of the construction or installation, for which they are responsible; alternatively, the person with chief responsibility for the system design, construction or installation, shall sign and submit the Certificate of Acceptance documentation for the entire construction or installation scope of work for the project. Subject to the requirements of Section 10-103(a)4, persons who prepare Certificate of Acceptance documentation (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. Persons who perform acceptance test procedures in accordance with the specifications in Reference Joint Appendix NA7, and report the results of

the acceptance tests on the Certificate of Acceptance (*field technicians*) shall sign a declaration statement on the documents they submit to certify the information provided on the documentation is true and correct. In accordance with applicable requirements of 10-103(a)4, the signatures provided by *responsible persons*, *field technicians*, and *documentation authors* shall be original signatures on paper documents or electronic signatures on electronic documents conforming to the electronic signature specifications in Reference Joint Appendix JA7.

A. All Certificate of Acceptance documentation shall conform to a format and informational order and content approved by the Energy Commission.

These documents shall:

i. Identify the features, materials, components, manufactured devices, and system performance diagnostic results required to demonstrate compliance with the acceptance requirements to which the applicant must conform as indicated in the plans and specifications submitted under Section 10-103(a)2, and as specified in Reference Nonresidential Appendix NA7.

ii. State the number of the building permit under which the construction or installation was performed.

iii. Display the unique registration number assigned by the data registry if Section 10-103(a)4 requires the document to be registered.

iv. Include a declaration statement indicating that the features, materials, components or manufactured devices identified on the Certificate of Acceptance conform to the applicable acceptance requirements as indicated in the plans and specifications submitted under Section 10-103(a), and with applicable acceptance requirements and procedures specified in the Reference Nonresidential Appendix NA7, and confirms that Certificate(s) of Installation described in Section 10-103(a)3 has been completed and is posted or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry.

v. Be signed by the *documentation author* to certify the documentation is accurate and complete. When document registration is required by Section 10-103(a)4, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

vi. Be signed by the *field technician* who performed the acceptance test procedures and reported the results on the Certificate of Acceptance. When document registration is required by Section 10-103(a)4, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

vii. Be signed by the *responsible person* in charge of the acceptance testing who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the system design, construction or installation in the applicable classification for the scope of work identified on the Certificate of Acceptance, or shall be signed by their authorized representative. When document registration is required by Section 10-103(a)4, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

B. Contingent upon approval of data registry(s) by the Commission, for all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person(s) responsible for the Certificate(s) of Acceptance shall submit the Certificate(s) for registration and retention to a data registry approved by the Commission. The submittals to the approved data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Acceptance documents that are registered and retained by an approved data registry shall also be automatically transmitted by the data registry, to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

C. A copy of the registered Certificate(s) of Acceptance shall be posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and shall be made available to the enforcement agency for all applicable inspections. If construction on any portion of the building subject to Part 6 will be impossible to inspect because of subsequent construction, the enforcement agency may require the Certificate(s) of Acceptance to be posted upon completion of that portion. A copy of the Certificate(s) of Acceptance shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).

5. **Certificate of Field Verification and Diagnostic Testing (Certificate of Verification).** For all buildings for which compliance requires HERS field verification, a certified HERS Rater shall conduct all required HERS field verification and diagnostic testing in accordance with applicable procedures specified in Reference Appendices RA2, RA3, NA1, and NA2. All applicable Certificate of Verification documentation shall be completed, signed, and submitted by the certified HERS Rater who performed the field verification and diagnostic testing services (*responsible person*) in accordance with the requirements of Section 10-103(a)5, and Reference Appendices RA2, and NA1, to certify conformance with Part 6. If more than one rater has responsibility for the HERS verification for the building, each rater shall sign and submit the Certificate of Verification documentation applicable to the portion of the building for which they are responsible. Subject to the requirements of Section 10-103(a)5, persons who prepare Certificate of Verification documentation (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. The signatures provided by *responsible persons* and *documentation authors* shall be electronic signatures on electronic documents.

A. All Certificate of Verification documentation shall conform to a format and informational order and content approved by the Energy Commission.

These documents shall:

i. Identify the installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification for compliance with Part 6 as specified on the Certificate(s) of Compliance for the building.

ii. State the number of the building permit under which the construction or installation was performed,

iii. Display the unique registration number assigned by the HERS provider data registry, and provide any additional information required by Reference Appendices RA2, RA3, NA1, and NA2.

iv. Include a declaration statement indicating that the installed features, materials, components or manufactured devices requiring HERS verification conform to the applicable requirements in Reference Appendices RA2, RA3, NA1, NA2, and the requirements specified on the Certificate(s) of Compliance approved by the local enforcement agency, and confirms the same features, materials, components or manufactured devices are identified on the applicable Certificate(s) of Installation signed and submitted by the person(s) responsible for the construction or installation as described in Section 10-103(a)3.

v. Be signed by the *documentation author* to certify the documentation is accurate and complete. The signatures shall be electronic signatures on electronic documents in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

vi. Be signed by the HERS Rater who performed the field verification and diagnostic testing services (*responsible person).* The signatures shall be electronic signatures on electronic documents in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

B. For all buildings for which compliance requires HERS field verification, the certified HERS Rater responsible for the Certificate(s) of Verification shall submit the Certificates for registration and retention to a HERS provider data registry in accordance with the applicable procedures in Reference Appendices RA2 and NA1.

The submittals to the HERS provider data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Verification documents that are registered and retained by a HERS provider data registry shall also be automatically transmitted by the data registry, to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

C. For all buildings, a copy of the registered Certificate(s) of Verification shall be posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and shall be made available to the enforcement agency for all applicable inspections. If construction on any portion of the building subject to Part 6 will be impossible to inspect because of subsequent construction, the enforcement agency may require the Certificate(s) of Verification to be posted upon completion of that portion. A copy of the registered Certificate(s) of Verification shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).

EXCEPTION to Section 10-103(a): Enforcing agencies may exempt nonresidential buildings that have no more than 1,000 square feet of conditioned floor area in the entire building and an occupant load of 49 persons or less from the documentation requirements of Section 10-103(a), provided a statement of compliance with Part 6 is submitted and signed by a licensed engineer or the licensed architect with chief responsibility for the design.

(b) **Compliance, Operating, Maintenance, and Ventilation Information to be provided by Builder.**

1. **Compliance information.**

A. For low-rise residential buildings, at final inspection, the enforcement agency shall require the builder to leave in the building, copies of the completed, signed, and submitted compliance documents for the building owner at occupancy. For low-rise residential buildings, such information shall, at a minimum, include copies of all Certificate of Compliance, Certificate of Installation, and Certificate of Verification documentation submitted. These documents shall be in paper or electronic format and shall conform to the applicable requirements of Section 10-103(a).

B. For nonresidential buildings, high-rise residential buildings and hotels and motels, at final inspection, the enforcement agency shall require the builder to leave in the building, copies of the completed, signed, and submitted compliance documents for the building owner at occupancy. For nonresidential buildings, high-rise residential buildings and hotels and motels, such information shall include copies of all Certificate of Compliance, Certificate of Installation, Certificate of Acceptance and Certificate of Verification documentation submitted. These documents shall be in paper or electronic format and shall conform to the applicable requirements of Section 10-103(a).

2. **Operating information.** At final inspection, the enforcement agency shall require the builder to leave in the building, for the building owner at occupancy, operating information for all applicable features, materials, components, and mechanical devices installed in the building. Operating information shall include instructions on how to operate the features, materials, components, and mechanical devices correctly and efficiently. The instructions shall be consistent with specifications set forth by the Executive Director. For low-rise residential buildings, such information shall be contained in a folder or manual which provides all information specified in Section 10-103(b). This operating information shall be in paper or electronic format.

For dwelling units, buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for operating the feature, material, component or mechanical device installed in the building. This operating information shall be in paper or electronic format.

3. **Maintenance information.** At final inspection, the enforcement agency shall require the builder to leave in the building, for the building owner at occupancy, maintenance information for all features, materials, components, and manufactured devices that require routine maintenance for efficient operation. Required routine maintenance actions shall be clearly stated and incorporated on a readily accessible label. The label

may be limited to identifying, by title and/or publication number, the operation and maintenance manual for that particular model and type of feature, material, component or manufactured device. For low-rise residential buildings, this information shall include a schedule of all interior luminaires and lamps installed to comply with Section 150(k).

For dwelling units, buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for maintaining the feature, material, component or mechanical device installed in the building. This information shall be in paper or electronic format.

4. **Ventilation information.** For low-rise residential buildings, the enforcement agency shall require the builder to leave in the building, for the building owner at occupancy, a description of the quantities of outdoor air that the ventilation system(s) are designed to provide to the building's conditioned space, and instructions for proper operation and maintenance of the ventilation system. For buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for operating and maintaining the feature, material, component or mechanical ventilation device installed in the building. This information shall be in paper or electronic format.

   For nonresidential buildings, high-rise residential buildings and hotels and motels, the enforcement agency shall require the builder to provide the building owner at occupancy a description of the quantities of outdoor and recirculated air that the ventilation systems are designed to provide to each area. For buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for operating and maintaining the feature, material, component or mechanical device installed in the building. This information shall be in paper or electronic format.

(c) **Equipment Information to be Provided by Manufacturer or Supplier.** The manufacturer or supplier of any manufactured device shall, upon request, provide to building designers and installers information about the device. The information shall include the efficiency (and other characteristics regulated by Part 6). This information shall be in paper or electronic format.

(d) **Enforcement Agency Requirements.**

1. **Permits.** An enforcement agency shall not issue a building permit for any construction unless the enforcement agency determines in writing that the construction is designed to comply with the requirements of Part 6 that are in effect on the date the building permit was applied for. The enforcement agency determination shall confirm that the documentation requirements of Sections 10-103(a)1 and 10-103(a)2 have been met.

   If a building permit has been previously issued, there has been no construction under the permit, and the permit has expired, the enforcement agency shall not issue a new permit unless the enforcement agency determines in writing that the construction is designed to comply with the requirements of Part 6 in effect on the date the new permit is applied for. The enforcement agency determination shall confirm that the documentation requirements of Sections 10-103(a)1 and 10-103(a)2 have been met.

   "Determines in writing" includes, but is not limited to, approval of a building permit with a stamp normally used by the enforcement agency.

2. **Inspection.** The enforcement agency shall inspect newly constructed buildings and additions, and alterations to existing buildings to determine whether the construction or installation is consistent with the agency's approved plans and specifications, and complies with Part 6. Final certificate of occupancy shall not be issued until such consistency and compliance is verified. For Occupancy Group R-3, final inspection shall not be complete until such consistency and compliance is verified.

   Such verification shall include determination that:

   A. All installed features, materials, components or manufactured devices, regulated by the Appliance Efficiency Regulations or Part 6 are indicated, when applicable, on the Certificate(s) of Installation, Certificate(s) of Acceptance and Certificate(s) of Verification, and are consistent with such features, materials, components or manufactured devices given in the plans and specifications and the Certificate(s) of Compliance approved by the local enforcement agency.

B. All required Certificates of Installation are posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and are made available to the enforcement agency for all applicable inspections, and that all required Certificates of Installation conform to the specifications of Section 10-103(a)3.

C. All required Certificates of Acceptance are posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and are made available to the enforcement agency for all applicable inspections, and that all required Certificates of Acceptance conform to the specifications of Section 10-103(a)4.

D. All required Certificates of Verification are posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and are made available to the enforcement agency for all applicable inspections, and that all required Certificates of Verification conform to the specifications of Section 10-103(a)5.

NOTE: Authority: Section 25402, Public Resources Code. Reference: Section 25402, Public Resources Code.

10-103.1 – NONRESIDENTIAL LIGHTING CONTROLS ACCEPTANCE TEST TRAINING AND CERTIFICATION

(a) **Scope.** The requirements of this section apply to nonresidential lighting control Acceptance Test Technicians and Employers, and the Certification Providers that train and certify them.

(b) **Industry Certification Threshold.** Lighting Controls Acceptance Test Technician and Employer certification requirements shall take effect when the Energy Commission finds that each of the following conditions are met. Until such time that Section 10-103.1(b)1 and 10-103.1(b)2 are met, Field Technicians are allowed to complete the acceptance test requirements in Section 130.4 without completing the Acceptance Test Technician certification requirements.

1. **Number of Certified Acceptance Test Technicians.** There shall be no less than 300 Lighting Controls Acceptance Test Technicians certified to perform the acceptance tests in Building Energy Efficiency Standards, Section 130.4. The number of certified Acceptance Test Technicians shall be demonstrated by Certification Provider-prepared reports submitted to the Energy Commission.

2. **Industry Coverage by Certification Provider(s).** The Certification Provider(s) approved by the Energy Commission, in their entirety, shall provide reasonable access to certification for technicians representing the majority of the following industry groups: electrical contractors, certified general electricians, licensed architects, professional engineers, controls installation and startup contractors and certified commissioning professionals who have verifiable training, experience and expertise in lighting controls and electrical systems. The Energy Commission will determine whether reasonable access to certification is provided by considering factors such as certification costs commensurate with the complexity of the training being provided, certification marketing materials, prequalification criteria, class availability, and curriculum.

(c) **Qualifications and Approval of Certification Providers.** The Acceptance Test Technician Certification Providers (ATTCPs) shall submit a written application to the Energy Commission with a summary and the related background documents to explain how the following criteria and procedures have been met:

1. **Requirements for Applicant ATTCPs to Document Organizational Structure.** ATTCPs shall provide written explanations of the organization type, by-laws, and ownership structure. ATTCPs shall explain in writing how their certification program meets the qualification requirements of Title 24, Part 1, Section 10-103.1(c). ATTCPs shall explain in their application to the Energy Commission their organizational structure and their procedures for independent oversight, quality assurance, supervision and support of the acceptance test training and certification processes.

2. **Requirements for Certification of Employers.** The ATTCPs shall provide written explanations of their certification and oversight of Acceptance Test Employers. This explanation shall document how the ATTCP ensures that the Employers are providing quality control and appropriate supervision and support for their Acceptance Test Technicians.

3. **Requirements for Applicant ATTCPs to Document Training and Certification Procedures.** ATTCPs shall include with their application a complete copy of all training and testing procedures, manuals, handbooks and materials. ATTCPs shall explain in writing how their training and certification procedures include, but are not limited to, the following:

   A. Training Scope. The scope of the training shall include both hands-on experience and theoretical training to certify competency in the technologies and skills necessary to perform the acceptance tests.

   B. Lighting Controls Acceptance Test Technician Training.

   (i) **Curricula.** Acceptance Test Technician Certification Provider training curricula for Lighting Control Acceptance Test Technicians shall include, but not be limited to, the analysis, theory, and practical application of the following:

   a) Lamp and ballast systems;

   b) Line voltage switching controls;

c) Low voltage switching controls;

d) Dimming controls;

e) Occupancy sensors;

f) Photosensors;

g) Demand responsive signal inputs to lighting control systems;

h) Building Energy Efficiency Standards required lighting control systems;

i) Building Energy Efficiency Standards required lighting control system-specific analytical/problem solving skills;

j) Integration of mechanical and electrical systems for Building Energy Efficiency Standards required lighting control installation and commissioning;

k) Safety procedures for low-voltage retrofits (<50 volts) to control line voltage systems (120 to 480 volts);

l) Accurate and effective tuning, calibration, and programming of Building Energy Efficiency Standards required lighting control systems;

m) Measurement of illuminance according to the Illuminating Engineering Society's measurement procedures as provided in the IESNA Lighting Handbook, 10th Edition, 2011, which are incorporated by reference;

n) Building Energy Efficiency Standards lighting controls acceptance testing procedures; and

o) Building Energy Efficiency Standard**s** acceptance testing compliance documentation for lighting controls.

(ii) Hands-on training. The ATTCP shall describe in their application the design and technical specifications of the laboratory boards, equipment and other elements that will be used to meet the hands-on requirements of the training and certification.

(iii) Prequalification. Participation in the technician certification program shall be limited to persons who have at least three years of professional experience and expertise in lighting controls and electrical systems as determined by the Lighting Controls ATTCPs.

(iv) Instructor to Trainee Ratio. The ATTCP shall document in its application to the Energy Commission why its instructor to trainee ratio is sufficient to ensure the integrity and efficacy of the curriculum and program based on industry standards and other relevant information.

(v) Tests. The ATTCP shall describe the written and practical tests used to demonstrate each certification applicant's competence in all specified subjects. The ATTCPs shall retain all results of these tests for five years from the date of the test.

(vi) Recertification. The ATTCP shall recertify all Acceptance Test Technicians and Acceptance Test Employers prior to the implementation of each adopted update to the Building Energy Efficiency Standards as these updates affect the acceptance test requirements. Recertification requirements and procedures shall only apply to those specific elements that are new or modified in future updates to Building Energy Efficiency Standards.

C. Lighting Controls Acceptance Test Employer Training. Training for Lighting Controls Acceptance Test Employers shall consist of a single class or webinar consisting of at least four hours of instruction that covers the scope and process of the acceptance tests in Building Energy Efficiency Standards, Section 130.4.

D. Complaint Procedures. The ATTCPs shall describe in their applications to the Energy Commission **p**rocedures for accepting and addressing complaints regarding the performance of any Acceptance Test Technician or Employer certified by the ATTCP, and explain how building departments and the public will be notified of these proceedings.

E. Certification Revocation Procedures. The ATTCPs shall describe in their applications to the Energy Commission procedures for revoking their certification of Acceptance Test Technicians and Employers based upon poor quality or ineffective work, failure to perform acceptance tests, falsification of documents, failure to comply with the documentation requirements of these regulations or other specified actions that justify decertification.

F. Quality Assurance and Accountability. The ATTCP shall describe in their application to the Energy Commission how their certification business practices include quality assurance and accountability measures, including but not limited to independent oversight of the certification processes and procedures, visits to building sites where certified technicians are completing acceptance tests, certification process evaluations, building department surveys to determine acceptance testing effectiveness, and expert review of the training curricula developed for Building Energy Efficiency Standards, Section 130.4. The ATTCP shall review a random sample of no less than 1 percent of each Technician's completed compliance forms, and shall perform randomly selected on-site audits of no less than 1 percent of each Technician's completed acceptance tests. Independent oversight may be demonstrated by accreditation under the ISO/IEC 17024 standard.

G. Certification Identification Number and Verification of ATT Certification Status. Upon certification of an ATT, the ATTCP shall issue a unique certification identification number to the ATT. The ATTCP shall maintain an accurate record of the certification status for all ATTs that the ATTCP has certified. The ATTCP shall provide verification of current ATT certification status upon request to authorized document Registration Provider personnel or enforcement agency personnel to determine the ATT's eligibility to sign Certificate of Acceptance documentation according to all applicable requirements in Sections 10-103.1, 10-102, 10-103(a**)**4, and the Reference Joint Appendix JA7.

(d) **Requirements for ATTCPs to Provide Regular Reports.** The ATTCP shall provide the following regular reports to the Energy Commission:

1. Annual Report: The ATTCP shall provide an annual report to the Energy Commission summarizing the certification services provided over the reporting period, including the total number of Acceptance Test Technicians and Employers certified by the ATTCP (i) during the reporting period and (ii) to date. The annual report shall include a summary of all actions taken against any Acceptance Test Technician or Employer as a result of the complaint or quality assurance procedures described by the ATTCP as required under Section 10-103.1(c)(3)(D) and 10-103.1(c)(3)(F).

2. Update Report: The ATTCP shall have no less than six months following the adoption of an update to the Building Energy Efficiency Standards to prepare an Update Report. The ATTCP shall submit an Update Report to the Energy Commission no less than six months prior to the effective date of any newly adopted update to the Building Energy Efficiency Standards. The ATTCP shall report to the Energy Commission what adjustments have been made to the training curricula, if any, to address changes to the Building Energy Efficiency Standards Acceptance Testing requirements, adopted updates to the Building Energy Efficiency Standards or to ensure training is reflective of the variety of lighting controls that are currently encountered in the field. All required update reports shall contain a signed certification that the ATTCP has met all requirements under Section 10-103.1(c). Update reports shall be approved through the Amendment Process provided under Section 10-103.1(f).

   All required reports shall contain a signed certification that the ATTCP has met all requirements for this program.

(e) **Application Review and Determination.** The Energy Commission shall review Acceptance Test Technician Certification Provider applications according to the criteria and procedures in Section 10-103.1(c) to determine if such providers meet the specified requirements for providing acceptance testing certification services.

1. Energy Commission staff will review and validate all information received on Acceptance Test Technician Certification Provider applications, and determine whether the application is complete and contains

sufficient information to be evaluated by staff. Complete applications shall be evaluated by staff based on their contents.

2. The Executive Director may require that the applicant provide additional information as required by staff to fully evaluate the Provider application.

3. The Executive Director shall provide a copy of the staff evaluation to interested persons and provide a reasonable opportunity for public comment.

4. The Executive Director shall issue a written recommendation that the Energy Commission designate the applicant as an authorized Acceptance Test Technician Certification Provider or deny the Provider application.

5. The Energy Commission shall make a final decision on the application at a publicly noticed hearing.

(f) **Amendment Process.**

The ATTCP may amend a submitted or approved application as described in this Section.

1. **Amendment Scope.**

   A. **Nonsubstantive Changes.** A nonsubstantive change is a change that does not substantively alter the requirements of the application materials for the ATTCP, ATT, or ATT Employer. For amendments making only nonsubstantive changes, the ATTCP shall submit a letter describing the change to the Energy Commission as an addendum to the application.

   B. **Substantive Changes.** A substantive change is a change that substantively alters the requirements of the application materials for the ATTCP, ATT, or ATT Employer. For amendments making any substantive changes, the ATTCP shall submit the following:

      (i) A document describing the scope of the change to the application, the reason for the change and the potential impact to the ATTCP, ATT, and ATT Employer as an addendum to the application;

      (ii) A replacement copy of the affected sections of the ATTCP application with the changes incorporated; and

      (iii) A copy of the affected sections of the ATTCP application showing the changes in underline and strikeout format.

2. **Amendment Review.** Amendments submitted prior to approval of an ATTCP application shall be included in the application's Application Review and Determination process specified in Section 10-103.1(e).

   Amendments submitted after approval of an ATTCP's application that contain only nonsubstantive changes shall be reviewed by the Executive Director for consistency with Section 10-103.1. Amendments determined to be consistent with this Section shall be incorporated into the approval as errata.

   Amendments submitted after approval of an ATTCP's application that contain any substantive changes shall be subject to the Application Review and Determination process specified in Section 10-103.1(e). If the Energy Commission finds that the amended application does not meet the requirements of Section 10-103.1, then the ATTCP shall either abide by the terms of their previously approved application or have their approval suspended.

(g) **Review by the Energy Commission.**

If the Energy Commission determines there is a violation of these regulations or that an Acceptance Test Technician Certification Provider is no longer providing adequate certification services, the Energy Commission may revoke the authorization of the Acceptance Test Technician Certification Provider pursuant to Section 1230 et seq. of Title 20 of the California Code of Regulations.

NOTE: Authority: Sections 25402, 25402.1, 25213, Public Resources Code. Reference: Sections 25007, 25402(a)-(b), 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code.

10-103.2 – NONRESIDENTIAL MECHANICAL ACCEPTANCE TEST TRAINING AND CERTIFICATION

(a) **Scope.** The requirements of this section apply to nonresidential mechanical Acceptance Test Technicians and Employers and the Certification Providers that train and certify them.

(b) **Industry Certification Threshold.** Mechanical Acceptance Test Technician and Employer certification requirements shall take effect when the Energy Commission finds that each of the following conditions are met. Until such time that Sections 10-103.2(b)1 and 10-103.2(b)2 are met, Field Technicians are allowed to complete the acceptance test requirements in Section 120.5 without completing the Acceptance Test Technician certification requirements.

1. **Number of Certified Acceptance Test Technicians.**

   A. There shall be no less than 300 Mechanical Acceptance Test Technicians certified to perform all of the acceptance tests in Building Energy Efficiency Standards, Section 120.5, except as provided in Subsection 10-103.2(b)1.B, below. The number of certified Mechanical Acceptance Test Technicians shall be demonstrated by Certification Provider-provided reports submitted to the Energy Commission.

   B. If there are less than 300 Mechanical Acceptance Test Technicians certified to perform all of the acceptance tests in Building Energy Efficiency Standards, Section 120.5, then there shall be at least 300 Mechanical Acceptance Test Technicians certified to complete the following tests:

   (i) NA7.5.1 Outdoor Air Ventilation Systems
   (ii) NA7.5.2 Constant Volume, Single Zone Unitary Air Conditioners and Heat Pumps
   (iii) NA7.5.4 Air Economizer Controls
   (iv) NA7.5.5 Demand Control Ventilation Systems
   (v) NA 7.5.6 Supply Fan Variable Flow Controls
   (vi) NA7.5.7, NA7.5.9 Hydronic System Variable Flow Controls
   (vii) NA7.5.10 Automatic Demand Shed Controls

   The number of certified Mechanical Acceptance Test Technicians shall be demonstrated by Certification Provider-provided reports submitted to the Energy Commission.

2. **Industry Coverage by Certification Provider(s).** The Mechanical Acceptance Test Technician Certification Provider(s) approved by the Energy Commission, in their entirety, provide reasonable access to certification for technicians representing the majority of the following industry groups: Professional engineers, licensed architects, HVAC installers, mechanical contractors, Testing and Balancing (TAB) certified technicians, controls installation and startup contractors and certified commissioning professionals who have verifiable training, experience and expertise in HVAC systems. The Energy Commission will determine reasonable access by considering factors such as certification costs commensurate with the complexity of the training being provided, certification marketing materials, prequalification criteria, class availability and curriculum.

(c) **Qualifications and Approval of Certification Providers.** The Acceptance Test Technician Certification Providers (ATTCPs) shall submit a written application to the Energy Commission with a summary and the necessary background documents to explain how the following criteria and procedures have been met:

1. **Requirements for Applicant ATTCPs to Document Organizational Structure.** ATTCPs shall provide written explanations of the organization type, by-laws, and ownership structure. ATTCPs shall explain in writing how their certification program meets the qualifications of Building Energy Efficiency Standards, Section 10-103.2(c). ATTCPs shall explain in their application to the Energy Commission their organizational structure and their procedures for independent oversight, quality assurance, supervision and support of the acceptance test training and certification processes.

2. **Requirement for Certification of Employers.** The ATTCPs shall provide written explanations of their certification and oversight of Acceptance Test Employers. This explanation shall document how the

ATTCP ensures that the Employers are providing quality control and appropriate supervision and support for their Acceptance Test Technicians.

3. **Requirements for Applicant ATTCPs to Document Training and Certification Procedures.** ATTCPs shall include with their application a complete copy of all training and testing procedures, manuals, handbooks and materials. ATTCPs shall explain in writing how their training and certification procedures include, but are not limited to, the following:

   A. **Training Scope.** The scope of the training shall include both hands-on experience and theoretical training to certify competency in the technologies and skills necessary to perform the acceptance tests.

   B. **Mechanical Acceptance Test Technician Training.**

      (i) **Curricula**. Acceptance Test Technician Certification Provider training curricula for Mechanical Acceptance Test Technicians shall include, but not be limited to, the analysis, theory, and practical application of the following:

      a) Constant volume system controls;

      b) Variable volume system controls;

      c) Air-side economizers;

      d) Air distribution system leakage;

      e) Demand controlled ventilation with CO_2 sensors;

      f) Demand controlled ventilation with occupancy sensors;

      g) Automatic demand shed controls;

      h) Hydronic valve leakage;

      i) Hydronic system variable flow controls;

      j) Supply air temperature reset controls;

      k) Condenser water temperature reset controls;

      l) Outdoor air ventilation systems;

      m) Supply fan variable flow controls;

      n) Boiler and chiller isolation controls;

      o) Fault detection and diagnostics for packaged direct-expansion units;

      p) Automatic fault detection and diagnostics for air handling units and zone terminal units;

      q) Distributed energy storage direct-expansion air conditioning systems;

      r) Thermal energy storage systems;

      s) Building Energy Efficiency Standards mechanical acceptance testing procedures; and

      t) Building Energy Efficiency Standards acceptance testing compliance documentation for mechanical systems.

      (ii) **Hands-on training.** The ATTCP shall describe in their application the design and technical specifications of the laboratory boards, equipment and other elements that will be used to meet the hands-on requirements of the training and certification.

      (iii) **Prequalification.** Participation in the technician certification program shall be limited to persons who have at least three years of professional experience and expertise in mechanical controls and systems as determined by the Mechanical ATTCPs.

(iv) **Instructor to Trainee Ratio.** The ATTCP shall document in its application to the Energy Commission why its instructor to trainee ratio is sufficient to ensure the integrity and efficacy of the curriculum and program based on industry standards and other relevant information.

(v) **Tests.** The ATTCP shall describe the written and practical tests used to demonstrate each certification applicant's competence in all specified subjects. The ATTCPs shall retain all results of these tests for five years from the date of the test.

(vi) **Recertification.** The ATTCP shall recertify all Acceptance Test Technicians and Acceptance Test Employers prior to the implementation of each adopted update to the Building Energy Efficiency Standards as these updates affect the acceptance test requirements.. Recertification requirements and procedures shall only apply to those specific elements that are new or modified in future updates to Building Energy Efficiency Standards.

C. **Mechanical Acceptance Test Employer Training.** Training for Mechanical Acceptance Test Employers shall consist of a single class or webinar consisting of at least four hours of instruction that covers the scope and process of the acceptance tests in Building Energy Efficiency Standards, Section 120.5.

D. **Complaint Procedures.** Procedures described in writing for notifying building departments and the public that the Acceptance Test Certification Provider will accept complaints regarding the performance of any certified acceptance test technician or employer, and procedures for how the Provider will address these complaints.

E. **Certification Revocation Procedures.** Procedures described in writing for revoking their certification of Acceptance Test Technicians and Employers based upon poor quality or ineffective work, failure to perform acceptance tests, falsification of documents, failure to comply with the documentation requirements of these regulations or other specified actions that justify decertification.

F. **Quality Assurance and Accountability.** The ATTCPs shall describe in their applications to the Energy Commission how their certification business practices include quality assurance and accountability measures, including but not limited to independent oversight of the certification processes and procedures, visits to building sites where certified technicians are completing acceptance tests, certification process evaluations, building department surveys to determine acceptance testing effectiveness, and expert review of the training curricula developed for Building Energy Efficiency Standards, Section 120.5. The ATTCP shall review a random sample of no less than 1 percent of each Technician's completed compliance forms, and shall perform randomly selected on-site audits of no less than 1 percent of each Technician's completed acceptance tests. Independent oversight may be demonstrated by accreditation under the ISO/IEC 17024 standard.

G. **Certification Identification Number and Verification of ATT Certification Status.** Upon certification of an ATT, the ATTCP shall issue a unique certification identification number to the ATT. The ATTCP shall maintain an accurate record of the certification status for all ATTs that the ATTCP has certified. The ATTCP shall provide verification of current ATT certification status upon request to authorized document Registration Provider personnel or enforcement agency personnel to determine the ATT's eligibility to sign Certificate of Acceptance documentation according to all applicable requirements in Sections 10-103.2, 10-102, 10-103(a)4, and Reference Joint Appendix JA7.

(d) **Requirements for ATTCPs to Provide Regular Reports.** The ATTCP shall provide the following regular reports to the Energy Commission:

1. Annual Report: The ATTCP shall provide an annual report to the Energy Commission summarizing the certification services provided over the reporting period, including the total number of Acceptance Test Technicians and Employers certified by the agency (i) during the reporting period and (ii) to date. The annual report shall include a summary of all actions taken against any Acceptance Test Technician or Employer as a result of the complaint or quality assurance procedures described by the ATTCP as required under Section 10-103.2(c)(3)(D) and 10-103.2(c)(3)(F).

2. Update Report: The ATTCP shall have no less than six months following the adoption of an update to the Building Energy Efficiency Standards to prepare an Update Report. The ATTCP shall submit an Update Report to the Energy Commission no less than six months prior to the effective date of any newly adopted update to the Building Energy Efficiency Standards, The ATTCP shall report to the Energy Commission what adjustments have been made to the training curricula, if any, to address changes to the Building Energy Efficiency Standards Acceptance Testing requirements, adopted updates to the Building Energy Efficiency Standards or to ensure training is reflective of the variety of mechanical equipment and systems currently encountered in the field. All required update reports shall contain a signed certification that the ATTCP has met all requirements under Section 10-103.2(c). Update reports shall be approved through the Amendment Process provided under Section 10-103.2(f).

   All required reports shall contain a signed certification that the ATTCP has met all requirements for this program.

(e) **Application Review and Determination.** The Energy Commission shall review Acceptance Test Technician Certification Provider applications according to the criteria and procedures in Section 10-103.2(c) to determine if such providers meet the specified requirements for providing acceptance testing certification services.

1. Energy Commission staff will review and validate all information received on Acceptance Test Technician Certification Provider applications, and determine whether the application is complete and contains sufficient information to be evaluated by staff. Complete applications shall be evaluated by staff based on their contents.
2. The Executive Director may require that the applicant provide additional information as required by staff to fully evaluate the Provider application.
3. The Executive Director shall provide a copy of the staff evaluation to interested persons and provide an opportunity for public comment.
4. The Executive Director shall issue a written recommendation that the Energy Commission designate the applicant as an authorized Mechanical Acceptance Tester Certification Provider or deny the Provider application.
5. The Energy Commission shall make a final decision on the application at a publicly noticed hearing.

(f) **Amendment Process.**

The ATTCP may amend a submitted or approved application as described in this Section.

1. **Amendment Scope.**

   A. **Nonsubstantive Changes.** A nonsubstantive change is a change that does not substantively alter the requirements of the application materials for the ATTCP, ATT, or ATT Employer. For amendments making only nonsubstantive changes, the ATTCP shall submit a letter describing the change to the Energy Commission as an addendum to the application.

   B. **Substantive Changes.** A substantive change is a change that substantively alters the requirements of the application materials for the ATTCP, ATT, or ATT Employer. For amendments making any substantive changes, the ATTCP shall submit the following:

      (i) A document describing the scope of the change to the application, the reason for the change and the potential impact to the ATTCP, ATT, and ATT Employer as an addendum to the application;

      (ii) A replacement copy of the affected sections of the ATTCP application with the changes incorporated; and

      (iii) A copy of the affected sections of the ATTCP application showing the changes in underline and strikeout format.

2. **Amendment Review.** Amendments submitted prior to approval of an ATTCP application shall be included in the application's Application Review and Determination process specified in Section 10-103.2(e).

Amendments submitted after approval of an ATTCP's application that contain only nonsubstantive changes shall be reviewed by the Executive Director for consistency with Section 10-103.2. Amendments determined to be consistent with this Section shall be incorporated into the approval as errata.

Amendments submitted after approval of an ATTCP's application that contain any substantive changes shall be subject to the Application Review and Determination process specified in Section 10-103.2(e). If the Energy Commission finds that the amended application does not meet the requirements of Section 10-103.2, then the ATTCP shall either abide by the terms of their previously approved application or have their approval suspended.

(g) **Review by the Energy Commission.**

If the Energy Commission determines there is a violation of these regulations or that an Acceptance Test Technician Certification Provider is no longer providing adequate certification services, the Energy Commission may revoke the authorization of the Acceptance Test Technician Certification Provider pursuant to Section 1230 et. seq. of Title 20 of the California Code of Regulations.

NOTE: Authority: Sections 25402, 25402.1, 25213, Public Resources Code. Reference: Sections 25007, 25402(a)-(b), 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code.

10-104 – EXCEPTIONAL DESIGNS

NOTE: See Section 10-109 for approval of calculation methods and Alternative Component Packages.

(a) **Requirements.** If a building permit applicant proposes to use a performance compliance approach, and the building designs cannot be adequately modeled by an approved calculation method, an applicant shall be granted a building permit if the Commission finds:

1. That the design cannot be adequately modeled with an approved calculation method;
2. Using an alternative evaluation technique, that the design complies with Part 6; and
3. That the enforcement agency has determined that the design complies with all other legal requirements.

(b) **Applications.** The applicant shall submit four copies of a signed application with the following materials to the Executive Director:

1. A copy of the plans and documentation required by Section 10-103(a)2;
2. A statement explaining why meeting the energy budget cannot be demonstrated using an approved calculation method;
3. Documentation from the enforcement agency stating that:
   A. Meeting the energy budget requirements cannot be demonstrated using an approved calculation method; and
   B. The design complies with all other legal requirements; and
4. A detailed evaluation of the energy consumption of the proposed building and the building's materials, components, and manufactured devices proposed to be installed to meet the requirements of Part 6 using an alternative evaluation technique. The evaluation shall include a copy of the technique, instructions for its use, a list of all input data, and all other information required to replicate the results.

NOTE: Authority: Sections 25402 and 25402.1, Public Resources Code. Reference: Sections 25402 and 25402.1, Public Resources Code.

10-105 – ENFORCEMENT BY THE COMMISSION

(a) **Where there is No Local Enforcement Agency.** Before new construction may begin in an area where there is no local enforcement agency, the Executive Director shall determine in writing that the building design conforms to the requirements of Part 6. The person proposing to construct the building shall submit the information described in Sections 10-103(a)1 and 10-103(a)2 to the Executive Director when such a determination is sought.

(b) **Where building construction is under the jurisdiction of a State agency.** Pursuant to Public Resources Code Section 25402.1(g)(5), no construction of any State building shall commence until the Department of General Services or the State agency that otherwise has jurisdiction over the property determines that the construction is designed to comply with the requirements of Part 6, and confirms that the documentation requirements of Sections 10-103(a)1 and 10-103(a)2 have been met and that the plans indicate the features and performance specifications needed to comply with Part 6. The responsible state agency shall notify the Commission's Executive Director of its determination.

(c) **Where the Enforcement Agency Fails to Enforce.** If an enforcement agency fails to enforce the requirements of this article or of Part 6 the Commission, after furnishing 10 days written notice, may condition building permit issuance on submission of the information described in Sections 10-103(a)1 and 10-103(a)2 to the Executive Director and on his or her written determination that proposed construction conforms to the requirements of Part 6.

NOTE: Authority: Code Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

10-106 – LOCALLY ADOPTED ENERGY STANDARDS

(a) **Requirements.** Local governmental agencies may adopt and enforce energy standards for newly constructed buildings, additions, alterations, and repairs to existing buildings provided the Energy Commission finds that the standards will require buildings to be designed to consume no more energy than permitted by Title 24, Part 6.

(b) **Documentation Application.** Local governmental agencies wishing to enforce locally adopted energy standards shall submit an application with the following materials to the Executive Director:

1. The proposed energy standards;
2. The local governmental agency's findings and supporting analyses on the energy savings and cost effectiveness of the proposed energy standards;
3. A statement or finding by the local governmental agency that the local energy standards will require buildings to be designed to consume no more energy than permitted by Part 6; and
4. Any findings, determinations, declarations or reports, including any negative declaration or environmental impact report, required pursuant to the California Environmental Quality Act, Pub. Resources Code Section 21000 et seq.

NOTE: Authority: Section 25402.1, Public Resources Code. Reference: Sections 25402.1, 21080.4, 21153, Public Resources Code.

10-107 – INTERPRETATIONS

(a) The Commission may make a written determination as to the applicability or interpretation of any provision of this article or of Part 6 upon written application, if a dispute concerning a provision arises between an applicant for a building permit and the enforcement agency, and the dispute has been heard by the local board of permit appeals or other highest local review body. Notice of any such appeal, including a summary of the dispute and the section of the regulations involved, shall if possible be sent to the Commission by the enforcing agency 15 days before the appeal is heard, and the result of the appeal shall be sent to the Commission within 15 days after the decision is made. Either party to the dispute may apply for a determination but shall concurrently deliver a copy of the application to the other party. The determinations are binding on the parties.

(b) The Executive Director may, upon request, give written advice concerning the meaning of any provision of this article or of Part 6. Such advice is not binding on any person.

NOTE: Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

10-108 – EXEMPTION

(a) **Requirements.** The Commission may exempt any building from any provision of Part 6 if it finds that:

1. Substantial funds had been expended in good faith on planning, designing, architecture, or engineering of the building before the adoption date of the provision; and
2. Compliance with the requirements of the provision would be impossible without both substantial delays and substantial increases in costs of construction above the reasonable costs of the measures required to comply with the provision.

(b) **Application.** The applicant shall submit four copies of a signed application with the following materials to the Executive Director:

1. A summary of the claimant's contracts for the project;
2. A summary of internal financial reports on the project;
3. Dated schedules of design activities; and
4. A progress report on project completion.

NOTE: Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

10-109 – COMPLIANCE SOFTWARE, ALTERNATIVE COMPONENT PACKAGES, EXCEPTIONAL METHODS, DATA REGISTRIES AND RELATED DATA INPUT SOFTWARE, ALTERNATIVE RESIDENTIAL FIELD VERIFICATION PROTOCOLS, AND ELECTRONIC DOCUMENT REPOSITORIES

(a) **Compliance software, alternative component packages, exceptional methods, data registries and related data input software, alternative residential field verification protocols or electronic document repositories** must be approved by the Commission in order to be used to demonstrate compliance with Part 6.

(b) **Application.** Applications for approval of compliance software, alternative component packages, exceptional methods, data registries and related data input software, and alternative field verification protocols must be made as follows:

1. An applicant shall submit four copies of a signed application form specified by the Executive Director.

2. The application shall include the following materials:

A. A description of the functional or analytical capabilities of the compliance software, alternative component package, calculation method, exceptional method, data registry or related data input software, and alternative field verification protocol; and

B. A demonstration that the criteria in Section 10-109 are met; and

C. An initial fee of one thousand dollars ($1,000). The total fee shall cover the Commission's cost of reviewing and analyzing the application. Within 75 days of receipt of an application, the Commission will provide an estimate of the total maximum cost to review and analyze the application and make a determination as to the completeness of the application. Consideration of the application will be delayed until the applicant submits requested additional information. After the Commission determines the total cost, if the cost exceeds the initial fee, the Commission shall assess an additional fee to cover the total cost. If the actual cost is less than the initial, or any estimated maximum, fee the Commission shall refund the difference to the applicant.

(c) **Compliance Software.**

1. **Public Domain Computer Programs.** In addition to the public domain computer programs that are approved pursuant to Public Resources Code Section 25402.1, the Commission may, upon written application or its own motion, approve additional public domain computer programs that may be used to demonstrate that proposed building designs meet energy budgets.

A. The Commission shall ensure that users' manuals or guides for each approved program are available.

B. The Commission shall approve a program only if it predicts energy consumption substantially equivalent to that predicted by the above-referenced public domain computer program, when it models building designs or features.

2. **Alternative Calculation Methods (All Occupancies)**. The Commission may approve non-public domain computer programs as an alternative calculation method that building permit applicants may then use to demonstrate compliance with the performance standards (energy budgets) in Part 6. In addition to the application requirements of subdivision (b) above, an application for approval of compliance software must include documentation demonstrating that the compliance software meets the requirements, specifications, and criteria set forth in the Residential or Nonresidential ACM Approval Manual, as appropriate.

NOTE: Copies of the ACM Approval Manuals may be obtained from the Commission's website at: www.energy.ca.gov/title24.

(d) **Alternative Component Packages.** In addition to the application requirements of subdivision (b) above, an application for approval of an alternative component package must include documentation that demonstrates that the package:

1. Will meet the applicable energy budgets; and
2. Is likely to apply to a significant percentage of newly constructed buildings or to a significant segment of the building construction and design community.

(e) **Exceptional Methods.** The Commission may approve an exceptional method that analyzes a design, material, or device that cannot be adequately modeled using the public domain computer programs. Applications for approval of exceptional methods shall include all information needed to verify the method's accuracy.

(f) **Commission Action.** The Commission may take the following actions on an application submitted pursuant to this section:

1. Approve the application unconditionally;
2. Restrict approval to specified occupancies, designs, materials, or devices; or
3. Reject the application.

(g) **Resubmittal.** An applicant may resubmit a rejected application or may request modification of a restricted approval. Such application shall include the information required pursuant to this section, and, if applicable, shall indicate how the proposed compliance software, alternative component package, exceptional method, data registry or related data input software has been changed to enhance its accuracy or capabilities.

1. Modification. Whenever an approved compliance software, alternative component package, exceptional method, data registry or related data input software is changed in any way, it must be resubmitted under this section for approval.
2. The Commission may modify or withdraw approval of compliance software, an alternative component package, an exceptional method, or a data registry or related data input software based on its approval of other programs, methods, registries or data input software that are more suitable.

(h) **In addition to** the procedures and protocols identified in the Alternative Calculation Method Approval Manuals and the Reference Appendices, the Commission may authorize alternative procedures or protocols that demonstrate compliance with Part 6.

(i) **Data Registries And Related Data Input Software, And Electronic Document Repositories.**

1. Data Registries and Related Data Input Software.

Data registries and related data input software shall conform to the requirements specified in Reference Joint Appendix JA7.

A. The Commission may approve residential data registries that provide for registration, when required by Part 6 of all residential compliance documentation and the nonresidential Certificates of Verification.

B. The Commission may approve nonresidential data registries that provide for registration, when required by Part 6 of all nonresidential compliance documentation. However, nonresidential data registries may not provide for registration of nonresidential Certificates of Verification.

C. The Commission may approve software used for data input to various data registries for registering, when required by Part 6 residential or nonresidential compliance documentation.

2. **Electronic Document Repositories.**

A. The Commission may approve electronic document repositories that retain for the Commission electronic compliance documentation generated by residential and nonresidential data registries when registration is required by Part 6.

(j) **Alternative Residential Field Verification Protocols.**

Alternative residential field verification protocols shall comply with the application requirements of Section 10-109(b) and any applicable requirements of Reference Residential Appendices RA1.

NOTE: Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

10-110 – PROCEDURES FOR CONSIDERATION OF APPLICATIONS UNDER SECTIONS 10-104, 10-106, 10-108, AND 10-109

(a) Within75 days of receipt of an application, the Executive Director shall determine if the application is complete with all the supporting information required pursuant to Sections 10-104, 10-106, 10-108, or 10-109 (the complete application package). If the application is complete, the Executive Director shall make the complete application package available to interested parties. Comments from interested parties must be submitted within 60 days after being made available.

(b) Within 75 days of the date the application is determined to be complete, the Executive Director may request any additional information needed to evaluate the application. Consideration of the application will be delayed until the applicant submits the requested additional information.

(c) Within 75 days of receipt of the date the application is determined to be complete, the Executive Director may convene a workshop to gather additional information from the applicant and other interested parties. Interested parties will have 15 days after the workshop to submit additional information regarding the application.

(d) Within 90 days of the date the application is determined to be complete, or within 30 days after receipt of complete additional information requested under Section 10-110(b), or within 60 days after the receipt of additional information submitted by interested parties under Section 10-110(c), whichever is later, the Executive Director shall submit to the Commission a written recommendation on the application.

(e) The complete application package, any additional information considered by the Executive Director, and the Executive Director's recommendation shall be placed on the consent calendar and considered at the next business meeting after submission of the recommendation. The matter may be removed from the consent calendar at the request of any person.

(f) The Executive Director may charge a fee to recover the costs of processing and reviewing applications, with the exception of Section 10-106 applications.

(g) All applicants have the burden of proof to establish that their applications should be granted.

NOTE: Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

10-111 – CERTIFICATION AND LABELING OF FENESTRATION PRODUCT U-FACTORS, SOLAR HEAT GAIN COEFFICIENTS, VISIBLE TRANSMITTANCE AND AIR LEAKAGE

This section establishes rules for implementing labeling and certification requirements relating to U-factors, solar heat gain coefficients (SHGCs), visible transmittance (VT) and air leakage for fenestration products under Section 110.6(a) of Part 6. This section also provides for designation of the National Fenestration Rating Council (NFRC) as the supervisory entity responsible for administering the state's certification program for fenestration products, provided NFRC meets specified criteria.

(a) **Labeling Requirements.**

1. **Temporary labels.**

   A. Every manufactured fenestration product shall have attached to it a clearly visible temporary label that lists the U-factor, the solar heat gain coefficient (SHGC) and Visible Transmittance (VT) and that certifies compliance with the air leakage requirements of Section 110.6(a)1. Component Modeling Approach (CMA) and site-built fenestration products shall have a label certificate that lists the U-factor, the Solar Heat Gain Coefficient (SHGC), and the Visible Transmittance (VT).

   B. U-factor, SHGC,VT and Air Leakage shall be determined by either:

      i. Fenestration products rated and certified using NFRC 100, NFRC 200, NFRC 202 NFRC 203 or NFRC 400 Rating Procedures. The manufacturer shall stipulate that the ratings were determined in accordance with applicable NFRC procedures. For manufactured fenestration products, a temporary label certificate approved by the supervisory entity (NFRC) meets the requirements of this section. For component modeling and site-built fenestration products, a label certificate approved by the supervisory entity (NFRC) meets the requirements of this section.

      ii. For manufactured or site-built fenestration products not rated by NFRC, a temporary label with the words “CEC Default U-factor,” followed by the appropriate default U-factor specified in Section 110.6(a)2 and with the words “CEC Default SHGC,” followed by the appropriate default SHGC specified in Section 110.6(a)3 and with the words "CEC Default VT," followed by the appropriate VT as specified in Section 110.6(a)4, meets the requirements of this Subsection B.

   C. Temporary labels shall also certify that the manufactured fenestration product complies with the air leakage requirements of Section 110.6(a)1 of the Standards.

2. **Permanent labels.** Rated products shall have a permanent label consistent with their rating and certification that is either a stand-alone label, an extension or tab of an existing permanent certification label being used by the manufacturer/responsible party, or series of marks or etchings on the product. The permanent label coupled with observable product characteristics, shall be usable to trace the product to certification information on file with the supervisory entity or to a directory of certified products, published by the supervisory entity. For CMA and site-built fenestration products, a label certificate approved by the supervisory entity meets the requirements of this section.

EXCEPTION to Section 10-111(a): Field-fabricated fenestration products.

(b) **Certification Requirements.**

1. **Certification to default ratings.** The manufacturer shall certify on the Default Label that the product's U-factor, SHGC and VT meets the default criteria in Sections 110.6(a)2, 110.6(a)3 and 110.6(a)4; and .

   A. A temporary label, affixed to the product, that meets the requirements of Section 10-111(a)1B meets this requirement.

   B. If the product claims the default U-factor for a thermal-break product, the manufacturer shall also certify on the label that the product meets the thermal-break product criteria, specified on the default table, on which the default value is based. Placing the terms “Meets Thermal-Break Default Criteria” on the default temporary label or default label certificate meets this requirement.

2. **Certification to NFRC rating procedure.** If a product's U-factor, SHGC or VT is based on the NFRC Rating Procedure, the U-factor, SHGC or VT shall be certified by the manufacturer according to the procedures of an independent certifying organization approved by the Commission.

   A. A temporary label, affixed to the product or label certificate for CMA and site-built fenestration, meeting the requirements of Section 10-111(a) certified by the independent certifying organization complies with this requirement.

   B. An “independent certifying organization approved by the Commission” means any organization authorized by the supervisory entity to certify U-factor ratings, Solar Heat Gain Coefficient and Visible Transmittance ratings in accordance with the NFRC Rating Procedure. If the Commission designates the NFRC as the supervisory entity, any independent certification and inspection agency (IA) licensed by NFRC shall be deemed to be an “independent certifying organization approved by the Commission.”

   C. The “supervisory entity” means the NFRC, except as provided in Section 10-111(c)1.

EXCEPTION to Section 10-111(b): Field-fabricated fenestration products.

(c) **Designation of Supervisory Entity.** The NFRC shall be the supervisory entity to administer the certification program relating to U-factors, SHGC, and VT ratings for fenestration products, provided the Commission determines that the NFRC meets the criteria in Section 10-111(d).

1. The Commission may consider designating a supervisory entity other than NFRC only if the Commission determines that the NFRC cannot meet the criteria in Section 10-111(d). Such other supervisory entity shall meet the criteria in Section 10-111(d) prior to being designated.

2. The Commission shall periodically review, at least annually, the structure and operations of the supervisory entity to ensure continuing compliance with the criteria in Section 10-111(d).

(d) **Criteria for Supervisory Entity.**

1. Membership in the entity shall be open on a nondiscriminatory basis to any person or organization that has an interest in uniform thermal performance ratings for fenestration products, including, but not limited to, members of the fenestration industry, glazing infill industry, building industry, design professionals, specifiers, utilities, government agencies, and public interest organizations. The membership shall be composed of a broad cross section of those interested in uniform thermal performance ratings for fenestration products.

2. The governing body of the entity shall reflect a reasonable cross-section of the interests represented by the membership.

3. The entity shall maintain a program of oversight of product manufacturers, laboratories, and independent certifying organizations that ensures uniform application of the NFRC Rating Procedures, labeling and certification, and such other rating procedures for other factors affecting energy performance as the NFRC and the Commission may adopt.

4. The entity shall require manufacturers and independent certifying organizations within its program to use laboratories accredited by the supervisory entity to perform simulations and tests under the NFRC Rating Procedure or by an NFRC Approved Calculation Entity (ACE) under the Component Modeling Approach (CMA)- Product Certification Program(PCP).

5. The entity shall maintain appropriate guidelines for testing and simulation laboratories, manufacturers, and certifying agencies, including requirements for adequate:

   A. Possession and calibration of equipment;

   B. Education, competence, and training of personnel;

   C. Quality control;

   D. Record keeping and reporting;

   E. Periodic review (including, but not limited to, blind testing by laboratories; inspections of products; and inspections of laboratories, manufacturing facilities, and certifying agencies);

F. Challenges to certified ratings; and

G. Guidelines to maintain the integrity of the program, including, but not limited to, provisions to avoid conflicts of interest within the rating and certification process.

6. The entity shall be a nonprofit organization and shall maintain reasonable, nondiscriminatory fee schedules for the services it provides and shall make its fee schedules, the financial information on which fees are based, and financial statements available to its members for inspection.

7. The entity shall provide hearing processes that give laboratories, manufacturers, and certifying agencies a fair review of decisions that adversely affect them.

8. The entity shall maintain a certification policy committee whose procedures are designed to avoid conflicts of interest in deciding appeals, resolving disputes, and setting policy for the certifying organizations within its program.

9. The entity shall publish at least annually a directory of products certified and decertified within its program.

10. The entity itself shall be free from conflict-of-interest ties or to undue influence from any particular fenestration manufacturing interest(s), testing or simulation lab(s), or independent certifying organization(s).

11. The entity shall provide or authorize the use of labels and label certificates for Component Modeling Approach and site-built fenestration products that can be used to meet the requirements of Sections 110.6(a)2, 110.6(a)3 and 110.6(a)4, and this section.

12. The entity's certification program shall allow for multiple participants in each aspect of the program to provide for competition between manufacturers, testing labs, simulation labs, and independent certifying organizations.

(e) **Certification for Other Factors.** Nothing in this section shall preclude any entity, whether associated with a U-factor, SHGC or VT certification program or not, from providing certification services relating to factors other than U-factors, SHGCs and VTs for fenestration products.

NOTE: Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

10-112 – CRITERIA FOR DEFAULT TABLES

(a) The Commission shall maintain tables of default U-factors and SHGCs for use as an alternative to U-factors and SHGCs derived based on the NFRC Rating Procedure. The default values shall meet the following criteria:

1. The values shall be derived from simulations of products using the same computer simulation program(s) used in the NFRC Rating Procedure.

2. The default values shall be set so that they do not provide to any significant number of products a lower U-factor or SHGC than those products would obtain if they were rated using the full NFRC Rating Procedure.

(b) The Commission shall periodically review and revise the default tables as necessary to ensure that the criteria are met.

NOTE: Authority : Section 25402.1, Public Resources Code.

10-113 – CERTIFICATION AND LABELING OF ROOFING PRODUCT REFLECTANCE AND EMITTANCE

This section establishes rules for implementing labeling and certification requirements relating to reflectance and emittance for roofing products for showing compliance with Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1H, and 150.2(b)2 of Title 24, California Code of Regulations, Part 6. This section also provides for designation of the Cool Roof Rating Council (CRRC) as the supervisory entity responsible for administering the state's certification program for roofing products, provided CRRC meets specified criteria.

(a) **Labeling Requirements.**

Every roofing product installed in construction to take compliance credit or meet the prescriptive requirements for reflectance and emittance under Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1H or 150.2(b)2 shall have a clearly visible packaging label that lists the emittance and the initial and 3-year aged solar reflectance, or a CRRC approved accelerated aged solar reflectance, tested in accordance with CRRC-1.

Packaging for liquid-applied roof coatings shall state the product meets the requirements specified in Section 110.8(i)4.

(b) **Certification Requirements.**

Every roofing product installed in construction to take compliance credit or meet the prescriptive requirements for reflectance and emittance under Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1H or 150.2(b)2 shall be certified by CRRC or another supervisory entity approved by the Commission pursuant to Section 10-113(c).

(c) **Designation of Supervisory Entity.** The CRRC shall be the supervisory entity to administer the certification program relating to reflectance and emittance ratings for roofing products, provided the Commission determines that the CRRC meets the criteria in Section 10-113(d).

1. The Commission may consider designating a supervisory entity other than CRRC if the Commission determines that the CRRC is not meeting the criteria in Section 10-113(d). Such other supervisory entity shall meet the criteria in Section 10-113(d) prior to being designated.
2. The Commission shall periodically review, at least annually, the structure and operations of the supervisory entity to ensure continuing compliance with the criteria in Section 10-113(d). The supervisory entity shall provide an annual report to the Commission explaining all of the measures it has taken to comply with the criteria in Section 10-113(d).

(d) **Criteria for Supervisory Entity.**

1. Membership in the entity shall be open on a nondiscriminatory basis to any person or organization that has an interest in uniform performance ratings for roofing products, including, but not limited to, members of the roofing industry, building industry, design professionals, specifiers, utilities, government agencies, and public interest organizations. The membership shall be composed of a broad cross section of those interested in uniform thermal performance ratings for roofing products.
2. The governing body of the entity shall reflect a reasonable cross-section of the interests represented by the membership.
3. The entity shall maintain a program of oversight of product manufacturers, laboratories, and independent certifying organizations that ensures uniform application of the CRRC testing and rating procedures, labeling and certification, and such other rating procedures for other factors that improves the accuracy of properties of roofing products affecting energy performance as the CRRC and the Commission may adopt.
4. The entity shall require manufacturers and independent certifying organizations within its program to use only laboratories accredited by the supervisory entity to perform tests under the CRRC rating procedure.
5. The entity shall maintain appropriate guidelines for testing laboratories and manufacturers, including requirements for adequate:
   A. Possession and calibration of equipment;

B. Education, competence, and training of personnel;

C. Quality control;

D. Record keeping and reporting;

E. Periodic review (including but not limited to, blind testing by laboratories; inspections of products; inspections of laboratories, and manufacturing facilities);

F. Challenges to certified ratings; and

G. Guidelines to maintain the integrity of the program, including, but not limited to, provisions to avoid conflicts of interest within the rating and certification process.

6. The entity shall be a nonprofit organization and shall maintain reasonable, nondiscriminatory fee schedules for the services it provides, and shall make its fee schedules, the financial information on which fees are based, and financial statements available to its members for inspection.

7. The entity shall provide hearing processes that give laboratories, manufacturers and certifying agencies a fair review of decisions that adversely affect them.

8. The entity shall maintain a certification policy committee, whose procedures are designed to avoid conflicts of interest in deciding appeals, resolving disputes and setting policy for the certifying organizations in its program.

9. The entity shall publish at least annually a directory of products certified and decertified within its program.

10. The entity itself shall be free from conflict-of-interest ties or to undue influence from any particular roofing product manufacturing interest(s), testing or independent certifying organization(s).

11. The entity shall provide or authorize the use of labels that can be used to meet the requirements for showing compliance with the requirements of Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1H and 150.2(b)2, and this section.

12. The entity's certification program shall allow for multiple participants in each aspect of the program to provide for competition between manufacturers and between testing labs.

NOTE: Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

10-114 – DETERMINATION OF OUTDOOR LIGHTING ZONES AND ADMINISTRATIVE RULES FOR USE

This section establishes rules for implementing outdoor lighting zones to show compliance with Section 140.7 of Title 24, California Code of Regulations, Part 6.

(a) **Lighting Zones.** Exterior lighting allowances in California vary by Lighting Zones (LZ).

(b) **Lighting Zone Characteristics.** TABLE 10-114-A specifies the relative ambient illumination level and the statewide default location for each lighting zone.

(c) **Amending the Lighting Zone Designation.** A local jurisdiction may officially adopt changes to the lighting zone designation of an area by following a public process that allows for formal public notification, review, and comment about the proposed change. The local jurisdiction may determine areas where Lighting Zone 4 is applicable and may increase or decrease the lighting zones for areas that are in State Default Lighting Zones 1, 2 and 3, as specified in TABLE 10-114-A.

(d) **Commission Notification, Amended Outdoor Lighting Zone Designation.** Local jurisdictions who adopt changes to the State Default Lighting Zones shall notify the Commission by providing the following materials to the Executive Director:

1. A detailed specification of the boundaries of the adopted Lighting Zones, consisting of the county name, the city name if any, the zip code(s) of the re designated areas, and a description of the physical boundaries within each zip code;
2. A description of the public process that was conducted in adopting the Lighting Zone changes; and
3. An explanation of how the adopted Lighting Zone changes are consistent with the specifications of Section 10-114.

(e) The Commission shall have the authority to not allow Lighting Zone changes which the Commission finds to be inconsistent with the specifications of Section 10-114.

TABLE 10-114-A LIGHTING ZONE CHARACTERISTICS AND RULES FOR AMENDMENTS BY LOCAL JURISDICTIONS

Zone	Ambient Illumination	State wide Default Location	Moving Up to Higher Zones	Moving Down to Lower Zones
LZ0	Very Low	Undeveloped areas of government designated parks, recreation areas, and wildlife preserves.	Undeveloped areas of government designated parks, recreation areas, and wildlife preserves can be designated as LZ1 or LZ2 if they are contained within such a zone.	Not applicable
LZ1	Low	Developed portion of government designated parks, recreation areas, and wildlife preserves. Those that are wholly contained within a higher lighting zone may be considered by the local government as part of that lighting zone.	Developed portion of a government designated park, recreation area, or wildlife preserve, can be designated as LZ2 or LZ3 if they are contained within such a zone.	Not applicable.
LZ2	Moderate	Rural areas, as defined by the 2010 U.S. Census.	Special districts within a default LZ2 zone may be designated as LZ3 or LZ4 by a local jurisdiction. Examples include special commercial districts or areas with special security considerations located within a rural area.	Special districts and government designated parks within a default LZ2 zone maybe designated as LZ1 by the local jurisdiction for lower illumination standards, without any size limits.
LZ3	Moderately High	Urban areas, as defined by the 2010 U.S. Census.	Special districts within a default LZ3 may be designated as a LZ4 by local jurisdiction for high intensity nighttime use, such as entertainment or commercial districts or areas with special security considerations requiring very high light levels.	Special districts and government designated parks within a default LZ3 zone may be designated as LZ1 or LZ2 by the local jurisdiction, without any size limits.
LZ4	High	None.	Not applicable.	Not applicable.

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EFFICIENCY STANDARDS
CALIFORNIA CODE OF REGULATIONS
TITLE 24, PART 6

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SUBCHAPTER 1
ALL OCCUPANCIES—GENERAL PROVISIONS

SECTION 100.0 – SCOPE

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

1. That are of Occupancy Group A, B, E, F, H, 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 by mechanical heating or mechanical cooling, or process spaces; or

   C. Low-rise residential buildings that are heated with a non-mechanical heating system.

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.

(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 110.11 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 110.11 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 140.8.

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 buildings.**

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

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

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

b. Either:

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

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

EXCEPTION 1 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.

EXCEPTION 2 to Section 100.0(e)2Diib: Low-rise residential buildings that are heated with a wood heater or another nonmechanical heating system and that use no energy obtained from depletable sources for lighting or water heating.

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

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

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

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

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

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

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

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

(h) **Certification Requirements for Manufactured Equipment, Products, and Devices.** Part 6 limits the installation of manufactured equipment, products, and devices to those that have been certified as specified by sections 110.0 and 110.1.

TABLE 100.0-A APPLICATION OF STANDARDS

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<tr><td>Indoor Lighting (conditioned, process spaces)</td><td>110.9, 120.8, 130.0, 130.1, 130.4</td><td>140.3(c), 140.6</td></tr>
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<tr><td>Outdoor Lighting</td><td>110.9, 130.0, 130.2, 130.4</td><td>140.7</td></tr>
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<tr><td>Solar Ready Buildings</td><td>110.10</td><td>N.A.</td><td>141.0(a)</td></tr>
<tr><td>Covered Processes[1]</td><td>Envelope, Ventilation, Process Loads</td><td>110.2, 120.6</td><td>140.9</td><td>140.1</td><td>120.6, 140.9</td></tr>
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<tr><td>Envelope (conditioned)</td><td>110.6, 110.7, 110.8, 150(a), 150.0(b), 150.0(c), 150.0(d), 150.0(e), 150.0(g)</td></tr>
<tr><td>HVAC (conditioned)</td><td>110.2, 110.5, 150.0(h), 150.0(i), 150.0(j), 150.0(m), 150.0(o)</td></tr>
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<tr><td>Outdoor Lighting</td><td>110.9, 130.0,150.0(k)</td></tr>
<tr><td>Pool and Spa Systems</td><td>110.4, 150.0(p)</td><td>N. A.</td><td>N.A.</td><td>150.2(a), 150.2(b)</td></tr>
<tr><td>Solar Ready Buildings</td><td>110.10</td><td>N. A.</td><td>N.A.</td><td>N.A.</td></tr>
<tr><td colspan="6">1 Nonresidential, high-rise and hotel/motel buildings that contain covered processes may conform to the applicable requirements of both occupancy types listed in this table.</td></tr>
</table>

SECTION 100.1 – DEFINITIONS AND RULES OF CONSTRUCTION

(a) **Rules of Construction.**

1. Where the context requires, the singular includes the plural and the plural includes the singular.
2. The use of "and" in a conjunctive provision means that all elements in the provision must be complied with, or must exist to make the provision applicable. Where compliance with one or more elements suffices, or where existence of one or more elements makes the provision applicable, "or" (rather than "and/or") is used.
3. "Shall" is mandatory and "may" is permissive.

(b) **Definitions.** Terms, phrases, words and their derivatives in Part 6 shall be defined as specified in Section 100.1. Terms, phrases, words and their derivatives not found in Section 100.1 shall be defined as specified in the "Definitions" chapters of Title 24, Parts 1 through 5 of the California Code of Regulations. Where terms, phrases, words and their derivatives are not defined in any of the references above, they shall be defined as specified in *Webster's Third New International Dictionary of the English Language, Unabridged* (1961 edition, through the 2002 addenda), unless the context requires otherwise.

ACCA is the Air Conditioning Contractors of America.

ACCA MANUAL J is the Air Conditioning Contractors of America document titled "Manual J - Residential Load Calculation" (ANSI/ACCA 2 Manual J – 2006).

ACCEPTANCE REQUIREMENTS FOR CODE COMPLIANCE is a description of test procedures in the Reference Nonresidential Appendices that includes equipment and systems to be tested, functions to be tested, conditions under which the test shall be performed, the scope of the tests, results to be obtained, and measurable criteria for acceptable performance.

ACCESSIBLE is having access thereto, but which first may require removal or opening of access panels, doors, or similar obstructions.

ADDITION is any change to a building that increases conditioned floor area and conditioned volume. See also "newly conditioned space." Addition is also any change that increases the floor area and volume of an unconditioned building of an occupancy group or type regulated by Part 6. Addition is also any change that increases the illuminated area of an outdoor lighting application regulated by Part 6.

AGRICULTURAL BUILDING is a structure designed and constructed to house farm implements, hay, grain, poultry, livestock or other horticultural products. It is not a structure that is a place of human habitation, a place of employment where agricultural products are processed, treated or packaged, or a place used by the public.

AIR BARRIER is a combination of interconnected materials and assemblies joined and sealed together to provide a continuous barrier to air leakage through the building envelope that separates conditioned from unconditioned space, or that separates adjoining conditioned spaces of different occupancies or uses.

AIR CONDITIONER is an appliance that supplies cooled and dehumidified air to a space for the purpose of cooling objects within the space.

AIR-COOLED AIR CONDITIONER is an air conditioner using an air-cooled condenser.

AIR-HANDLING UNIT or AIR HANDLER is a blower or fan that distributes supply air to a room, space, or area.

AIR FILTER EQUIPMENT or AIR FILTER DEVICE is air-cleaning equipment used for removing particulate matter from the air.

AIR FILTER MEDIA is the part of the air filter equipment which is the actual particulate removing agent.

AIR-TO-AIR HEAT EXCHANGER is a device which will reduce the heat losses or gains that occur when a building is mechanically ventilated, by transferring heat between the conditioned air being exhausted and outside air being supplied.

AIR-SOURCE HEAT PUMP is an appliance that consists of one or more factory-made assemblies, that includes an indoor conditioning coil, a compressor, and a refrigerant-to-air heat exchanger, and that provides heating and cooling functions.

ALTERATION is any change to a building's water-heating system, space-conditioning system, lighting system, electrical power distribution system, or envelope that is not an addition. Alteration is also any change that is regulated by Part 6 to an outdoor lighting system that is not an addition. Alteration is also any change that is regulated by Part 6 to signs located either indoors or outdoors. Alteration is also any change that is regulated by Part 6 to a covered process that is not an addition.

ALTERED COMPONENT is a component that has undergone an alteration and is subject to all applicable Standards requirements.

ALTERNATIVE CALCULATION METHODS (ACM) are compliance softwares, or alternative component packages, or exceptional methods approved by the Commission under Section 10-109. ACMs are also referred to as Compliance Software.

ALTERNATIVE CALCULATION METHODS (ACM) APPROVAL MANUAL are the documents establishing the requirements for Energy Commission approval of Compliance Software used to demonstrate compliance with the Building Energy Efficiency Standards for Residential and Nonresidential Buildings currently adopted by the Energy Commission.

ANNUAL FUEL UTILIZATION EFFICIENCY (AFUE) is a measure of the percentage of heat from the combustion of gas or oil which is transferred to the space being heated during a year, as determined using the applicable test method in the Appliance Efficiency Regulations or Section 110.2.

ANNUNCIATED is a type of visual signaling device that indicates the on, off, or other status of a load.

ANSI is the American National Standards Institute.

ANSI C82.6-2005 is the American National Standards Institute document titled “Ballasts for High-Intensity Discharge Lamps – Methods of Measurement.” (ANSI C82.6-2005)

ANSI/IES RP-16-10 is the document coauthored by the American National Standards Institute and the Illuminating Engineering Society of North America, Recommended Practice titled "Nomenclature and Definitions for Illuminating Engineering"

ANSI Z21.10.3 is the American National Standards Institute document titled “Gas Water Heaters - Volume III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour,” 2011 (ANSI Z21.10.3-2011/CSA 4.3-2011).

ANSI Z21.13 is the American National Standards Institute document titled “Gas-Fired Low Pressure Steam and Hot Water Boilers,” 2010 (ANSI Z21.13-2010/CSA 4.9-2010).

ANSI Z21.40.4A is the American National Standards Institute document titled “Addenda 1 to ANSI Z21.40.4-1996/CGA 2.94-M96, Performance Testing and Rating of Gas-Fired, Air Conditioning and Heat Pump Appliances,” 1998 (ANSI Z21.40.4-1998/CGA 2.94A-M98).

ANSI Z21.47 is the American National Standards Institute document titled “Gas-Fired Central Furnaces,” 2006 (ANSI Z21.47-2006/CSA 2.3-2006).

ANSI Z83.8 is the American National Standards Institute document titled “American National Standard/CSA Standard For Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters and Gas-Fired Duct Furnaces,” 2009 (ANSI Z83.8 -2009/CSA 2.6-2009).

APPLIANCE EFFICIENCY REGULATIONS are the regulations in Title 20, Sections 1601 et seq. of the California Code of Regulations.

APPROVED CALCULATION METHOD (See “alternative calculation methods”)

AHRI is the Air-Conditioning, Heating, and Refrigeration Institute.

AHRI 210/240 is the Air-Conditioning, Heating, and Refrigeration Institute document titled “Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment,” 2008 (ANSI/AHRI Standard 210/240-2008 with Addenda 1 and 2).

ANSI/AHRI/CSA 310/380 is the Air-Conditioning, Heating, and Refrigeration Institute document titled “Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA-C744-04),” 2004 (ANSI/AHRI/CSA Standard 310/380-2004).

AHRI 320 is the Air-Conditioning, Heating, and Refrigeration Institute document titled “Water-Source Heat Pumps,” 1998 (AHRI Standard 320-1998).

AHRI 325 is the Air-Conditioning, Heating, and Refrigeration Institute document titled “Ground Water-Source Heat Pumps,” 1998 (ARI Standard 325-1998).

ANSI/AHRI 340/360 is the Air-Conditioning, Heating, and Refrigeration Institute document titled “Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment,” 2007 (ANSI/AHRI Standard 340/360-2007 with Addenda 1 and 2).

ANSI/AHRI 365 is the Air-Conditioning, Heating, and Refrigeration Institute document titled "Commercial and Industrial Unitary Air-Conditioning Condensing Units," 2009 (ANSI/AHRI Standard 365 (I-P)-2009).

ANSI/AHRI 390 is the Air-Conditioning, Heating, and Refrigeration Institute document titled "Performance Rating of Single Package Vertical Air-Conditioners and Heat Pumps," 2003 (ANSI/AHRI Standard 390 (I-P)-2003).

ANSI/AHRI 400 is the Air-Conditioning, Heating, and Refrigeration Institute document titled "Liquid to Liquid Heat Exchangers," 2001 (ANSI/AHRI Standard 400 (I-P)-2001) with addenda 1 and 2.

ANSI/AHRI 460 is the Air-Conditioning, Heating, and Refrigeration Institute document titled “Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers,” 2005 (ANSI/AHRI Standard 460-2005).

AHRI 550/590 is the Air-Conditioning, Heating, and Refrigeration Institute document titled “Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle,” 2011 (AHRI Standard 550/590-(I-P)-2011).

ANSI/AHRI 560 is the Air-Conditioning, Heating, and Refrigeration Institute document titled “Absorption Water Chilling and Water Heating Packages,” 2000 (ANSI/AHRI Standard 560-2000).

AHRI 680 is the Air-Conditioning, Heating, and Refrigeration Institute document titled “Performance Rating of Residential Air Filter Equipment,” 2009 (ANSI/AHRI Standard 680).

AHRI 1230 is the Air-Conditioning, Heating, and Refrigeration Institute document titled “Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment,” 2010 (AHRI Standard 1230-2010) with Addendum 1.

ASHRAE is the American Society of Heating, Refrigerating, and Air-conditioning Engineers.

ASHRAE CLIMATIC DATA FOR REGION X is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "ASHRAE Climatic Data for Region X, Arizona, California, Hawaii and Nevada,” Publication SPCDX, 1982 and “Supplement,” 1994.

ASHRAE HANDBOOK, APPLICATIONS VOLUME is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Applications" (2011).

ASHRAE HANDBOOK, EQUIPMENT VOLUME is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems and Equipment" (2008).

ASHRAE HANDBOOK, FUNDAMENTALS VOLUME is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "ASHRAE Handbook: Fundamentals" (2009).

ASHRAE STANDARD 52.2 is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size,” 2012 (ANSI/ASHRAE Standard 52.2-2012).

ASHRAE STANDARD 55 is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled " Thermal Environmental Conditions for Human Occupancy,” 2010 (ASHRAE Standard 55-2010).

ASHRAE STANDARD 62.2 is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings,” 2010 (ANSI/ASHRAE Standard 62.2-2010 including ANSI/ASHRAE Addenda b, c, e, g, h, i and l to ANSI/ASHRAE 62.2-2010 published in the 2011 supplement, and ANSI/ASHRAE Addendum j to ANSI/ASHRAE Standard 62.2-2010 published in March, 2012, and ANSI/ASHRAE Addendum n to ANSI/ASHRAE Standard 62.2-2010 published in February, 2012).

ASHRAE STANDARD 193 is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "Method of Test for Determining the Airtightness of HVAC Equipment," 2010 (ANSI/ASHRAE Standard 193-2010).

ASME is the American Society of Mechanical Engineers.

ASME A17.1/CSA B44 is the American Society of Mechanical Engineers document titled “Handbook on Safety Code for Elevators and Escalators” 2013 (ASME Standard A17.1/CSAB44-2013).

ASME A112.18.1/CSA B125.1 is the American Society of Mechanical Engineers document titled “Plumbing Fixture Fittings” 2011 (ASME Standard A112.18.1-2011/CSA B125.1-11).

ASTM is the American Society for Testing and Materials International.

ASTM C55 is the American Society for Testing and Materials document titled “Standard Specification for Concrete Brick,” 2014 (ASTM C55-14).

ASTM C177 is the American Society for Testing and Materials document titled “Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus,” 2013 (ASTM C177-13).

ASTM C272 is the American Society for Testing and Materials document titled “Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions,” 2012 (ASTM C272-12).

ASTM C335 is the American Society for Testing and Materials document titled “Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation,” 2010 (ASTM C335-10).

ASTM C518 is the American Society for Testing and Materials document titled “Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus,” 2010 (ASTM C518-10).

ASTM C731 is the American Society for Testing and Materials document titled “Standard Test Method for Extrudability, After Package Aging of Latex Sealants,” 2010 (ASTM C731-10).

ASTM C732 is the American Society for Testing and Materials document titled “Standard Test Method for Aging Effects of Artificial Weathering on Latex Sealants,” 2006 (ASTM C732-06 (2012).

ASTM C836 is the American Society of Testing and Materials document titled, “Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course,” 2012 (ASTM C836/C836M-12).

ASTM C1167 is the American Society for Testing and Materials document titled “Standard Specification for Clay Roof Tiles,” 2011 (ASTM C1167-11).

ASTM C1371 is the American Society for Testing and Materials document titled “Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers,” 2010 (ASTM C1371- 04a(2010).

ASTM C1492 is the American Society for Testing and Materials document entitled “Standard Specification for Concrete Roof Tile,” 2009 (ASTM C1492-03(2009)).

ASTM C1549 is the American Society for Testing and Materials document entitled, "Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer,"2014 (ASTM C1549- 09 (2014).

ASTM C1583 is the American Society of Testing and Materials document titled, “Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method),” 2013 (ASTM C1583/c1583M-13).

ASTM D448 is the American Society for Testing and Materials document titled, "Standard Classification for Sizes of Aggregate for Road and Bridge Construction,"2012 (ASTM D448-12).

ASTM D522 is the American Society of Testing and Materials document titled, “Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings,” 2013 (ASTM D522/D522M-13).

ASTM D822 is the American Society of Testing and Materials document titled, “Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings,” 2013 (ASTM D822/D822M-13).

ASTM D1003 is the American Society for Testing and Materials document titled “Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics,” 2013 (ANSI/ASTM D1003-13).

ASTM D1653 is the American Society of Testing and Materials document titled, “Standard Test Methods for Water Vapor Transmission of Organic Coating Films,” 2013 (ASTM D1653-13).

ASTM D1863 is the American Society for Testing and Materials document titled, "Standard Specification for Mineral Aggregate Used on Built-Up Roofs,"2011 (ASTM D1863/D1863M-05 (2011)).

ASTM D2370 is the American Society of Testing and Materials document titled, “Standard Test Method for Tensile Properties of Organic Coatings,” 2010 ASTM D2370-98 (2010).

ASTM D2824 is the American Society of Testing and Materials document titled “Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Nonfibered, Asbestos Fibered, and Fibered without Asbestos,” 2013 (ASTM D2824/D2824M-13).

ASTM D3468 is the American Society of Testing and Materials document titled, “Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing,” 2013 (ASTM D3468/D3468M-99 (2013)).

ASTM D3805 is the American Society of Testing and Materials document titled “Standard Guide for Application of Aluminum-Pigmented Asphalt Roof Coatings,” 1997 (ASTM D3805/D3805M-97 (2009)).

ASTM D4798 is the American Society for Testing and Materials document titled “Standard Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method),” 2011 (ASTM D4798/D4798M-11).

ASTM D5870 is the American Society of Testing and Materials document titled, “Standard Practice for Calculating Property Retention Index of Plastics,” 2011 (ASTM D5870-11).

ASTM D6083 is the American Society of Testing and Materials document titled, “Standard Specification for Liquid Applied Acrylic Coating Used in Roofing,” 2005 (ASTM D6083-05e1).

ASTM D6694 is the American Society of Testing and Materials document titled, “Standard Specification for Liquid-Applied Silicone Coating Used in Spray Polyurethane Foam Roofing,” 2013 (ASTM D6694/D6694M-08 (2013).

ASTM D6848 is the American Society of Testing and Materials document titled “Standard Specification for Aluminum-Pigmented Emulsified Asphalt Used as a Protective Coating for Roofing,” 2002 (ASTM D6848-02).

ASTM E96 is the American Society for Testing and Materials document titled “Standard Test Methods for Water Vapor Transmission of Materials,” 2014 (ASTM E96/E96M-14).

ASTM E283 is the American Society for Testing and Materials document titled “Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen,” 2012 (ASTM E283-04(2012)).

ASTM E408 is the American Society for Testing and Materials document titled, “Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques,” 2013 (ASTM E408-13).

ASTM E779 is the American Society for Testing and Materials document titled, “Standard Test Method for Determining Air Leakage Rate by Fan Pressurization,” 2010 (ASTM E779-10).

ASTM E972 is the American Society for Testing and Materials document titled, "Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight,"1996 (ASTM E972-96(2013)).

ASTM E1677 is the American Society for Testing and Materials document titled, “Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls,” 2011 (ASTM E1677-11).

ASTM E1918 is the American Society for Testing and Materials document entitled, "Standard Test Method for Measuring Solar reflectance of Horizontal and Low-Sloped Surfaces in the Field,"2015 (ASTM E1918-06(2015)).

ASTM E1980 is the American Society for Testing and Materials document titled, “Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surface,” 2011 (ASTM E1980-11)

ASTM E2178 is the American Society for Testing and Materials document titled, "Standard Test Method for Air Permeance of Building Materials," 2013 (ASTM E21778-13).

ASTM E2357 is the American Society for Testing and Materials document titled, "Standard Test Method for determining air leakage of air barrier assemblies" 2011 (ASTM E2357-11).

ATTIC is an enclosed space directly below the roof deck and above the ceiling beams.

AUTOMATIC is capable of operating without human intervention.

AUTOMATED TELLER MACHINE (ATM) is any electronic information processing device which accepts or dispenses currency in connection with a credit, deposit, or convenience account without involvement by a clerk.

BACK-UP COMPRESSORS are those compressors not used to meet peak compressed air loads. Back-up compressors are physically connected to the compressed air piping system and can be automatically controlled to turn on if one of the online compressors fails. Back-up compressors do not normally operate.

BELOW-GRADE WALL is the portion of a wall, enclosing conditioned space that is below the grade line.

BUBBLE POINT is the liquid saturation temperature of a refrigerant at a specified pressure.

BUILDING is any structure or space covered by Section 100.0 of the Building Energy Efficiency Standards.

BUILDING COMMISSIONING is a systematic quality assurance process that spans the entire design and construction process, including verifying and documenting that building systems and components are planned, designed, installed, tested, operated and maintained to meet the owner's project requirements.

BUILDING ENVELOPE is the ensemble of exterior and demising partitions of a building that enclose conditioned space.

CALL CENTER is a phone center that handles large number of phone calls including but not limited to help desk, customer and sales support, technical support, emergency response, telephone answering service, and inbound and outbound telemarketing.

CENTRAL FAN-INTEGRATED VENTILATION SYSTEM is a central forced air heating and/or cooling system which is intended to operate on a regular basis to bring in outdoor ventilation air and/or distribute air around the home for comfort and ventilation even when heating and cooling are not needed.

CERTIFIED TO THE ENERGY COMMISSION means, when used in association with appliances, certified under Section 1606 of Title 20 of the California Code of Regulations; and otherwise means certified by the manufacturer in a declaration, executed under penalty of perjury under the laws of the State of California, that all the information provided pursuant to the certification is true, complete, accurate and in compliance with all applicable provisions of Part 6; and if applicable that the equipment, product, or device was tested under the applicable test method specified in Part 6.

CERTIFYING ORGANIZATION is an independent organization recognized by the Commission to certify manufactured devices for performance values in accordance with procedures adopted by the Commission.

CIE 13.3 is the International Commission on Illumination (Commission Internationale de l'Eclairage) document titled "Method of Measuring and Specifying Colour Rendering Properties of Light Sources," 1995 (CIE 13.3-1995).

CIE 15 is the International Commission on Illumination (Commission Internationale de l'Eclairage) document titled "Technical Report: Colorimetry," 2004 (CIE 15:2004).

CLIMATE ZONES are the 16 geographic areas of California for which the Commission has established typical weather data, prescriptive packages and energy budgets. Climate zones are defined by ZIP code and listed in Reference Joint Appendix JA2 FIGURE 100.1-A is an approximate map of the 16 Climate Zones.

CLOSED-CIRCUIT COOLING TOWER is a cooling tower that utilizes indirect contact between a heated fluid, typically water or glycol, and the cooling atmosphere to transfer the source heat load through sensible heat, latent heat, and mass transfer indirectly to the air, essentially combining a heat exchanger and cooling tower into an integrated and relatively compact device.

CODES, CALIFORNIA HISTORICAL BUILDING CODE is the California Historical Building Code, California Code of Regulations, Title 24, Part 8 and Part 2 (Chapter 34).

CODES, CBC is the 2013 California Building Code.

CODES, CEC is the 2013 California Electric Code.

CODES, CMC is the 2013 California Mechanical Code.

CODES, CPC is the 2013 California Plumbing Code.

COEFFICIENT OF PERFORMANCE (COP), COOLING, is the ratio of the rate of net heat removal to the rate of total energy input, calculated under designated operating conditions and expressed in consistent units, as determined using the applicable test method in the Appliance Efficiency Regulations or Section 110.2.

COEFFICIENT OF PERFORMANCE (COP), HEATING, is the ratio of the rate of net heat output to the rate of total energy input, calculated under designated operating conditions and expressed in consistent units, as determined using the applicable test method in the Appliance Efficiency Regulations or Section 110.2.

COEFFICIENT OF PERFORMANCE (COP), HEAT PUMP is the ratio of the rate of useful heat output delivered by the complete heat pump unit (exclusive of supplementary heating) to the corresponding rate of energy input, in consistent units and as determined using the applicable test method in Appliance Efficiency Regulations or Section 110.2.

COMBUSTION AIR POSITIVE SHUT-OFF is a means of restricting air flow through a boiler combustion chamber during standby periods, used to reduce standby heat loss. A flue damper and a vent damper are two examples of combustion air positive shut-off devices.

COMBUSTION EFFICIENCY is a measure of the percentage of heat from the combustion of gas or oil that is transferred to the medium being heated or lost as jacket loss.

COMMERCIAL BOILER is a type of boiler with a capacity (rated maximum input) of 300,000 Btus per hour (Btu/h) or more and serving a space heating or water heating load in a commercial building.

COMMISSION is the California State Energy Resources Conservation and Development Commission.

COMPLEX MECHANICAL SYSTEMS: are systems that include 1) fan systems each serving multiple thermostatically controlled zones; or 2) built-up air handler systems (non-unitary or non-packaged HVAC equipment); or 3) hydronic or steam heating systems; or 4) hydronic cooling systems. Complex systems are NOT the following: (a) unitary or packaged equipment listed in Tables 110.2-A, 110.2-B, 110.2-C, and 110.2-E that each serve one zone, or (b) two-pipe, heating only systems serving one or more zones.

COMPLIANCE SOFTWARE is software that has been approved pursuant to Section 10-109 of Part 1 of Title 24 of the California Code of Regulations, to demonstrate compliance with the performance approach of Part 6.

COMPRESSED AIR SYSTEM is a system of at least one compressor providing compressed air at 40 psig or higher.

COMPUTER ROOM is a room within a building whose primary function is to house electronic equipment and that has a design equipment power density exceeding 20 watts/ft^2 (215 watts/m^2) of conditioned floor area.

CONDENSER SPECIFIC EFFICIENCY is the full load condenser Total Heat of Rejection (THR) capacity at standardized conditions divided by the fan input electric power (including but not limited to spray pump electric input power for evaporative condensers) at 100 percent rated fan speed.

CONDITIONED FLOOR AREA (CFA) is the floor area (in square feet) of enclosed conditioned space on all floors of a building, as measured at the floor level of the exterior surfaces of exterior walls enclosing the conditioned space.

CONDITIONED SPACE is space in a building that is either directly conditioned or indirectly conditioned.

CONDITIONED SPACE, DIRECTLY is an enclosed space that is provided with wood heating, is provided with mechanical heating that has a capacity exceeding 10 Btu/hr-ft^2, or is provided with mechanical cooling that has a capacity exceeding 5 Btu/hr-ft^2, unless the space-conditioning system is designed for process space or process load. (See “process load” and “process space.”)

CONDITIONED SPACE, INDIRECTLY is enclosed space, including, but not limited to, unconditioned volume in atria, that (1) is not directly conditioned space; and (2) either (a) has a thermal transmittance area product (UA) to directly conditioned space exceeding that to the outdoors or to unconditioned space and does not have fixed vents or openings to the outdoors or to unconditioned space, or (b) is a space through which air from directly conditioned spaces is transferred at a rate exceeding three air changes per hour.

CONDITIONED VOLUME is the total volume (in cubic feet) of the conditioned space within a building.

CONTINUOUS INSULATION (c.i.) is insulation that is continuous across all assemblies that separate conditioned from unconditioned space. It is installed on the exterior or interior or is integral to any opaque surface of the building envelope and has no thermal bridges other than fasteners and necessary service openings.

CONTROLLED ATMOSPHERE is an airtight space maintained at reduced oxygen levels for the purpose of reducing respiration of perishable product in long term storage.

COOLER is a space to be capable of operation at a temperature greater than or equal to 28°F but less than 55°F.

COOL ROOF is a roofing material with high thermal emittance and high solar reflectance, or low thermal emittance and exceptionally high solar reflectance as specified in Part 6 that reduces heat gain through the roof.

COOLING EQUIPMENT is equipment used to provide mechanical cooling for a room or rooms in a building.

CRAWL SPACE is a space immediately under the first floor of a building adjacent to grade.

CRRC-1 is the Cool Roof Rating Council document titled "Product Rating Program Manual."

CTI is the Cooling Technology Institute.

CTI ATC-105 is the Cooling Technology Institute document titled "Acceptance Test Code for Water Cooling Towers," 2000 (CTI ATC-105-00).

CTI ATC-105S(11) is the Cooling Technology Institute document titled "Acceptance Test Code for Closed-Circuit Cooling Towers," 2011 (CTI ATC-105-11).

CTI STD-201 is the Cooling Technology Institute document titled "Standard for Thermal Performance Certification of Evaporative Heat Rejection Equipment," 2011 (CTI STD-201-11).

CURRENT AIR DEMAND is the actual cubic feet per minute (acfm) of total air flow necessary for end uses in a compressed air system.

C-VALUE (also known as C-factor) is the time rate of heat flow through unit area of a body induced by a unit temperature difference between the body surfaces, in Btu (hr x ft^2 x °F). It is not the same as K-value or K-factor.

CYCLES OF CONCENTRATION is the number of times the concentration of total dissolved solids (TDS) in cooling tower water is multiplied relative to the TDS in the makeup water. Because evaporation of pure water leaves dissolved solids behind in the system water, TDS increases over time as the tower operates. The number of times the dissolved minerals are concentrated is relative to the TDS in the makeup water. For example, five cycles of concentration represents five times the concentration of solids in the cooling tower system water relative to the TDS in the makeup water entering the tower.

DATA CENTER is a building whose primary function is to house computer room(s).

DAYLIT ZONE is the floor area under skylights or next to windows. Types of Daylit Zones include Primary Sidelit Daylit Zone, Secondary Sidelit Daylit Zone, and Skylit Daylit Zone.

DEADBAND is the temperature range within which the HVAC system is neither calling for heating or cooling.

DECORATIVE GAS APPLIANCE is a gas appliance that is designed or installed for visual effect only, cannot burn solid wood, and simulates a fire in a fireplace.

DEGREE DAY, HEATING, is a unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal annual heating load of a building. For any one day, when the mean temperature is less than 65°F, there exist as many degree days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 65°F. The number of degree days for specific geographical locations are those listed in the Reference Joint Appendix JA2. For those localities not listed in the Reference Joint Appendix JA2, the number of degree days is as determined by the applicable enforcing agency.

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

a. changes in the price of electricity; or

b. participation in programs or services designed to modify electricity use

   i. in response to wholesale market prices, or

ii. when system reliability is jeopardized.

DEMAND RESPONSE PERIOD is a period of time during which electricity loads are modified in response to a demand response signal.

DEMAND RESPONSE SIGNAL is a signal sent by the local utility, Independent System Operator (ISO), or designated curtailment service provider or aggregator, to a customer, indicating a price or a request to modify electricity consumption, for a limited time period.

DEMAND RESPONSIVE CONTROL is a kind of control that is capable of receiving and automatically responding to a demand response signal.

DEMISING PARTITION is a wall, fenestration, floor, or ceiling that separates conditioned space from enclosed unconditioned space.

DESIGN CONDITIONS are the parameters and conditions used to determine the performance requirements of space-conditioning systems. Design conditions for determining design heating and cooling loads are specified in Section 140.4(b) for nonresidential, high-rise residential, and hotel/motel buildings and in Section 150.0(h) for low-rise residential buildings.

DESIGN HEAT GAIN RATE is the total calculated heat gain through the building envelope under design conditions.

DESIGN HEAT LOSS RATE is the total calculated heat loss through the building envelope under design conditions.

DESIGN REVIEW is an additional review of the construction documents (drawings and specifications) that seeks to improve compliance with existing Title 24 regulations, to encourage adoption of best practices in design, and to encourage designs that are constructible and maintainable. It is an opportunity for an experienced design engineer or architect to look at a project with a fresh perspective in an effort to catch missing or unclear design information and to suggest design enhancements.

DEW POINT TEMPERATURE is the vapor saturation temperature at a specified pressure for a substance undergoing phase change from vapor to liquid.

DIRECT DIGITAL CONTROL (DDC) is a type of control where controlled and monitored analog or binary data, such as temperature and contact closures, are converted to digital format for manipulation and calculations by a digital computer or microprocessor, then converted back to analog or binary form to control mechanical devices.

DIRECT-VENT APPLIANCE or “sealed combustion” appliance is an appliance that is constructed and installed so that air from combustion is derived directly from the outdoors and flue gases are discharged to the outdoors.

DISPLAY PERIMETER is the length of an exterior wall in a Group B; Group F, Division 1; or Group M, Occupancy that immediately abuts a public sidewalk, measured at the sidewalk level for each story that abuts a public sidewalk.

DOOR is an operable opening in the building envelope, including swinging and roll-up doors, fire doors, pet doors and access hatches with less than 50 percent glazed area. When that operable opening has 50 percent or more glazed area it is a glazed door. See Fenestration: Glazed Door.

DUAL-GLAZED GREENHOUSE WINDOWS are a type of dual-glazed fenestration product which adds conditioned volume but not conditioned floor area to a building.

DUCT SEALING is a procedure for installing a space conditioning distribution system that minimizes leakage of air from or to the distribution system. Minimum specifications for installation procedures, materials, diagnostic testing and field verification are contained in the Reference Residential Appendix RA3 and Reference Nonresidential Appendix NA1.

DUCT SYSTEM is all the ducts, duct fittings, plenums and fans when assembled to form a continuous passageway for the distribution of air.

DUCTED SYSTEM is an air conditioner or heat pump, either a split system or single-packaged unit, that is designed to be permanently installed equipment and delivers conditioned air to an indoor space through a duct.

DWELLING is a building that contains one or two dwelling units used, intended or designed to be used, rented, leased, let or hired out to be occupied for living purposes.

DWELLING UNIT is a single unit providing complete, independent living facilities for one or more persons including access permanent provisions for living, sleeping, eating, cooking and sanitation.

EAST-FACING (See "orientation.")

ECONOMIZER, AIR, is a ducting arrangement, including dampers, linkages, and an automatic control system that allows a cooling supply fan system to supply outside air to reduce or eliminate the need for mechanical cooling.

ECONOMIZER, WATER, is a system by which the supply air of a cooling system is cooled directly or indirectly by evaporation of water, or other appropriate fluid, in order to reduce or eliminate the need for mechanical cooling.

ELECTRICAL POWER DISTRIBUTION SYSTEMS. The following definitions are intended to apply to Section 130.5 only:

> **EQUIPMENT**. A general term, including devices, luminaires, apparatus, machinery, and the like used as a part of, or in connection with, an electrical installation.
>
> **PLUG LOAD** is the energy consumed by any appliances or electronic device that is plugged into a receptacle or receptacle outlet. Plug loads are not related to general lighting, heating, ventilation, cooling, and water heating, domestic and service water system, renewable power, information technology equipment, computer room electronic equipment, and electric vehicle charging.
>
> **ELECTRICAL METERING** is a device or system for measuring the electrical power and energy supplied to a customer or premise(s).
>
> **LOW VOLTAGE DRY-TYPE DISTRIBUTION TRANSFORMER** is a distribution transformer that has an input voltage of 600 volts or less, that is air-cooled, and that does not use oil as a coolant.
>
> **SERVICE** is the conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premise served.
>
> **SERVICE EQUIPMENT** is the necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service conductors to a building or other structure, or an otherwise designated area, and intended to constitute the main control and cutoff of the supply.

ELECTRONICALLY-COMMUTATED MOTOR is a brushless DC motor with a permanent magnet rotor that is surrounded by stationary motor windings, and an electronic controller that varies rotor speed and direction by sequentially supplying DC current to the windings.

EMITTANCE, THERMAL is the ratio of the radiant heat flux emitted by a sample to that emitted by a blackbody radiator at the same temperature.

ENCLOSED SPACE is space that is substantially surrounded by solid surfaces, including walls, ceilings or roofs, doors, fenestration areas, and floors or ground.

ENERGY BUDGET is the maximum amount of Time Dependent Valuation (TDV) energy that a proposed building, or portion of a building, can be designed to consume, calculated with the approved procedures specified in Part 6.

ENERGY COMMISSION is the California State Energy Resources Conservation and Development Commission.

ENERGY EFFICIENCY RATIO (EER) is the ratio of net cooling capacity (in Btu/hr) to total rate of electrical energy input (in watts), of a cooling system under designated operating conditions, as determined using the applicable test method in the Appliance Efficiency Regulations or Section 110.2.

ENERGY FACTOR (EF) of a water heater is a measure of overall water heater efficiency, as determined using the applicable test method in the Appliance Efficiency Regulations.

ENERGY MANAGEMENT CONTROL SYSTEM (EMCS) is a computerized control system designed to regulate the energy consumption of a building by controlling the operation of energy consuming systems, such as the heating, ventilation and air conditioning (HVAC), lighting, and water heating systems, and is capable of monitoring environmental and system loads, and adjusting HVAC operations in order to optimize energy usage and respond to demand response signals.

ENERGY OBTAINED FROM DEPLETABLE SOURCES is electricity purchased from a public utility, or any energy obtained from coal, oil, natural gas, or liquefied petroleum gases.

ENERGY OBTAINED FROM NONDEPLETABLE SOURCES is energy that is not energy obtained from depletable sources.

ENFORCEMENT AGENCY is the city, county, or state agency responsible for issuing a building permit.

ENTIRE BUILDING is the ensemble of all enclosed space in a building, including the space for which a permit is sought, plus all existing conditioned and unconditioned space within the structure.

ENVELOPE (See "building envelope")

EXFILTRATION is uncontrolled outward air leakage from inside a building, including leakage through cracks and interstices, around windows and doors, and through any other exterior partition or duct penetration.

EXTERIOR FLOOR/SOFFIT is a horizontal exterior partition, or a horizontal demising partition, under conditioned space. For low-rise residential occupancies, exterior floors also include those on grade.

EXTERIOR PARTITION is an opaque, translucent, or transparent solid barrier that separates conditioned space from ambient air or space. For low-rise residential occupancies, exterior partitions also include barriers that separate conditioned space from unconditioned space, or the ground.

EXTERIOR ROOF/CEILING is an exterior partition, or a demising partition, that has a slope less than 60 degrees from horizontal, that has conditioned space below, and that is not an exterior door or skylight.

EXTERIOR ROOF/CEILING AREA is the area of the exterior surface of exterior roof/ceilings.

EXTERIOR WALL is any wall or element of a wall, or any member or group of members, which defines the exterior boundaries or courts of a building and which has a slope of 60 degrees or greater with the horizontal plane. An exterior wall or partition is not an exterior floor/soffit, exterior door, exterior roof/ceiling, window, skylight, or demising wall.

EXTERIOR WALL AREA is the area of the opaque exterior surface of exterior walls.

FACADE is the contiguous exterior of a building surface, but not limited to fenestration products.

FACTORY ASSEMBLED COOLING TOWERS are cooling towers constructed from factory-assembled modules either shipped to the site in one piece or put together in the field.

FENESTRATION: Includes the following:

ACE is an NFRC-Approved Calculation Entity that conducts calculations of fenestration product ratings for certification authorization using the NFRC Component Modeling approach and issues label certificates to Specifying Authorities for product certification authorization in accordance with NFRC requirements.

ALTERATION is any change to an existing building's exterior fenestration product that is not a repair (see Fenestration Repair) that:

i. Replaces existing fenestration in an existing wall or roof with no net area added; or

ii. Replaces existing fenestration and adds new net area in the existing wall or roof; or

iii. Adds a new window that increases the net fenestration area to an existing wall or roof.

ALTERED COMPONENT is a new fenestration component that has undergone an alteration other than a repair and is subject to all applicable Standards requirements.

BAY WINDOW is a combination assembly which is composed of three or more individual windows either joined side by side or installed within opaque assemblies and which projects away from the wall on which it is installed. Center windows, if used are parallel to the wall on which the bay is installed, the end panels or two side windows are angled with respect to the center window. Common angles are 30° and 45°, although other angles may be employed.

CMA (component modeling approach) is a fenestration product certification program from the National Fenestration Rating Council (NFRC) that enables energy-related performance ratings for nonresidential fenestration products, including the thermal performance U-factor, Solar Heat Gain Coefficient, and Visible Transmittance.

CMAST (Component Modeling Approach Software Tool) is an NFRC approved software which allows a user to create a fenestration product "virtually," and generate its energy-related performance ratings, including the thermal performance U-factor, Solar Heat Gain Coefficient, and Visible Transmittance.

CURTAIN WALL/STOREFRONT is an external nonbearing wall intended to separate the exterior nonconditioned and interior conditioned spaces. It also consists of any combination of framing materials, fixed glazing, opaque glazing, operable windows, or other in-fill materials.

GLAZED DOOR is an exterior door having a glazed area of 50 percent or greater of the area of the door.

DUAL-GLAZED GREENHOUSE WINDOWS is a double glass pane separated by an air or other gas space which adds conditioned volume but not conditioned floor area to a building.

DYNAMIC GLAZING SYSTEMS are glazing systems that have the ability to reversibly change their performance properties, including U-factor, Solar Heat Gain Coefficient (SHGC), and/or Visible Transmittance (VT) between well-defined end points. These may include, but are not limited to chromogenic glazing systems and integrated shading systems (defined below). Dynamic Glazing systems do not include internally mounted or externally mounted shading devices that attach to the window framing/glazing that may or may not be removable.

CHROMOGENIC GLAZING is a class of switchable glazing which includes active materials (e.g. electrochromic) and passive materials (e.g. photochromic and thermochromic) permanently integrated into the glazing assembly. Their primary function is to switch reversibly from a high transmission state to a low transmission state with associated changes in VT and SHGC.

INTEGRATED SHADING SYSTEM is a class of fenestration products including an active layer: e.g. shades, louvers, blinds or other materials permanently integrated between two or more glazing layers. The U-factor and/or SHGC and VT of the insulating glass assembly can be altered by reversibly changing the enclosed active layer.

FENESTRATION AREA for windows is the total window rough opening area which includes the fenestration, fenestration frame components in the exterior walls and roofs.

FENESTRATION PRODUCT is any transparent or translucent material plus any sash, frame, mullions and dividers, in the facade of a building, including, but not limited to, windows, sliding glass doors, french doors, skylights, curtain walls, dynamic glazing, garden windows and glass block.

FENESTRATION REPAIR is the reconstruction or renewal for the purpose of maintenance of any fenestration product, component or system and shall not increase the preexisting energy consumption of the repaired fenestration product, component, system, or equipment. Replacement of any component, system, or equipment for which there are requirements in the Standards are considered an alteration (see Fenestration, Alterations) and not a repair and is subject to the requirements of Part 6 of the Standards.

FIELD-FABRICATED is a fenestration product whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product. Field fabricated does not include site-built fenestration.

FIN is an opaque surface, oriented vertically and projecting outward horizontally from an exterior vertical surface.

FIN OFFSET is the horizontal distance from the edge of exposed exterior glazing at the jamb of a window to the fin.

FIN PROJECTION is the horizontal distance, measured outward horizontally, from the surface of exposed exterior glazing at the jamb of a window to the outward edge of a fin.

FIXED is fenestration that is not designed to be opened or closed.

GREENHOUSE or GARDEN WINDOW is a window unit that consists of a three-dimensional, five-sided structure generally protruding from the wall in which it is installed. Operating sash may or may not be included.

MANUFACTURED or **KNOCKED DOWN PRODUCT** is a fenestration product constructed of materials which are factory cut or otherwise factory formed with the specific intention of being used to fabricate a fenestration product. Knocked down or partially assembled products may be sold as a fenestration product when provided with temporary and permanent labels as described in Section 10-111; or as a site-built fenestration product when not provided with temporary and permanent labels as described in Section 10-111.

NFRC 100 is the National Fenestration Rating Council document titled "NFRC 100: Procedure for Determining Fenestration Product U-factors."

NFRC 200 is the National Fenestration Rating Council document titled "NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence." (2014).

NFRC 202 is the National Fenestration Rating Council document titled "NFRC 202: Procedures for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence." (2014).

NFRC 203 is the National Fenestration Rating Council document titled "NFRC 203: Procedure for Determining Visible Transmittance of Tubular Daylighting Devices." (2014).

NFRC 400 is the National Fenestration Rating Council document titled "NFRC 400: Procedure for Determining Fenestration Product Air Leakage." (2014).

OPERABLE SHADING DEVICE is a device at the interior or exterior of a building or integral with a fenestration product, which is capable of being operated, either manually or automatically, to adjust the amount of solar radiation admitted to the interior of the building.

RELATIVE SOLAR HEAT GAIN COEFFICIENT (RSHGC) is the ratio of solar heat gain through a fenestration product (corrected for external shading) to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted, or convected into the space.

SITE-BUILT is fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing units, that are manufactured with the intention of being assembled at the construction site. These include storefront systems, curtain walls, and atrium roof systems.

SOLAR HEAT GAIN COEFFICIENT (SHGC) is the ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted, or convected into the space.

SPANDREL is opaque glazing material most often used to conceal building elements between floors of a building so they cannot be seen from the exterior, also known as "opaque in-fill systems".

TINTED GLASS is colored glass by incorporation of a mineral admixture resulting in a degree of tinting. Any tinting reduces both visible and radiant transmittance.

VISIBLE TRANSMITTANCE (VT) is the ratio (expressed as a decimal) of visible light that is transmitted through a glazing fenestration. The higher the VT rating, the more light is allowed through a window.

WINDOW is fenestration that is not a skylight and that is an assembled unit consisting of a frame and sash component holding one or more pieces of glazing.

WINDOW AREA is the area of the surface of a window, plus the area of the frame, sash, and mullions.

WINDOW HEAD HEIGHT is the height from the floor to the top of the window.

WINDOW WALL RATIO is the ratio of the window area to the gross exterior wall area.

FIELD ERECTED COOLING TOWERS are cooling towers which are custom designed for a specific application and which cannot be delivered to a project site in the form of factory assembled modules due to their size, configuration, or materials of construction.

FIREPLACE is a hearth and fire chamber, or similar prepared place, in which a fire may be made and which is built in conjunction with a flue or chimney, including but not limited to factory-built fireplaces, masonry fireplaces, and masonry heaters as further clarified in the CBC.

FLOOR/SOFFIT TYPE is a type of floor/soffit assembly having a specific heat capacity, framing type, and U-factor.

FLUID COOLER is a fan-powered heat rejection device that includes a water or glycol circuit connected by a closed circulation loop to a liquid-cooled refrigerant condenser, and may be either evaporative-cooled, air-cooled, or a combination of the two.

FLUX is the rate of energy flow per unit area.

FOOD PREPARATION EQUIPMENT is cooking equipment intended for commercial use, including coffee machines, espresso coffee makers, conductive cookers, food warmers including heated food servers, fryers, griddles, nut warmers, ovens, popcorn makers, steam kettles, ranges, and cooking appliances for use in commercial kitchens, restaurants, or other business establishments where food is dispensed.

FREEZER is a space designed to be capable of operation at less than 28°F.

GAS COOLING EQUIPMENT is cooling equipment that produces chilled water or cold air using natural gas or liquefied petroleum gas as the primary energy source.

GAS HEATING SYSTEM is a system that uses natural gas or liquefied petroleum gas as a fuel to heat a conditioned space.

GAS LOG is a self-contained, free-standing, open-flame, gas-burning appliance consisting of a metal frame or base supporting simulated logs, and designed for installation only in a vented fireplace.

GLAZING (See “fenestration product”)

GLOBAL WARMING POTENTIAL (GWP) is the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of carbon dioxide over a given period of time.

GLOBAL WARMING POTENTIAL VALUE (GWP Value) is the 100-year GWP value published by the Intergovernmental Panel on Climate Change (IPCC) in either its Second Assessment Report (SAR) (IPCC, 1995), or its Fourth Assessment A-3 Report (AR4) (IPCC, 2007). Both the 1995 IPCC SAR values and the 2007 IPCC AR4 values are published in table 2.14 of the 2007 IPCC AR4. The SAR GWP values are found in column “SAR (100-yr)” of Table 2.14.; the AR4 GWP values are found in column “100 yr” of Table 2.14.”

GOVERNMENTAL AGENCY is any public agency or subdivision thereof, including, but not limited to, any agency of the state, a county, a city, a district, an association of governments, or a joint power agency.

GROSS EXTERIOR ROOF AREA is the sum of the skylight area and the exterior roof/ceiling area.

GROSS EXTERIOR WALL AREA is the sum of the window area, door area, and exterior wall area.

HABITABLE SPACE is space in a building for living, sleeping, eating or cooking. Bathrooms, toilets, hallways, storage areas, closets, or utility rooms and similar areas are not considered habitable spaces.

HABITABLE STORY is a story that contains space in which humans may work or live in reasonable comfort, and that has at least 50 percent of its volume above grade.

HEAT CAPACITY (HC) or thermal capacity, is the measurable physical quantity that characterizes the amount of heat required to change a substance's temperature by a given amount..

HEAT PUMP is an appliance, that consists of one or more assemblies; that uses an indoor conditioning coil, a compressor, and a refrigerant-to-outdoor air heat exchanger to provide air heating; and that may also provide air cooling, dehumidifying, humidifying, circulating, or air cleaning.

HEATED SLAB FLOOR is a concrete floor either, on-grade, raised, or a lightweight concrete slab topping. Heating is provided by a system placed within or under the slab, and is sometimes referred to as a radiant slab floor.

HEATING EQUIPMENT is equipment used to provide mechanical heating for a room or rooms in a building.

HEATING SEASONAL PERFORMANCE FACTOR (HSPF) is the total heating output of a central air-conditioning heat pump (in Btu) during its normal use period for heating divided by the total electrical energy input (in watt-hours) during the same period, as determined using the applicable test method in the Appliance Efficiency Regulations.

HI is the Hydronics Institute of the Gas Appliance Manufacturers Association (GAMA).

HI HTG BOILER STANDARD is the Hydronics Institute document titled “Testing and Rating Standard for Rating Boilers,” 1989.

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

HOTEL/MOTEL is a building or buildings that has six or more guest rooms or a lobby serving six or more guest rooms, where the guest rooms are intended or designed to be used, or which are used, rented, or hired out to be occupied, or which are occupied for sleeping purposes by guests, and all conditioned spaces within the same building envelope. Hotel/motel also includes all conditioned spaces which are (1) on the same property as the hotel/motel, (2) served by the same central heating, ventilation, and air-conditioning system as the hotel/motel, and (3) integrally related to the functioning of the hotel/motel as such, including, but not limited to, exhibition facilities, meeting and conference facilities, food service facilities, lobbies, and laundries.

HVAC SYSTEM is a space-conditioning system or a ventilation system.

IES HB (See IES Lighting Handbook)

IES LIGHTING HANDBOOK is the Illuminating Engineering Society document titled “The IES Lighting Handbook: Reference and Applications, Tenth Edition” (2011).

IES LM-79-08 is the Illuminating Engineering Society document titled, “IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.’

IES TM-15-11 is the Illuminating Engineering Society document titled, “Luminaire” Classification Systems for Outdoor Luminaires

INFILTRATION is uncontrolled inward air leakage from outside a building or unconditioned space, including leakage through cracks and interstices, around windows and doors, and through any other exterior or demising partition or pipe or duct penetration. See AIR BARRIER.

INTEGRATED ENERGY EFFICIENCY RATIO (IEER) is a single-number cooling part load efficiency figure of merit calculated as specified by the method described in ANSI/AHRI Standard 340/360/1230 . This metric replaces the IPLV for ducted and non-ducted units.

INTEGRATED PART LOAD VALUE (IPLV) is a single-number cooling partload efficiency figure of merit calculated as specified by the method described in ANSI/AHRI Standard 550/590 for use with chillers.

ISO STANDARD 17025 is the International Organization for Standardization document titled "General Criteria for the Competence of Testing and Calibration Laboratories", 2005 (ANS/ISO/IEC Standard 17025:2005).

ISO 13256-1 is the International Organization for Standardization document titled "Water-source heat pumps -- Testing and rating for performance -- Part 1: Water-to-air and brine-to-air heat pumps," 1998.

ISO 13256-2 is the International Organization for Standardization document titled "Water-source heat pumps -- Testing and rating for performance -- Part 1: Water-to-water and brine-to-water heat pumps," 1998.

LANGELIER SATURATION INDEX (LSI) is expressed as the difference between the actual system pH and the saturation pH. LSI indicates whether water will precipitate, dissolve, or be in equilibrium with calcium carbonate, and is a function of hardness, alkalinity, conductivity, pH and temperature.

LARGEST NET CAPACITY INCREMENT is the largest increase in capacity when switching between combinations of base compressors that is expected to occur under the compressed air system control scheme.

LIGHTING definitions:

> **ACCENT LIGHTING** is directional lighting designed to highlight or spotlight objects. It can be recessed, surface mounted, or mounted to a pendant, stem, or track.
>
> **CHANDELIER** is a ceiling-mounted, close-to-ceiling, or suspended decorative luminaire that uses glass, crystal, ornamental metals, or other decorative material.
>
> **COLOR RENDERING INDEX (CRI)** is the ability of a light source to reflect the color of illuminated objects with fidelity relative to ideal or natural light sources of the same color temperature. CRI is calculated according to CIE 13.3

CORRELATED COLOR TEMPERATURE (CCT) is a description of color of light relative to the chromaticity of the radiative emission of heated black body and reported in temperature units of Kelvin according to CIE 15

COLORED LIGHT SOURCE is a light source designed and marketed as a colored light source and not designed or marketed for general lighting applications with either of the following characteristics maintained throughout all modes of operation including color changing operation:

(1) A Color Rendering Index (CRI) less than 40, as determined according to the method set forth in CIE Publication 13.3; or

(2) A Correlated Color Temperature less than 2,200 K or greater than 7,000 K as determined according to the method set forth in IES LM-66 or IES LM-79 as appropriate.

COMPACT FLUORESCENT LAMP is a fluorescent lamp less than nine inches maximum overall length with a T5 or smaller diameter glass tube that is folded, bent, or bridged.

DECORATIVE (LIGHTING/LUMINAIRE) is lighting or luminaires installed only for aesthetic purposes and that does not serve as display lighting or general lighting.

DISPLAY LIGHTING is lighting that provides a higher level of illuminance to a specific area than the level of surrounding ambient illuminance. Types of display lighting include:

FLOOR: supplementary lighting required to highlight features, such as merchandise on a clothing rack, which is not displayed against a wall.

WALL: supplementary lighting required to highlight features, such as merchandise on a shelf, which is displayed on perimeter walls.

WINDOW: lighting of objects such as merchandise, goods, and artifacts, in a show window, to be viewed from the outside of a space through a window.

CASE: lighting of small art objects, artifacts, or valuable collections which involves customer inspection of very fine detail from outside of a glass enclosed display case.

ENCLOSED LUMINAIRES are luminaires which contain enclosed lamp compartments where ventilation openings are less than 3 square inches per lamp in the lamp compartment as defined by UL 1598.

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

GU-24 is the designation of a lamp holder and socket configuration, based on a coding system by the International Energy Consortium, where "G" indicates the broad type of two or more projecting contacts, such as pins or posts, "U" distinguishes between lamp and holder designs of similar type but that are not interchangeable due to electrical or mechanical requirements, and "24" indicates 24 millimeters center to center spacing of the electrical contact posts.

ILLUMINANCE is the area density of the luminous flux incident at a point on a surface.

ILLUMINATION is light incident on a surface of body, or the general condition of being illuminated.

INSEPARABLE SOLID STATE LIGHTING (SSL) LUMINAIRE is a luminaire featuring solid state lighting components such as LEDs and driver components which cannot be easily removed or replaced by the end user, thus requiring replacement of the entire luminaire. Removal of solid state lighting components may require the cutting of wires, use of a soldering iron, or damage to or destruction of the luminaire.

INSTITUTIONAL TUNING is the process of adjusting the maximum light output of lighting systems to support visual needs or save energy. Institutional tuning differs from personal tuning in that the control strategy is implemented at the institutional rather than the individual user level, and maximum light level adjustments are available only to authorized personnel.

LAMP is an electrical appliance that produces optical radiation for the purpose of visual illumination, designed with a base to provide an electrical connection between the lamp and a luminaire, and designed to be installed into a luminaire by means of a lamp-holder integral to the luminaire.

LANDSCAPE LIGHTING is a type of outdoor lighting that is recessed into or mounted on the ground, paving, or raised deck, which is mounted less than 42 inches above grade or mounted onto trees or trellises, and that is intended to be aimed only at landscape features.

LANTERN is an outdoor luminaire that uses an electric lamp to replicate the appearance of a pre-electric lantern, which used a flame to generate light.

LIGHT is the luminous equivalent of power and is properly called luminous flux.

LIGHTING, or illumination, is the application of light to achieve some practical or aesthetic effect.

LIGHT EMITTING DIODE (LED) is a p-n junction solid state diode whose radiated output is a function of its physical construction, material used and exciting current. The output may be in the near ultraviolet, the visible or in the infrared regions of the spectrum.

LED LIGHT ENGINE is an integrated assembly comprised of LED packages, LED components, LED arrays, LED modules, or LED driver, and other optical, thermal, mechanical and electrical components. The device is intended to connect directly to the branch circuit through a custom connector compatible with the LED luminaire for which it was designed and does not use an ANSI standard base. (IES RP-16-10).

NON-INTEGRATED LED LAMP is an assembly comprised of an LED array (module) or LED packages (components) and ANSI standard base. The device is intended to connect to the LED driver of an LED luminaire through an ANSI standard lamp-holder (socket). The device cannot be connected to the branch circuit (ANSI/IES RP-16-10).

INTEGRATED LED LAMP is an integrated assembly comprised of LED packages (components) or LED arrays (modules), LED driver, ANSI standard base and other optical, thermal, mechanical and electrical components. The device is intended to connect directly to the branch circuit via a corresponding ANSI standard lamp-holder (socket) (ANSI/IES RP-16-10).

LOW VOLTAGE is less than 90 volts.

LUMEN MAINTENANCE is a strategy used to provide a precise, constant level of lighting from a lighting system regardless of the age of the lamps or the maintenance of the luminaires.

LUMINAIRE is a complete lighting unit consisting of a light source such as a lamp or lamps, together with the parts that distribute the light, position and protect the light source and connect it to the power supply.

LUMINANCE is the luminous intensity of the source or surface divided by the area of the source or surface seen by the observer.

LUMINOUS EFFICACY is a measure of the luminous efficiency of a light source. It is the quotient of the total luminous flux emitted by the total light source power input, expressed in lm/W.

LUMINOUS FLUX is visually evaluated radiant flux and defines “light” for purposes of lighting design and illuminating engineering.

MARQUEE LIGHTING is a permanent lighting system consisting of one or more rows of many small lamps, including light emitting diodes (LEDs) lamps, tungsten lamps, low pressure discharge lamps or fiber optic lighting, attached to a canopy.

ORNAMENTAL LIGHTING for compliance with Part 6 is the following:

> **LUMINAIRES** installed outdoor which are rated for 100 watts or less that are post-top luminaires, lanterns, pendant luminaires, chandeliers, and marquee lighting, not providing general lighting or task lighting.
>
> **DECORATIVE LUMINAIRES** installed indoor that are chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights, and light color panels, not providing general lighting or task lighting.

PENDANT (SUSPENDED) - A luminaire that is hung from a ceiling by supports.

PERMANENTLY INSTALLED LIGHTING consists of luminaires that are affixed to land, within the meaning of Civil Code Section 658 and 660, except as provided below. Permanently installed luminaires may be mounted inside or outside of a building or site. Permanently installed luminaires may have either plug-in or hardwired connections for electric power. Examples include track and flexible lighting systems; lighting attached to walls, ceilings, columns, inside or outside of permanently installed cabinets, internally illuminated cabinets, mounted on poles, in trees, or in the ground; attached to ceiling fans and integral to exhaust fans. Permanently installed lighting does not include portable lighting or lighting that is installed by the manufacturer in exhaust hoods for cooking equipment, refrigerated cases, food preparation equipment, and scientific and industrial equipment.

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

POST TOP LUMINAIRE is an outdoor luminaire that is mounted directly on top of a lamp-post.

PRECISION LIGHTING is task lighting for commercial or industrial work that illuminates low contrast, finely detailed, or fast moving objects.

RADIANT POWER is the time-rate-flow of radiant energy.

RADIANT ENERGY is energy travelling in the form of electromagnetic waves. It is measured in units of energy such as joules or kilowatt hours.

RECESSED LUMINAIRE is a luminaire that is mounted in the ceiling or behind a wall or other surface with the opening of the luminaire flush with the surface.

SCONCE is a wall mounted decorative accent luminaire.

SOURCE (LIGHT) is the general term used to reference a source of light. It can refer variously to an electric lamp, a light emitting diode (LED), an entire luminaire with lamp and optical control, or fenestration for daylighting.

SPECIAL EFFECTS LIGHTING is lighting installed to give off luminance instead of providing illuminance, which does not serve as general, task, or display lighting.

TASK LIGHTING is lighting that is not general lighting and that specifically illuminates a location where a task is performed.

TEMPORARY LIGHTING is a lighting installation, with plug-in connections, that does not persist beyond 60 consecutive days or more than 120 days per year.

TRACK LIGHTING is a system that includes luminaires and a track, rails, or cables that both mount the system, and deliver electric power. Track lighting includes the following types:

LINE-VOLTAGE TRACK LIGHTING is equipped with luminaires that, use line-voltage lamps or that are equipped with integral transformers at each luminaire.

LOW-VOLTAGE TRACK LIGHTING is equipped with remote transformers for use with low-voltage equipment along the entire length of track.

TRACK LIGHTING INTEGRAL CURRENT LIMITER consists of a current limiter integral to the end-feed housing of a manufactured line-voltage track lighting system.

TRACK LIGHTING SUPPLEMENTARY OVERCURRENT PROTECTION PANEL is a panelboard containing Supplementary Overcurrent Protection Devices as defined in Article 100 of the California Electrical Code, and used only with line voltage track lighting.

TRACK MOUNTED LUMINAIRES are luminaires designed to be attached at any point along a track lighting system. Track mounted luminaires may be line-voltage or low-voltage.

TUNING is the ability to set maximum light levels at a lower level than full lighting power.

LIGHTING CONTROLS consist of the following:

ASTRONOMICAL TIME-SWITCH CONTROL is an Automatic Time-Switch Control that controls lighting based on the time of day and astronomical events such as sunset and sunrise, accounting for geographic location and calendar date.

AUTOMATIC DAYLIGHT CONTROL uses one or more photosensors to detect changes in daylight illumination and then automatically adjusts the luminous flux of the electric lighting system in response.

AUTOMATIC MULTI-LEVEL DAYLIGHT CONTROL adjusts the luminous flux of the electric lighting system in either a series of steps or by continuous dimming in response to available daylight. This kind of control uses one or more photosensors to detect changes in daylight illumination and then automatically adjusts the electric lighting levels in response.

AUTOMATIC SCHEDULING CONTROL is a time-based lighting control device or system that is capable of being programmed to turn off outdoor luminaire power for a portion of the night and the day.

AUTOMATIC TIME SWITCH CONTROL controls lighting based on the time of day.

CAPTIVE-KEY OVERRIDE is a type of lighting control in which the key that activates the override cannot be released when the lights are in the on position.

COUNTDOWN TIMER SWITCH turns lighting or other loads ON when activated using one or more selectable count-down time periods and then automatically turns lighting or other loads OFF when the selected time period had elapsed.

DIMMER varies the luminous flux of the electric lighting system by changing the power delivered to that lighting system.

DIMMER, FULL-RANGE, or Continuous Dimmer, means a dimmer that varies the luminous flux of the electric lighting system over a continuous range from the device's maximum light output to the device's minimum light output without visually apparent abrupt changes in light level between the various steps.

DIMMER, STEPPED varies the luminous flux of the electric lighting system in one or more predetermined discrete steps between maximum light output and OFF with changes in light level between adjacent steps being visually apparent.

DIMMER, FORWARD PHASE CUT, varies the luminous flux of the electric lighting system in which a portion of the alternating current voltage waveform supplying to the light source is removed.

LIGHTING CONTROL, SELF CONTAINED is a unitary lighting control module that requires no additional components to be a fully functional lighting control.

LIGHTING CONTROL SYSTEM requires two or more components to be installed in the building to provide all of the functionality required to make up a fully functional and compliant lighting control.

MULTI-LEVEL ASTRONOMICAL TIME SWITCH is an Astronomical Time Switch Control that reduces lighting power in multiple steps.

MULTI-LEVEL LIGHTING CONTROL reduces power going to a lighting system in multiple steps.

MULTISCENE PROGRAMMABLE CONTROL allows for two or more pre-defined lighting settings, in addition to all-OFF, for two or more groups of luminaires to suit multiple activities in the space.

NEMA SSL 7A is the National Electrical Manufacturers Association document titled "Phase Cut Dimming for Solid State Lighting: Basic Compatibility," 2013. (NEMA SSL 7A-2013).

OCCUPANT SENSING CONTROLS automatically control levels of illumination, allow for manual operation, and consist of the following types:

MOTION SENSOR is used outdoors, automatically turns lights OFF after an area is vacated of occupants, and automatically turns the lights ON when the area is occupied.

OCCUPANT SENSOR is used indoors and automatically turns lights OFF after an area is vacated of occupants and is capable of automatically turning the lighting load ON when an area is occupied.

PARTIAL-ON OCCUPANT/MOTION SENSOR automatically turns lights OFF after an area is vacated of occupants and is capable of automatically or manually turning ON part of the lighting load when an area is occupied.

PARTIAL-OFF OCCUPANT/MOTION SENSOR automatically turns OFF part of the lighting load after an area is vacated of occupants and is capable of automatically turning ON the lighting load when an area is occupied.

VACANCY SENSOR automatically turns lights OFF after an area is vacated of occupants but requires lights to be turned ON manually.

PART-NIGHT OUTDOOR LIGHTING CONTROL is a light sensing and time-based lighting control device or system that is programmed to reduce or turn off the lighting power to an outdoor luminaire for a portion of the night.

PHOTO CONTROL automatically turns lights ON and OFF, or automatically adjusts lighting levels, in response to the amount of daylight that is available. A Photo Control may also be one component of a field assembled lighting system, the component having the capability to provide a signal proportional to the amount of daylight to a Lighting Control System to dim or brighten the electric lights in response.

SHUT-OFF CONTROLS is any lighting control capable of automatically shutting OFF the lighting in a space when the space is typically unoccupied.

LISTED is in accordance with Article 100 of the California Electrical Code.

LOW-GWP REFRIGERANT is a compound used as a heat transfer fluid or gas that is: (A) any compound or blend of compounds, with a GWP Value less than 150; and (B) U.S. EPA Significant New Alternatives Policy (SNAP)-approved; and (C) not an ozone depleting substance as defined in Title 40 of the Code of Federal Regulations, Part 82, §82.3 (as amended March 10, 2009).

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

R-2, multi-family, with three stories or less; or

R-3, single family; or

U-building, located on a residential site.

LPG is liquefied petroleum gas.

MAKEUP AIR is outdoor air that is intentionally conveyed by openings or ducts into the building from the outside; is supplied to the vicinity of an exhaust hood; and replaces air, vapor and contaminants being exhausted by the exhaust hood. Makeup air is generally filtered and fan-forced, and it may be heated or cooled. Makeup air may be delivered through openings or ducts integral to the exhaust hood.

MANUAL is capable of being operated by personal intervention.

MANUFACTURED DEVICE is any heating, cooling, ventilation, lighting, water heating, refrigeration, cooking, plumbing fitting, insulation, door, fenestration product, or any other appliance, device, equipment, or system subject to Sections 110.0 through 110.9 of Part 6.

MANUFACTURED or KNOCKED DOWN PRODUCT is a fenestration product constructed of materials that are factory cut or otherwise factory formed with the specific intention of being used to fabricate a fenestration product. Knocked down or partially assembled products may be sold as a fenestration product when provided with temporary and permanent labels as described in Section 10-111, or as a site-built fenestration product when not provided with temporary and permanent labels as described in Section 10-111.

MECHANICAL COOLING is lowering the temperature within a space using refrigerant compressors or absorbers, desiccant dehumidifiers, or other systems that require energy from depletable sources to directly condition the space. In nonresidential, high-rise residential, and hotel/motel buildings, cooling of a space by direct or indirect evaporation of water alone is not considered mechanical cooling.

MECHANICAL HEATING is raising the temperature within a space using electric resistance heaters, fossil fuel burners, heat pumps, or other systems that require energy from depletable sources to directly condition the space.

MERV is the minimum efficiency reporting value as determined by ASHRAE Standard 52.2 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

METAL BUILDING is a complete integrated set of mutually dependent components and assemblies that form a building, which consists of a steel-framed superstructure and metal skin. This does not include structural glass or metal panels such as in a curtainwall system.

MICROCHANNEL CONDENSER is an air-cooled condenser for refrigeration systems which utilizes multiple small parallel gas flow passages in a flat configuration with fin surfaces bonded between the parallel gas passages.

MINISPLIT AIR CONDITIONERS AND HEAT PUMPS are air conditioner or heat pump systems that have a single outdoor section and one or more indoor sections. The indoor sections cycle on and off in unison in response to a single indoor thermostat.

MODELING ASSUMPTIONS are the conditions (such as weather conditions, thermostat settings and schedules, internal gain schedules, etc.) that are used for calculating a building's annual energy consumption as specified in the Alternative Calculation Methods (ACM) Approval Manuals.

MULTIPLE-SPLIT AIR CONDITIONERS AND HEAT PUMPS are air conditioner or heat pump systems that have two or more indoor sections. The indoor sections operate independently and can be used to condition multiple zones in response to multiple indoor thermostats.

MULTIPLE ZONE SYSTEM is an air distribution system that supplies air to more than one Space Conditioning Zone, each of which has one or more devices (such as dampers, cooling coils, and heating coils) that regulate airflow, cooling, or heating capacity to the zone.

NET EXHAUST FLOW RATE is the exhaust flow rate for a hood, minus any internal discharge makeup air flow rate.

NEWLY CONDITIONED SPACE is any space being converted from unconditioned to directly conditioned or indirectly conditioned space. Newly conditioned space must comply with the requirements for an addition. See Section 141.0 for nonresidential occupancies and Section 150.2 for residential occupancies.

NEWLY CONSTRUCTED BUILDING is a building that has never been used or occupied for any purpose.

NONDUCTED SYSTEM is an air conditioner or heat pump that: is permanently installed; directly heats or cools air within the conditioned space; and uses one or more indoor coils that are mounted on walls or ceilings within the conditioned space. The system may be of a modular design that allows for combining multiple outdoor coils and compressors to create one unified system.

NFRC 100 is the National Fenestration Rating Council document titled "NFRC 100: Procedure for Determining Fenestration Product U-factors." (2011; NFRC 100 includes procedures for site fenestration formerly included in a separate document, NFRC 100-SB).

NFRC 200 is the National Fenestration Rating Council document titled "NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence." (2011).

NFRC 202 is the National Fenestration Rating Council document titled "NFRC 202: Procedures for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence." (2011).

NFRC 203 is the National Fenestration Rating Council document titled "NFRC 203: Procedure for Determining Visible Transmittance of Tubular Daylighting Devices." (2012).

NFRC 400 is the National Fenestration Rating Council document titled "NFRC 400: Procedure for Determining Fenestration Product Air Leakage." (2010).

NONRESIDENTIAL BUILDING is any building which is identified in the California Building Code Table; Description of Occupancy as Group A, B, E, F, H, M, or S; and is a U; as defined by Part 2 of Title24 of the California Code or Regulation.
NOTE: Requirements for high-rise residential buildings and hotels/motels are included in the nonresidential sections of Part 6.

NONRESIDENTIAL BUILDING OCCUPANCY TYPES are building types in which a minimum of 90 percent of the building floor area functions as one of the following, which do not qualify as any other Building Occupancy Types more specifically defined in Section 100.1, and which do not have a combined total of more than 10 percent of the area functioning of any Nonresidential Function Areas specifically defined in Section 100.1:

> **AUDITORIUM BUILDING** is a public building in which a minimum of 90 percent of the building floor area are rooms with fixed seating that are primarily used for public meetings or gatherings.
>
> **CLASSROOM BUILDING** is a building for an educational institution in which a minimum of 90 percent of the building floor area are classrooms or educational laboratories.
>
> **COMMERCIAL AND INDUSTRIAL STORAGE BUILDING** is a building for which a minimum or 90 percent of the building floor area is used for storing items.
>
> **CONVENTION CENTER BUILDING** is a building in which a minimum of 90 percent of the building floor area are rooms for meetings and conventions, which have neither fixed seating nor fixed staging.

FINANCIAL INSTITUTION BUILDING is a building in which a minimum of 90 percent of the building floor area are rooms used for an institution which collects funds from the public and places them in financial assets, such as deposits, loans, and bonds.

GENERAL COMMERCIAL AND INDUSTRIAL WORK BUILDING is a building in which a minimum of 90 percent of the building floor area are rooms for performing a craft, assembly or manufacturing operation.

GROCERY STORE BUILDING is a building in which a minimum of 90 percent of the building floor area is sales floor for the sale of foodstuffs.

LIBRARY BUILDING is a building in which a minimum of 90 percent of the building floor area are rooms use as a repository of literary materials, kept for reading or reference such as books, periodicals, newspapers, pamphlets and prints.

MEDICAL BUILDINGS AND CLINIC BUILDINGS are non "I" occupancy buildings in which a minimum of 90 percent of the building floor area are rooms where medical or clinical care is provided, does not provide overnight patient care, and is used to provide physical and mental care through medical, dental, or psychological examination and treatment.

OFFICE BUILDING is a building of CBC Group B Occupancy in which a minimum of 90 percent of the building floor area are rooms in which business, clerical or professional activities are conducted.

PARKING GARAGE BUILDING is a building in which a minimum of 90 percent of the building floor area is for the purpose of parking vehicles, which consists of at least a roof over the parking area enclosed with walls on all sides. The building includes areas for vehicle maneuvering to reach designated parking spaces. If the roof of a parking structure is also used for parking, the section without an overhead roof is considered an outdoor parking lot instead of a parking garage.

RELIGIOUS FACILITY BUILDING is a building in which a minimum of 90 percent of the floor area in the building floor area are rooms for assembly of people to worship.

RESTAURANT BUILDING is a building in which a minimum of 90 percent of the building floor area are rooms in which food and drink are prepared and served to customers in return for money.

SCHOOL BUILDING is a building in which a minimum of 90 percent of the building floor area is used for an educational institution, but in which less than 90 percent of the building floor area is classrooms or educational laboratories, and may include an auditorium, gymnasium, kitchen, library, multi-purpose room, cafeteria, student union, or workroom. A maintenance or storage building is not a school building.

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

NONRESIDENTIAL COMPLIANCE MANUAL is the manual developed by the Commission, under Section 25402.1(e) of the Public Resources Code, to aid designers, builders, and contractors in meeting the energy efficiency requirements for nonresidential, high-rise residential, and hotel/motel buildings.

NONRESIDENTIAL FUNCTION AREAS are those areas, rooms, and spaces within Nonresidential Buildings which fall within the following particular definitions, and are defined according to the most specific definition:

AISLE WAY is the passage or walkway between storage racks permanently anchored to the floor in a Commercial or Industrial Storage Building, where the racks are used to store materials such as goods and merchandise.

ATRIUM is a large-volume indoor space created by openings between two or more stories but is not used for an enclosed stairway, elevator hoistway, escalator opening, or utility shaft for plumbing, electrical, air-conditioning or other equipment.

AUDITORIUM ROOM is a room with fixed seats used for public meetings or gatherings.

AUTO REPAIR BAY is a room or area used to repair automotive equipment and/or vehicles.

BEAUTY SALON is a room or area in which the primary activity is manicures, pedicures, facials, or the cutting or styling of hair.

CIVIC MEETING PLACE is a space in a government building designed or used for public debate, discussion, or public meetings of governmental bodies.

CLASSROOM, LECTURE, TRAINING, VOCATIONAL ROOM is a room or area where an audience or class receives instruction.

COMMERCIAL AND INDUSTRIAL STORAGE AREA is a room or area used for storing of items such as goods and merchandise.

COMMERCIAL AND INDUSTRIAL STORAGE AREA (REFRIGERATED) is a room or area used for storing items where mechanical refrigeration is used to maintain the space temperature at 55° F or less.

CONVENTION, CONFERENCE, AND MEETING CENTERS are rooms or areas that are designed or used for meetings, conventions or events, and that have neither fixed seating nor fixed staging.

CORRIDOR is a passageway or route into which compartments or rooms open.

DINING is a room or area where meals that are served to the customers will be consumed.

ELECTRICAL/MECHANICAL/TELEPHONE ROOM is a room in which the building's electrical switchbox or control panels, telephone switchbox, and/or HVAC controls or equipment is located.

EXERCISE CENTER OR GYMNASIUM is a room or area equipped for gymnastics, exercise equipment, or indoor athletic activities.

EXHIBIT, MUSEUM AREA is a room or area in a museum that has for its primary purpose exhibitions, having neither fixed seating nor fixed staging. An exhibit does not include a gallery or other place where art is for sale. An exhibit does not include a lobby, conference room, or other occupancies where the primary function is not exhibitions.

FINANCIAL TRANSACTION AREA is a room or area used by an institution which collects funds from the public and places them in financial assets, such as deposits, loans and bonds, and includes tellers, work stations, and customers' waiting areas; to complete financial transactions. Financial transaction areas do not include private offices, hallways, restrooms, or other support areas.

GENERAL COMMERCIAL AND INDUSTRIAL WORK AREA is a room or area in which an art, craft, assembly or manufacturing operation is performed. Lighting installed in these areas is classified as follows:

> **HIGH BAY**: Where the luminaires are 25 feet or more above the floor.
>
> **LOW BAY**: Where the luminaires are less than 25 feet above the floor.
>
> **PRECISION**: Where visual tasks of small size or fine detail such as electronics assembly, fine woodworking, metal lathe operation, fine hand painting and finishing, egg processing operations, or tasks of similar visual difficulty are performed.

GROCERY SALES AREA is a room or area that has as its primary purpose the sale of foodstuffs requiring additional preparation prior to consumption.

HOTEL FUNCTION AREA is a hotel room or area such as a hotel ballroom, meeting room, exhibit hall or conference room, together with pre-function areas and other spaces ancillary to its function.

KITCHEN/FOOD PREPARATION is a room or area with cooking facilities or an area where food is prepared.

LABORATORY, SCIENTIFIC is a room or area where research, experiments, and measurement in medical and physical sciences are performed requiring examination of fine details. The area may include workbenches, countertops, scientific instruments, and associated floor spaces. Scientific laboratory does not refer to film, computer, and other laboratories where scientific experiments are not performed.

LAUNDRY is a room or area primarily designed or used for laundering activities.

LIBRARY AREA is a room or area primarily designed or used as a repository for literary materials, such as books, periodicals, newspapers, pamphlets and prints, kept for reading or reference.

> **READING AREA** is a room or area in a library containing tables, chairs, or desks for patrons to use for the purpose of reading books and other reference documents. Library reading areas include reading, circulation,

and checkout areas. Reading areas do not include private offices, meeting, photocopy, or other rooms not used specifically for reading by library patrons.

STACK AREA is a room or area in a library with grouping of shelving sections. Stack aisles include pedestrian paths located in stack areas.

LOBBY, HOTEL is the contiguous area in a hotel/motel between the main entrance and the front desk, including reception, waiting and seating areas.

MAIN ENTRY is the contiguous area in buildings other than hotel/motel that is directly located by the main entrance of the building through which persons must pass, including any ancillary reception, waiting and seating areas.

LOCKER OR DRESSING ROOM is a room or area for changing clothing, sometimes equipped with lockers.

LOUNGE is a room or area in a public place such as a hotel, airport, club, or bar, designated for people to sit, wait and relax.

MALL is a roofed or covered common pedestrian area within a mall building that serves as access for two or more tenants.

MEDICAL AND CLINICAL CARE AREA is a non "I" occupancy room or area in a building that does not provide overnight patient care and that is used to provide physical and mental care through medical, dental, or psychological examination and treatment, including, but not limited to, laboratories and treatment spaces.

MUSEUM is a room or area in which the primary function is the care or exhibit of works of artistic, historical, or scientific value. A museum does not include a gallery or other place where art is for sale. A museum does not include a lobby, conference room, or other occupancies where the primary function is not the care or exhibit of works of artistic, historical, or scientific value.

OFFICE AREA is a room, area in a building of CBC Group B Occupancy in which business, clerical or professional activities are conducted.

OPEN AREA is a warehouse facility term describing a large unobstructed area that is typically used for the handling and temporary storage of goods.

PARKING GARAGE AREAS include the following:

PARKING AREAS are the areas of a Parking Garage used for the purpose of parking and maneuvering of vehicles on a single floor. Parking areas include sloping floors of a parking garage. Parking areas do not include Daylight Transition Zones, Dedicated Ramps, or the roof of a Parking Garage, which may be present in a Parking Garage.

DAYLIGHT TRANSITION ZONE in a Parking Garage is the interior path of travel for vehicles to enter a parking garage as needed to transition from exterior daylight levels to interior light levels. Daylight Transition Zones only include the path of vehicular travel and do not include adjacent Parking Areas.

DEDICATED RAMPS in Parking Garages are driveways specifically for the purpose of moving vehicles between floors of a parking garage and which have no adjacent parking. Dedicated ramps do not include sloping floors of a parking structure, which are considered Parking Areas.

RELIGIOUS WORSHIP AREA is a room or area in which the primary function is for an assembly of people to worship. Religious worship does not include classrooms, offices, or other areas in which the primary function is not for an assembly of people to worship.

RESTROOM is a room providing personal facilities such as toilets and washbasins.

RETAIL MERCHANDISE SALES AREA is a room or area in which the primary activity is the sale of merchandise.

SERVER ROOM is a room smaller than 500 square feet, within a larger building, in which networking equipment and Information Technology (IT) server equipment is housed, and a minimum of five IT severs are installed in frame racks.

SERVER AISLE is an aisle of racks of Information Technology (IT) server equipment in a Server Room. While networking equipment may also be housed on these racks, it is largely a room to manage server equipment.

STAIRS is a series of steps providing passage for persons from one level of a building to another, including escalators.

STAIRWELL is a vertical shaft in which stairs are located.

SUPPORT AREA is a room or area used as a passageway, utility room, storage space, or other type of space associated with or secondary to the function of an occupancy that is listed in these regulations.

TENANT LEASE AREA is a room or area in a building intended for lease for which a specific tenant is not identified at the time of building permit application.

THEATER AREAS include the following:

MOTION PICTURE THEATER is an assembly room or area with tiers of rising seats or steps for the showing of motion pictures.

PERFORMANCE THEATER is an assembly room or area with tiers of rising seats or steps for the viewing of dramatic performances, lectures, musical events and similar live performances.

TRANSPORTATION FUNCTION AREA is the ticketing area, waiting area, baggage handling areas, concourse, in an airport terminal, bus or rail terminal or station, subway or transit station, or a marine terminal.

VIDEOCONFERENCING STUDIO is a room with permanently installed videoconferencing cameras, audio equipment, and playback equipment for both audio-based and video-based two-way communication between local and remote sites.

VOCATIONAL AREA is a room or area used to provide training in a special skill to be pursued as a trade.

WAITING AREA is an area other than a hotel lobby or main entry lobby normally provided with seating and used for people waiting.

WHOLESALE SHOWROOM is a room or area where samples of merchandise are displayed.

NONSTANDARD PART LOAD VALUE (NPLV) is a single- number part-load efficiency figure of merit for chillers referenced to conditions other than IPLV conditions. (See "integrated part load value.")

NORTH-FACING (See "orientation.")

OCCUPIABLE SPACE is any enclosed space inside the pressure boundary and intended for human activities, including, but not limited to, all habitable spaces, toilets, closets, halls, storage and utility areas, and laundry areas.

ONLINE CAPACITY is the total combined capacity in actual cubic feet per minute of compressed air at a given pressure from all online compressors.

ONLINE COMPRESSORS are all the compressors that are physically connected to compressed air piping and are available to serve peak load. Online compressors do not include back up compressors whose only purpose is to be available when an online compressor fails.

OPEN COOLING TOWER is an open, or direct contact, cooling tower which exposes water directly to the cooling atmosphere, thereby transferring the source heat load from the water directly to the air by a combination of heat and mass transfer.

OPERABLE FENESTRATION is designed to be opened or closed.

OPTIMUM START CONTROLS are controls that are designed to automatically adjust the start time of a space conditioning system each day with the intent of bringing the space to desired occupied temperature levels at the beginning of scheduled occupancy.

OPTIMUM STOP CONROLS are controls that are designed to setup or setback thermostat setpoints before scheduled unoccupied periods based upon the thermal lag and acceptable drift in space temperature that is within comfort limits.

ORIENTATION, CARDINAL is one of the four principal directional indicators, north, east, south, and west, which are marked on a compass, also called cardinal directions.

ORIENTATION, EAST-FACING is oriented to within 45 degrees of true east, including 45°00'00" south of east (SE), but excluding 45°00'00" north of east (NE).

ORIENTATION, NORTH-FACING is oriented to within 45 degrees of true north, including 45°00'00" east of north (NE), but excluding 45°00'00' west of north (NW).

ORIENTATION, SOUTH-FACING is oriented to within 45 degrees of true south including 45°00'00" west of south (SW), but excluding 45°00'00" east of south (SE).

ORIENTATION, WEST-FACING is oriented to within 45 degrees of true west, including 45°00'00" north of due west (NW), but excluding 45°00'00" south of west (SW).

OUTDOOR AIR (Outside air) is air taken from outdoors and not previously circulated in the building.

OUTDOOR LIGHTING is electrical lighting used to illuminate outdoor areas.

OUTDOOR AREAS are areas external to a building. These include but are not limited to the following areas:

BUILDING ENTRANCE WAY is the external area of any operable doorway in or out of a building, including overhead doors. These areas serve any doorway, set of doors (including elevator doors such as in parking garages), turnstile, vestibule, or other form of portal that is ordinarily used to gain access to the building by its users and occupants. Where buildings have separate one-way doors to enter and to leave, this also includes any area serving any doors ordinarily used to leave the building.

BUILDING FAÇADE is the exterior surfaces of a building, not including horizontal roofing, signs, and surfaces not visible from any public accessible viewing location.

CANOPY is a permanent structure, other than a parking garage area, consisting of a roof and supporting building elements, with the area beneath at least partially open to the elements. A canopy may be freestanding or attached to surrounding structures. A canopy roof may serve as the floor of a structure above.

CARPORT is a covered, open-sided structure designed or used primarily for the purpose of parking vehicles, having a roof over the parking area. Typically, carports are free-standing or projected from the side of the building and are only two or fewer car lengths deep. A Carport is not a Garage.

HARDSCAPE is the area of an improvement to a site that is paved or has other structural features such as curbs, plazas, entries, parking lots, site roadways, driveways, walkways, sidewalks, bikeways, water features and pools, storage or service yards, loading docks, amphitheaters, outdoor sales lots, and private monuments and statuary.

OUTDOOR SALES FRONTAGE is the portion of the perimeter of an outdoor sales area immediately adjacent to a public street, road, or sidewalk.

OUTDOOR SALES LOT is an uncovered paved area used exclusively for the display of vehicles, equipment or other merchandise for sale. All internal and adjacent access drives, walkway areas, employee and customer parking areas, vehicle service or storage areas are not outdoor sales lot areas, but are considered hardscape.

PARKING LOT is an uncovered area for the purpose of parking vehicles. Parking lot is a type of hardscape.

PAVED AREA is an area that is paved with concrete, asphalt, stone, brick, gravel, or other improved wearing surface, including the curb.

PRINCIPAL VIEWING LOCATION is anywhere along the adjacent highway, street, road or sidewalk running parallel to an outdoor sales frontage.

PUBLIC MONUMENTS are statuary, buildings, structures, and/or hardscape on public land.

OUTDOOR SALES CANOPY is a canopy specifically to cover and protect an outdoor sales area.

STAIRWAYS AND RAMPS. Stairways are one or more flights of stairs with the necessary landings and platforms connecting them to form a continuous and uninterrupted passage from one level to another. An exterior stairway is open on at least one side, except for required structural columns, beams, handrails and guards. The adjoining open areas shall be either yards, courts or public ways. The other sides of the exterior stairway need not be open. Ramps are walking surfaces with a slope steeper than 5 percent.

VEHICLE SERVICE STATION is a gasoline, natural gas, diesel, or other fuel dispensing station.

OUTDOOR LIGHTING ZONE is a geographic area designated by the California Energy Commission in accordance with Part 1, Section 10-114, that determines requirements for outdoor lighting, including lighting power densities and specific control, equipment or performance requirements. Lighting zones are numbered LZ0, LZ1, LZ2, LZ3 and LZ4.

OVERHANG is a contiguous opaque surface, oriented horizontally and projecting outward horizontally from an exterior vertical surface.

OVERHANG OFFSET is the vertical distance from the edge of exposed exterior glazing at the head of a window to the overhang.

OVERHANG PROJECTION is the horizontal distance, measured outward horizontally from the surface of exposed exterior glazing at the head of a window to the outward edge of an overhang.

PART 1 means Part 1 of Title 24 of the California Code of Regulations.

PART 6 means Part 6 of Title 24 of the California Code of Regulations.

PART LOAD OPERATION occurs when a system or device is operating below its maximum rated capacity.

PARTICLE SIZE EFFICIENCY is the fraction (percentage) of particles that are captured on air filter equipment as determined during rating tests conducted in accordance with ASHRAE Standard 52.2 or AHRI Standard 680. Particle Size Efficiency is measured in three particle size ranges: 0.3-1.0, 1.0-3.0, 3.0-10 microns.

POOLS, ANSI/NSPI-5 is the American National Standards Institute and National Spa and Pool Institute document titled “American National Standard for Residential Inground Swimming Pools” 2003 (ANSI/NSPI-5 2003).

POOLS, AUXILIARY POOL LOADS are features or devices that circulate pool water in addition to that required for pool filtration, including, but not limited to, solar pool heating systems, filter backwashing, pool cleaners, waterfalls, fountains, and spas.

POOLS, BACKWASH VALVE is a diverter valve designed to backwash filters located between the circulation pump and the filter, including, but not limited to, slide, push-pull, multi-port, and full-flow valves.

POOLS, MULTISPEED PUMP is a pump capable of operating at two or more speeds and includes two-speed and variable-speed pumps.

POOLS, NSF/ANSI 50 is the NSF International (formerly National Sanitation Foundation) Standard and American National Standards Institute document titled “Circulation System Components and Related Materials for Swimming Pools, Spas/Hot Tubs” 2005 (NSF/ANSI 50 – 2005).

POOLS, RESIDENTIAL are permanently installed residential in-ground swimming pools intended for use by a single-family home for noncommercial purposes and with dimensions as defined in ANSI/NSPI-5.

PRESSURE BOUNDARY is the primary air enclosure boundary separating indoor and outdoor air. For example, a volume that has more leakage to the outside than to the conditioned space would be considered outside the pressure boundary. Exposed earth in a crawlspace or basement shall not be considered part of the pressure boundary.

PRIMARY AIRFLOW is the airflow (cfm or L/s) supplied to the zone from the air-handling unit at which the outdoor air intake is located. It includes outdoor intake air and recirculated air from that air-handling unit but does not include air transferred or air recirculated to the zone by other means.

PRIMARY STORAGE is compressed air storage located upstream of the distribution system and any pressure flow regulators.

PROCESS is an activity or treatment that is not related to the space conditioning, lighting, service water heating, or ventilating of a building as it relates to human occupancy.

PROCESS BOILER is a type of boiler with a capacity (rated maximum input) of 300,000 Btus per hour (Btu/h) or more that serves a process.

PROCESS, COVERED are processes that are regulated under Part 6, serving computer rooms, data centers, elevators, escalators and moving walkways, laboratories, enclosed parking garages, commercial kitchens, refrigerated warehouses, commercial refrigeration, compressed air systems, and process boilers.

PROCESS, EXEMPT is a process that is not a covered process.

PROCESS LOAD is a load resulting from a process.

PROCESS LOAD, COVERED the energy consumption of and/or the heat generated by a piece of equipment or device that is part of a covered process.

PROCESS LOAD, EXEMPT is the energy consumption of and/or the heat generated by a piece of equipment or device that is part of an exempt process.

PROCESS SPACE is a space that is thermostatically controlled to maintain a process environment temperature less than 55º F or to maintain a process environment temperature greater than 90º F for the whole space that the system serves, or that is a space with a space-conditioning system designed and controlled to be incapable of operating at temperatures above 55º F or incapable of operating at temperatures below 90º F at design conditions.

PROPOSED DESIGN BUILDING ENERGY USE is the predicted energy use of proposed building derived from application of the building energy use modeling rules described in the Alternative Calculation Method (ACM) Approval Manual.

PUBLIC AREAS are spaces generally open to the public at large, customers or congregation members, or similar spaces where occupants need to be prevented from controlling lights for safety, security, or business reasons.

R-VALUE is the measure of the thermal resistance of insulation or any material or building component expressed in ft^2-hr-^oF/Btu.

RADIANT BARRIER is a highly reflective, low emitting material installed at the underside surface of the roof deck and the inside surface of gable ends or other exterior vertical surfaces in attics to reduce solar heat gain.

RAISED FLOOR is a floor (partition) over a crawl space, or an unconditioned space, or ambient air.

READILY ACCESSIBLE is capable of being reached quickly for operation, repair or inspection, without requiring climbing or removing obstacles, or resorting to access equipment.

RECOOL is the cooling of air that has been previously heated by space-conditioning equipment or systems serving the same building.

RECOVERED ENERGY is energy used in a building that (1) is recovered from space conditioning, service water heating, lighting, or process equipment after the energy has performed its original function; (2) provides space conditioning, service water heating, or lighting; and (3) would otherwise be wasted.

REFERENCE APPENDICES is the support document for the Building Energy Efficiency Standards and the ACM Approval Manuals. The document consists of three sections: the Reference Joint Appendices (JA), the Reference Residential Appendices (RA), and the Reference Nonresidential Appendices (NA).

REFLECTANCE, SOLAR is the ratio of the reflected solar flux to the incident solar flux.

REFRIGERATED CASE is a manufactured commercial refrigerator or freezer, including but not limited to display cases, reach-in cabinets, meat cases, and frozen food and soda fountain units.

REFRIGERATED SPACE is a space constructed for storage or handling of products, where mechanical refrigeration is used to maintain the space temperature at 55° F or less.

REFRIGERATED WAREHOUSE is a building or a space greater than or equal to 3,000 square feet constructed for storage or handling of products, where mechanical refrigeration is used to maintain the space temperature at 55° F or less.

REHEAT is the heating of air that has been previously cooled by cooling equipment or supplied by an economizer.

RELOCATABLE PUBLIC SCHOOL BUILDING is a relocatable building as defined by Title 24, Part 1, Section 4-314, which is subject to Title 24, Part 1, Chapter 4, Group 1.

REPAIR is the reconstruction or renewal for the purpose of maintenance of any component, system, or equipment of an existing building. Repairs shall not increase the preexisting energy consumption of the repaired component, system, or equipment. Replacement of any component, system, or equipment for which there are requirements in the Standards is considered an alteration and not a repair.

REPLACEMENT AIR is air that is used to replace air removed from a building through an exhaust system. Replacement air may be derived from one or more of the following: makeup air, portions of supply air, transfer air, or infiltration air.

SUPPLY AIR is air entering a space from an air-conditioning, heating, or ventilating system for the purpose of comfort conditioning. Supply air is generally filtered, fan-forced, and heated, cooled, humidified or dehumidified as necessary to maintain specified temperature and humidity conditions.

TRANSFER AIR is air transferred, whether actively by fans or passively by pressure differentials, from one room to another within a building through openings in the room envelope.

INFILTRATION AIR is outdoor air that enters a building or space through openings in the building or space envelope due to negative pressure in the space or building relative to the exterior of the building envelope.

RESIDENTIAL BUILDING (See "high-rise residential building" and "low-rise residential building.")

RESIDENTIAL COMPLIANCE MANUAL is the manual developed by the Commission, under Section 25402.1 of the Public Resources Code, to aid designers, builders, and contractors in meeting Energy Efficiency Standards for low-rise residential buildings.

RESIDENTIAL SPACE TYPE is one of the following:

> **BATHROOM** is a room or area containing a sink used for personal hygiene, toilet, shower, or a tub.
>
> **CLOSET** is a nonhabitable room used for the storage of linens, household supplies, clothing, non-perishable food, or similar uses, and which is not a hallway or passageway.
>
> **GARAGE** is a nonhabitable building or portion of building, attached to or detached from a residential dwelling unit, in which motor vehicles are parked.
>
> **KITCHEN** is a room or area used for cooking, food storage and preparation and washing dishes, including associated counter tops and cabinets, refrigerator, stove, ovens, and floor area.
>
> **LAUNDRY** is a nonhabitable room or space which contains plumbing and electrical connections for a washing machine or clothes dryer.
>
> **STORAGE BUILDING** is a nonhabitable detached building used for the storage of tools, garden equipment, or miscellaneous items.
>
> **UTILITY ROOM** is a nonhabitable room or building which contains only HVAC, plumbing, or electrical controls or equipment; and which is not a bathroom, closet, garage, or laundry room.

ROOF is the outside cover of a building or structure including the structural supports, decking, and top layer that is exposed to the outside with a slope less than 60 degrees from the horizontal.

ROOF, LOW-SLOPED is a roof that has a ratio of rise to run of 2:12 or less (9.5 degrees from the horizontal).

ROOF, STEEP-SLOPED is a roof that has a ratio of rise to run of greater than 2:12 (9.5 degrees from the horizontal).

ROOFING PRODUCT is the top layer of the roof that is exposed to the outside, which has properties including but not limited to solar reflectance, thermal emittance, and mass.

ROOF RECOVER BOARD is a rigid type board, installed directly below a low-sloped roof membrane, with or without above deck thermal insulation, to: (a) improve a roof system's compressive strength, (b) physically separate the roof membrane from the thermal insulation, or (c) physically separate a new roof covering from an underlying roof membrane as part of a roof overlay project.

RUNOUT is piping that is no more than 12 feet long and connects to a fixture or an individual terminal unit.

SATURATED CONDENSING TEMPERATURE (also known as CONDENSING TEMPERATURE) is: (a) for single component and azeotropic refrigerants, the saturation temperature corresponding to the refrigerant pressure at the condenser entrance, or (b) for zeotropic refrigerants, the arithmetic average of the Dew Point and Bubble Point temperatures corresponding to the refrigerant pressure at the condenser entrance.

SCIENTIFIC EQUIPMENT is measurement, testing or metering equipment used for scientific research or investigation, including but not limited to manufactured cabinets, carts and racks.

SEASONAL ENERGY EFFICIENCY RATIO (SEER) is the total cooling output of an air conditioner in Btu during its normal usage period for cooling divided by the total electrical energy input in watt-hours during the same period, as determined using the applicable test method in the Appliance Efficiency Regulations.

SERVICE WATER HEATING is heating of water for sanitary purposes for human occupancy, other than for comfort heating.

SHADING is the protection from heat gains because of direct solar radiation by permanently attached exterior devices or building elements, interior shading devices, glazing material, or adherent materials.

SHADING COEFFICIENT (SC) is the ratio of the solar heat gain through a fenestration product to the solar heat gain through an unshaded 1/8-inch-thick clear double strength glass under the same set of conditions. For nonresidential, high-rise residential, and hotel/motel buildings, this shall exclude the effects of mullions, frames, sashes, and interior and exterior shading devices.

SIGN definitions include the following:

ELECTRONIC MESSAGE CENTER (EMC) is a pixilated image producing electronically controlled sign formed by any light source. Bare lamps used to create linear lighting animation sequences through the use of chaser circuits, also known as "chaser lights" are not considered an EMC.

ILLUMINATED FACE is a side of a sign that has the message on it. For an exit sign it is the side that has the word "EXIT" on it.

SIGN, CABINET is an internally illuminated sign consisting of frame and face, with a continuous translucent message panel, also referred to as a panel sign.

SIGN, CHANNEL LETTER is an internally illuminated sign with multiple components, each built in the shape of an individual three dimensional letters or symbol that are each independently illuminated, with a separate translucent panel over the light source for each element.

SIGN, DOUBLE-FACED is a sign with two parallel opposing faces.

SIGN, EXTERNALLY ILLUMINATED is any sign or a billboard that is lit by a light source that is external to the sign directed towards and shining on the face of the sign.

SIGN, INTERNALLY ILLUMINATED is a sign that is illuminated by a light source that is contained inside the sign where the message area is luminous, including cabinet signs and channel letter signs.

SIGN, TRAFFIC is a sign for traffic direction, warning, and roadway identification.

SIGN, UNFILTERED is a sign where the viewer perceives the light source directly as the message, without any colored filter between the viewer and the light source, including neon, cold cathode, and LED signs.

SINGLE FAMILY RESIDENCE is a building that is of Occupancy Group R-3.

SINGLE PACKAGE VERTICAL AIR CONDITIONER (SPVAC): Is a type of air-cooled small or large commercial package air-conditioning and heating equipment; factory assembled as a single package having its major components arranged vertically, which is an encased combination of cooling and optional heating components; is intended for exterior mounting on, adjacent interior to, or through an outside wall; and is powered by single or three-phase current. It may contain separate indoor grille, outdoor louvers, various ventilation options, indoor free air discharge, ductwork, wall plenum, or sleeve. Heating components may include electrical resistance, steam, hot water, gas, or no heat but may not include reverse cycle refrigeration as a heating means.

SINGLE PACKAGE VERTICAL HEAT PUMP (SPVHP): Is an SPVAC that utilizes reverse cycle refrigeration as its primary heat source, with secondary supplemental heating by means of electrical resistance, steam, hot water, or gas.

SINGLE ZONE SYSTEM is an air distribution system that supplies air to one thermal zone.

SITE-BUILT is fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing units that are manufactured with the intention of being assembled at the construction site. These include storefront systems, curtain walls and atrium roof systems.

SITE SOLAR ENERGY is thermal, chemical, or electrical energy derived from direct conversion of incident solar radiation at the building site.

SKYLIGHT is fenestration installed on a roof less than 60 degrees from the horizontal.

SKYLIGHT AREA is the area of the rough opening for the skylight.

SKYLIGHT TYPE is one of the following three types of skylights: glass mounted on a curb, glass not mounted on a curb or plastic (assumed to be mounted on a curb).

SMACNA is the Sheet Metal and Air-Conditioning Contractors National Association.

SMACNA HVAC DUCT CONSTRUCTION STANDARDS is the Sheet Metal Contractors' National Association document "HVAC Duct Construction Standards Metal and Flexible - 3rd Edition," 2006 (2006ANSI/SMACNA-006-2006 HVAC Duct Construction Standards Metal and Flexible 3rd Edition)

SMACNA RESIDENTIAL COMFORT SYSTEM INSTALLATION STANDARDS MANUAL is the Sheet Metal Contractors' National Association document titled "Residential Comfort System Installation Standards Manual, Seventh Edition." (1998).

SOCIAL SERVICES BUILDING is a space where public assistance and social services are provided to individuals or families.

SOLAR REFLECTANCE INDEX (SRI) is a measure of the roof's ability to reject solar heat which includes both reflectance and emittance.

SOLAR SAVINGS FRACTION (SSF) is the fraction of domestic hot water demand provided by a solar water-heating system.

SOLAR ZONE is a section of the roof designated and reserved for the future installation of a solar electric or solar thermal system.

SOUTH-FACING (See "orientation.")

SPA is a vessel that contains heated water in which humans can immerse themselves, is not a pool, and is not a bathtub.

SPACE-CONDITIONING SYSTEM is a system that provides heating, or cooling within or associated with conditioned spaces in a building, and may incorporate use of components such as chillers/compressors, fluid distribution systems (e.g., air ducts, water piping, refrigerant piping), pumps, air handlers, cooling and heating coils, air or water cooled condensers, economizers, terminal units, and associated controls.

SPANDREL is opaque glazing material most often used to conceal building elements between floors of a building so they cannot be seen from the exterior, also known as "opaque in-fill systems."

STANDARD DESIGN BUILDING is a building that complies with the mandatory and prescriptive requirements in the Title 24 Building Energy Efficiency Standards by using the building energy modeling rules described in the Alternative Calculation Method (ACM) Reference Manual.

STORAGE, COLD, is a storage area within a refrigerated warehouse where space temperatures are maintained at or above 32° F.

STORAGE, FROZEN is a storage area within a refrigerated warehouse where the space temperatures are maintained below 32° F.

TENANT SPACE is a portion of a building occupied by a tenant.

THERMAL MASS is solid or liquid material used to store heat for later heating use or for reducing cooling requirements.

THERMAL RESISTANCE (R) is a measurement of the resistance over time of a material or building component to the passage of heating (hr x ft² x ºF)/Btu.

THERMOSTAT is an automatic control device or system used to maintain temperature at a fixed or adjustable setpoint.

THERMOSTATIC EXPANSION VALVE (TXV) is a refrigerant metering valve, installed in an air conditioner or heat pump, which controls the flow of liquid refrigerant entering the evaporator in response to the superheat of the gas leaving it.

TIME DEPENDENT VALUATION (TDV) ENERGY is the time varying energy caused to be used by the building to provide space conditioning and water heating and for specified buildings lighting. TDV energy accounts for the energy used at the building site and consumed in producing and in delivering energy to a site, including, but not limited to, power generation, transmission and distribution losses.

TINTED GLASS is colored glass by incorporation of a mineral admixture resulting in a degree of tinting. Any tinting reduces both visible and radiant transmittance.

TOTAL HEAT OF REJECTION (THR) is the heat rejected by refrigeration system compressors at design conditions, consisting of the design cooling capacity plus the heat of compression added by the compressors.

TOWNHOUSE is a single-family dwelling unit constructed in a group of three or more attached units in which each unit extends from the foundation to roof and with open space on at least two sides.

TRANSFER AIR is air transferred, whether actively by fans or passively by pressure differentials, from one room to another within a building through openings in the room envelope.

TRIM COMPRESSOR is a compressor that is designated for part-load operation, handling the short term variable trim load of end uses, in addition to the fully loaded base compressors.

U-FACTOR is the overall coefficient of thermal transmittance of a fenestration, wall, floor, or roof/ceiling component, in Btu/(hr x ft^2 x ºF), including air film resistance at both surfaces.

UL is the Underwriters Laboratories.

UL 727 is the Underwriters Laboratories document titled "Standard for Oil-Fired Central Furnaces," 2006.

UL 731 is the Underwriters Laboratories document titled "Standard for Oil-Fired Unit Heaters," 2006 with revision 1 through 7.UL 1574 is the Underwriters Laboratories document entitled "Track Lighting Systems," 2000.

UL 1598 is the Underwriters Laboratories document titled "Luminaires," 2008.

UNCONDITIONED SPACE is enclosed space within a building that is not directly conditioned, or indirectly conditioned.

UNIT INTERIOR MASS CAPACITY (UIMC) is the amount of effective heat capacity per unit of thermal mass, taking into account the type of mass material, thickness, specific heat, density and surface area.

USDOE 10 CFR 430 is the regulation issued by Department of Energy and available in the Code of Federal Regulation - Title 10, Chapter II, Sub-chapter D, Part 430 – Energy Conservation Program for Consumer Products. Relevant testing methodologies are specified in "Appendix N to sub-part B of Part 430 – Uniform test method for measuring the energy consumption of furnaces and boilers."

USDOE 10 CFR 431 is the regulation issued by Department of Energy and available in the Code of Federal Regulation - Title 10, Chapter II, Sub-chapter D, Part 431 - Energy Conservation Program for Certain Commercial and Industrial equipment. Relevant testing methodologies are specified in "Subpart E to Part 431 – Uniform test method for the measurement of energy efficiency of commercial packaged boilers."

VAPOR RETARDER CLASS is a measure of the ability of a material or assembly to limit the amount of moisture that passes through the material or assembly meeting Section 202 of the California Building Code.

VARIABLE AIR VOLUME (VAV) SYSTEM is a space-conditioning system that maintains comfort levels by varying the volume of supply air to the zones served.

VENDING MACHINE is a machine for vending and dispensing refrigerated or non-refrigerated food and beverages or general merchandise.

VERY VALUABLE MERCHANDISE is rare or precious objects, including, but not limited to, jewelry, coins, small art objects, crystal, ceramics, or silver, the selling of which involves customer inspection of very fine detail from outside of a locked case.

WALL TYPE is a type of wall assembly having a specific heat capacity, framing type, and U-factor.

WATER BALANCE IN EVAPORATIVE COOLING TOWERS The water balance of a cooling tower is:

M = E + B, where:

M = makeup water (from the mains water supply)

E = losses due to evaporation

B = losses due to blowdown

WEST-FACING (See "orientation")

WINDOW FILM is fenestration attachment products which consist of a flexible adhesive-backed polymer film which may be applied to the interior or exterior surface of an existing glazing system.

WOOD HEATER is an enclosed wood-burning appliance used for space heating and/or domestic water heating.

WOOD STOVE (See "wood heater.")

ZONE, CRITICAL is a zone serving a process where reset of the zone temperature setpoint during a demand shed event might disrupt the process, including but not limited to computer rooms, data centers, telecom and private branch exchange (PBX) rooms, and laboratories.

ZONE, NON-CRITICAL is a zone that is not a critical zone.

ZONE, SPACE-CONDITIONING, is a space or group of spaces within a building with sufficiently similar comfort conditioning requirements so that comfort conditions, as specified in Section 140.4(b)3 or 150.0(h), as applicable, can be maintained throughout the zone by a single controlling device.

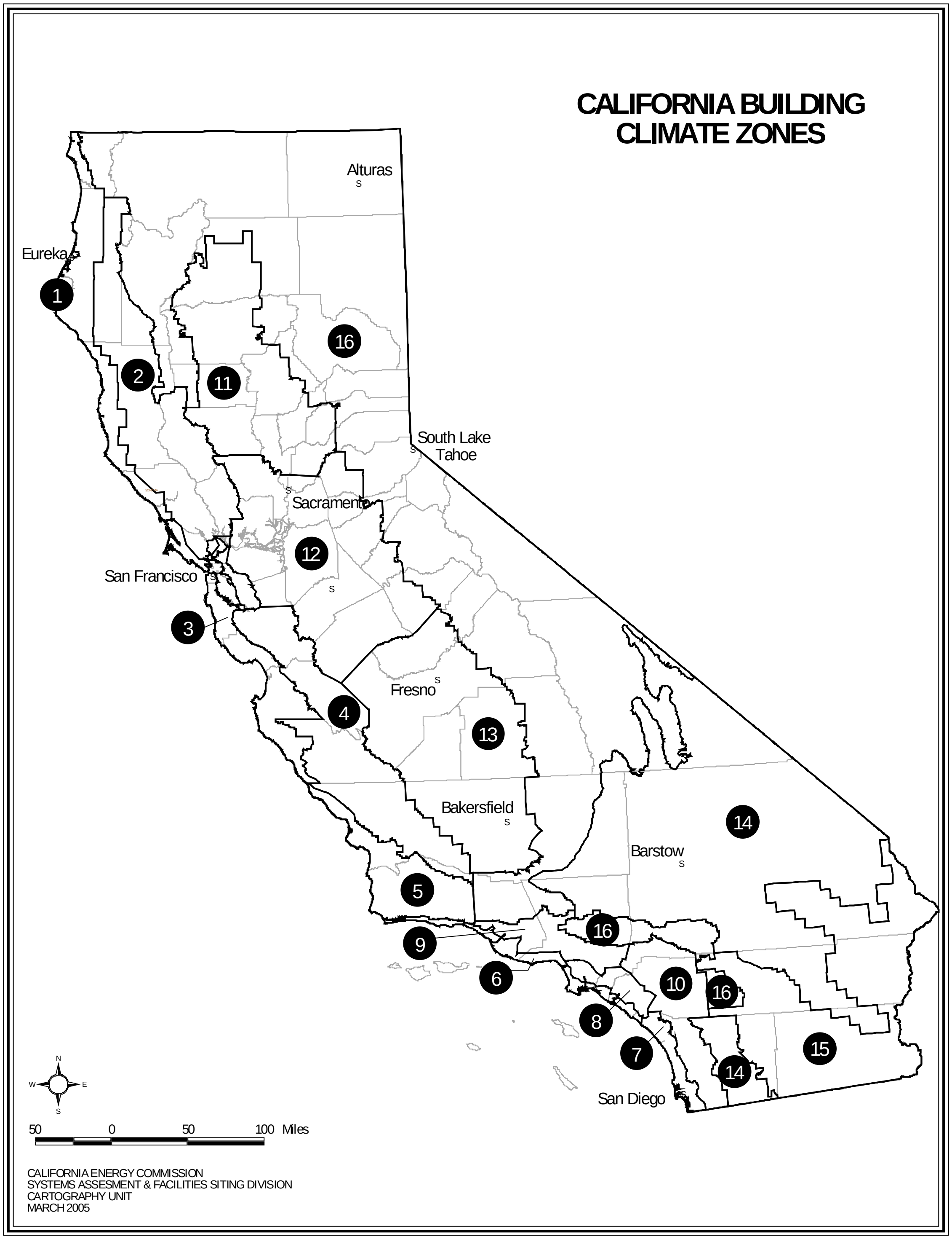

FIGURE 100.1-A—CALIFORNIA CLIMATE ZONES

Climate Zones for Residential and Nonresidential Occupancies

SECTION 100.2 – CALCULATION OF TIME DEPENDENT VALUATION (TDV) ENERGY

Time Dependent Valuation (TDV) energy shall be used to compare proposed designs to their energy budget when using the performance compliance approach. TDV energy is calculated by multiplying the site energy use (electricity kWh, natural gas therms, or fuel oil or LPG gallons) for each energy type times the applicable TDV multiplier. TDV multipliers vary for each hour of the year and by energy type (electricity, natural gas or propane), by Climate Zone and by building type (low-rise residential or nonresidential, high-rise residential or hotel/motel). TDV multipliers are summarized in Reference Joint Appendix JA3. TDV multipliers for propane shall be used for all energy obtained from depletable sources other than electricity and natural gas.

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SUBCHAPTER 2
ALL OCCUPANCIES—MANDATORY REQUIREMENTS FOR THE MANUFACTURE, CONSTRUCTION AND INSTALLATION OF SYSTEMS, EQUIPMENT AND BUILDING COMPONENTS

SECTION 110.0 – SYSTEMS AND EQUIPMENT—GENERAL

Sections 110.1 through 110.11 specify requirements for manufacturing, construction, and installation of certain systems, equipment, appliances and building components that are installed in buildings within the scope of Section 100.0(a).

NOTE: The requirements of Sections 110.0 through 110.11 apply to newly constructed buildings. Sections 141.0 and 150.2 specify which requirements of Sections 110.1 through 110.11 also apply to additions and alterations to existing buildings.

(a) **General Requirements.** Systems, equipment, appliances and building components shall only be installed in a building within the scope of Section 100.0(a) if:

1. The manufacturer has certified that the system, equipment, appliances or building component complies with the applicable manufacturing provisions of Sections 110.1 through 110.11, and

2. The system, equipment, appliance or building component complies with all applicable installation provisions of Sections 110.1 through 110.11.

(b) **Certification Requirements for Manufactured Systems, Equipment, Appliances and Building Components.**

1. Appliances that are within the scope of Section 1601 of the Appliance Efficiency Regulations shall only be installed if they have been certified to the Energy Commission by the manufacturer, pursuant to the provisions of Title 20 California Code of Regulations, Section 1606; or

2. Systems, equipment, appliances and building components that are required by Part 6 or the Reference Appendices to be certified to the Energy Commission, which are not appliances that are within the scope of Section 1601 of the Appliance Efficiency Regulations, shall only be installed if they are certified by the manufacturer in a declaration, executed under penalty of perjury under the laws of the State of California, that:

   A. all the information provided pursuant to the certification is true, complete, accurate and in compliance with all applicable requirements of Part 6; and

   B. the equipment, product, or device was tested using the test procedure specified in Part 6 if applicable.

3. The certification status of any system, equipment, appliance or building component shall be confirmed only by reference to:

   A. A directory published or approved by the Commission; or

   B. A copy of the application for certification from the manufacturer and the letter of acceptance from the Commission staff; or

   C. Written confirmation from the publisher of a Commission-approved directory that a device has been certified; or

   D. A Commission-approved label on the device.

NOTE: Part 6 does not require a builder, designer, owner, operator, or enforcing agency to test any certified device to determine its compliance with minimum specifications or efficiencies adopted by the Commission.

SECTION 110.1 – MANDATORY REQUIREMENTS FOR APPLIANCES

(a) Any appliance regulated by the Appliance Efficiency Regulations, Title 20 California Code of Regulations, Section 1601 et seq., may be installed only if the appliance fully complies with Section 1608(a) of those regulations.

(b) Except for those circumstances described in Section 110.1(c), conformance with efficiency levels required to comply with Part 6 mandatory, prescriptive and performance standards shall be verified utilizing data from either:

1. The Energy Commission's database of certified appliances maintained pursuant to Title 20 California Code of Regulations, Section 1606, and which is available at: www.energy.ca.gov/appliances/database/; or

2. An equivalent directory published by a federal agency; or

3. An approved trade association directory as defined in Title 20 California Code of Regulations, Section 1606(h).

(c) Conformance with efficiency levels required to comply with Part 6 mandatory, prescriptive and performance standards shall be demonstrated either by default to the mandatory efficiency levels specified in Part 6 or by following procedures approved by the Commission pursuant to Section 10-109 of Title 24, Part 1, when:

1. Data to verify conformance with efficiency levels required to comply with Part 6 mandatory, prescriptive and performance standards is not available pursuant to subdivision (b); or

2. Field verification and diagnostic testing is required for compliance with Part 6 and the Energy Commission has not approved a field verification and diagnostic test protocol that is applicable to the appliance; or

3. The appliance meets the requirements of Section 110.1(a) but has been site-modified in a way that affects its performance; or

4. The U.S. Department of Energy has approved a waiver from federal test procedures, pursuant to 10 CFR Section 430.27 or Section 431.401 and that waiver fails to specify how the efficiency of the system shall be determined.

SECTION 110.2 – MANDATORY REQUIREMENTS FOR SPACE-CONDITIONING EQUIPMENT

Certification by Manufacturers. Any space-conditioning equipment listed in this section may be installed only if the manufacturer has certified to the Commission that the equipment complies with all the applicable requirements of this section.

(a) **Efficiency.** Equipment shall meet the applicable efficiency requirements in TABLE 110.2-A through TABLE 110.2-K subject to the following:

1. If more than one efficiency standard is listed for any equipment in TABLE 110.2-A through TABLE 110.2-K, the equipment shall meet all the applicable standards that are listed; and
2. If more than one test method is listed in TABLE 110.2-A through TABLE 110.2-K, the equipment shall comply with the applicable efficiency standard when tested with each listed test method; and
3. Where equipment serves more than one function, it shall comply with the efficiency standards applicable to each function; and
4. Where a requirement is for equipment rated at its "maximum rated capacity" or "minimum rated capacity," the capacity shall be as provided for and allowed by the controls, during steady-state operation.

EXCEPTION 1 to Section 110.2(a): Water-cooled centrifugal water-chilling packages that are not designed for operation at ANSI/AHRI Standard 550/590 test conditions of 44°F leaving chilled water temperature and 85°F entering condenser water temperature with 3 gallons per minute per ton condenser water flow shall have a maximum full load kW/ton and NPLV ratings adjusted using the following equation:

Adjusted maximum full-load kW/ton rating = (fullload kW/ton from TABLE 110.2-D) / Kadj

Adjusted maximum NPLV rating = (IPLV from TABLE 110.2-D) / Kadj

Where:

Kadj = (A) x (B)

$A = 0.00000014592 \times (LIFT)^4 - 0.0000346496 \times (LIFT)^3 + 0.00314196 \times (LIFT)^2 - 0.147199 \times (LIFT) + 3.9302$

LIFT = LvgCond – LvgEvap (°F)

LvgCond = Full-load leaving condenser fluid temperature (°F)

LvgEvap = Full-load leaving evaporator fluid temperature (°F)

B = (0.0015 x LvgEvap) + 0.934

The adjusted full-load and NPLV values are only applicable for centrifugal chillers meeting all of the following full-load design ranges:

- Minimum Leaving Evaporator Fluid Temperature: 36°F
- Maximum Leaving Condenser Fluid Temperature: 115°F
- LIFT ≥ 20°F and ≤ 80°F

Centrifugal chillers designed to operate outside of these ranges are not covered by this exception.

EXCEPTION 2 to Section 110.2(a): Positive displacement (air- and water-cooled) chillers with a leaving evaporator fluid temperature higher than 32°F shall show compliance with TABLE 110.2-D when tested or certified with water at standard rating conditions, per the referenced test procedure.

EXCEPTION 3 to Section 110.2(a): Equipment primarily serving refrigerated warehouses or commercial refrigeration.

(b) **Controls for Heat Pumps with Supplementary Electric Resistance Heaters.** Heat pumps with supplementary electric resistance heaters shall have controls:

1. That prevent supplementary heater operation when the heating load can be met by the heat pump alone; and
2. In which the cut-on temperature for compression heating is higher than the cut-on temperature for supplementary heating, and the cut-off temperature for compression heating is higher than the cut-off temperature for supplementary heating.

EXCEPTION 1 to Section 110.2(b): The controls may allow supplementary heater operation during:

A. Defrost; and

B. Transient periods such as start-ups and following room thermostat setpoint advance, if the controls provide preferential rate control, intelligent recovery, staging, ramping or another control mechanism designed to preclude the unnecessary operation of supplementary heating.

EXCEPTION 2 to Section 110.2(b): Room air-conditioner heat pumps.

(c) **Thermostats.** All unitary heating or cooling systems not controlled by a central energy management control system (EMCS) shall have a setback thermostat.

1. **Setback Capabilities.** All thermostats shall have a clock mechanism that allows the building occupant to Program the temperature setpoints for at least four periods within 24 hours. Thermostats for heat pumps shall meet the requirements of Section 110.2(b).

EXCEPTION to Section 110.2(c): Gravity gas wall heaters, gravity floor heaters, gravity room heaters, noncentral electric heaters, fireplaces or decorative gas appliances, wood stoves, room air conditioners, and room air-conditioner heat pumps.

(d) **Gas- and Oil-Fired Furnace Standby Loss Controls.** Gas-fired and oil-fired forced air furnaces with input ratings ≥225,000 Btu/h shall also have an intermittent ignition or interrupted device (IID), and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for furnaces where combustion air is drawn from the conditioned space. All furnaces with input ratings ≥225,000 Btu/h, including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75 percent of the input rating.

(e) **Open and Closed Circuit Cooling Towers.** All open and closed circuit cooling tower installations shall comply with the following:

1. Be equipped with Conductivity or Flow-based Controls that maximize cycles of concentration based on local water quality conditions. Controls shall automate system bleed and chemical feed based on conductivity, or in proportion to metered makeup volume, metered bleed volume, recirculating pump run time, or bleed time. Conductivity controllers shall be installed in accordance with manufacturer’s specifications in order to maximize accuracy.
2. Documentation of Maximum Achievable Cycles of Concentration. Building owners shall document the maximum cycles of concentration based on local water supply as reported annually by the local water supplier, and using the calculator approved by the Energy Commission. The calculator is intended to determine maximum cycles based on a Langelier Saturation Index (LSI) of 2.5 or less. Building owner shall document maximum cycles of concentration on the mechanical compliance form which shall be reviewed and signed by the Professional Engineer (P.E.) of Record.
3. Be equipped with a Flow Meter with an analog output for flow either hardwired or available through a gateway on the makeup water line.
4. Be equipped with an Overflow Alarm to prevent overflow of the sump in case of makeup water valve failure. Overflow alarm shall send an audible signal or provide an alert via the Energy Management Control System to the tower operator in case of sump overflow.
5. Be equipped with Efficient Drift Eliminators that achieve drift reduction to 0.002 percent of the circulated water volume for counter-flow towers and 0.005 percent for cross-flow towers.

EXCEPTION to Section 110.2(e): Towers with rated capacity < 150 tons.

(f) **Low Leakage Air-Handling Units**. To qualify as a low leakage air-handling unit for use for meeting the requirements for applicable low leakage air-handling unit compliance credit(s) available in the performance standards set forth in Sections 150.1(b) and 140.1, the manufacturer shall certify to the Energy Commission that the air-handling unit meets the specifications in Reference Joint Appendix JA9.

TABLE 110.2-A ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Efficiency [a, b]		Test Procedure[c]
		Before 1/1/2016	After 1/1/2016	
Air conditioners, air cooled both split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h	11.2 EER 11.4 IEER	11.2 EER 12.9 IEER	ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	11.0 EER 11.2 IEER	11.0 EER 12.4 IEER	ANSI/AHRI 340/360
	≥ 240,000 Btu/h and < 760,000 Btu/h	10.0 EER 10.1 IEER	10.0 EER 11.6 IEER	
	≥ 760,000 Btu/h	9.7 EER 9.8 IEER	9.7 EER 11.2 IEER	
Air conditioners, water cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	12.1 EER 12.3 IEER	12.1 EER 13.9 IEER	ANSI/AHRI 340/360
	≥135,000 Btu/h and < 240,000 Btu/h	12.5 EER 12.5 IEER	12.5 EER 13.9 IEER	ANSI/AHRI 340/360
	≥240,000 Btu/h and < 760,000 Btu/h	12.4 EER 12.6 IEER	12.4 EER 13.6 IEER	ANSI/AHRI 340/360
	≥ 760,000 Btu/h	12.2 EER 12.4 IEER	12.2EER 13.5 IEER	ANSI/AHRI 340/360
Air conditioners, evaporatively cooled	≥65,000 Btu/h and < 135,000 Btu/h	12.1 EER[b] 12.3 IEER[b]		ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	12.0 EER[b] 12.2 IEER[b]		ANSI/AHRI 340/360
	≥240,000 Btu/h and < 760,000 Btu/h	11.9 EER[b] 12.1 IEER[b]		ANSI/AHRI 340/360
	≥ 760,000 Btu/h	11.7 EER[b] 11.9 IEER[b]		ANSI/AHRI 340/360
Condensing units, air cooled	≥ 135,000 Btu/h	10.5 EER 11.8 IEER		ANSI/AHRI 365
Condensing units, water cooled	≥ 135,000 Btu/h	13.5 EER 14.0 IEER		
Condensing units, evaporatively cooled	≥ 135,000 Btu/h	13.5 EER 14.0 IEER		

[a] IEERs are only applicable to equipment with capacity control as as specified by ANSI/AHRI 340/360 test procedures

[b] Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat.

[c] Applicable test procedure and reference year are provided under the definitions.

TABLE 110.2-B UNITARY AND APPLIED HEAT PUMPS, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Efficiency [a,b]		Test Procedure[c]
		Before 1/1/2016	After 1/1/2016	
Air Cooled (Cooling Mode), both split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h	11.0 EER 11.2 IEER	11.0 EER 12.2 IEER	ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	10.6 EER 10.7 IEER	10.6 EER 11.6 IEER	
	≥ 240,000 Btu/h	9.5 EER 9.6 IEER	9.5 EER 10.6 IEER	
Water source (cooling mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	86ºF entering water	13.0 EER	ISO-13256-1
Groundwater source (cooling mode)	< 135,000 Btu/h	59ºF entering water	18.0 EER	ISO-13256-1
Ground source (cooling mode)	< 135,000 Btu/h	77ºF entering water	14.1 EER	ISO-13256-1
Water source water-to-water (cooling mode)	< 135,000 Btu/h	86ºF entering water	10.6 EER	ISO-13256-2
Groundwater source water-to-water (cooling mode)	< 135,000 Btu/h	59ºF entering water	16.3 EER	ISO-13256-1
Ground source brine-to-water (cooling mode)	< 135,000 Btu/h	77ºF entering water	12.1 EER	ISO-13256-2
Air Cooled (Heating Mode) Split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)	47° F db/43° F wb outdoor air	3.3 COP	ANSI/AHRI 340/360
		17° F db/15° F wb outdoor air	2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)	47° F db/43° F wb outdoor air	3.2 COP	
		17° F db/15° F wb outdoor air	2.05 COP	

CONTINUED: TABLE 110.2-B UNITARY AND APPLIED HEAT PUMPS, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Subcategory or Rating Condition	Efficiency [a]	Test Procedure[c]
Water source (heating mode)	< 135,000 Btu/h (cooling capacity)	68ºF entering water	4.3 COP	ISO-13256-1
	≥ 135,000 Btu/h and < 240,000 Btu/h	68ºF entering water	2.90 COP	
Groundwater source (heating mode)	< 135,000 Btu/h (cooling capacity)	50ºF entering water	3.7 COP	ISO-13256-1
Ground source (heating mode)	< 135,000 Btu/h (cooling capacity)	32ºF entering water	3.2 COP	ISO-13256-1
Water source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	68ºF entering water	3.7 COP	ISO-13256-2
Groundwater source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	50ºF entering water	3.1 COP	ISO-13256-2
Ground source brine-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	32ºF entering water	2.5 COP	ISO-13256-2

[a] IEERs are only applicable to equipment with capacity control as as specified by ANSI/AHRI 340/360 test procedures.

[b] Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat.

[c] Applicable test procedure and reference year are provided under the definitions.

TABLE 110.2-C AIR-COOLED GAS-ENGINE HEAT PUMPS

Equipment Type	Size Category	Subcategory or Rating Condition	Efficiency	Test Procedure[a]
Air-Cooled Gas-Engine Heat Pump (Cooling Mode)	All Capacities	95° F db Outdoor Air	0.60 COP	ANSI Z21.40.4A
Air-Cooled Gas-Engine Heat Pump (Heating Mode)	All Capacities	47° F db/43° F wb Outdoor Air	0.72 COP	ANSI Z21.40.4A

[a] Applicable test procedure and reference year are provided under the definitions.

TABLE 110.2-D WATER CHILLING PACKAGES – MINIMUM EFFICIENCY REQUIREMENTS [a,b]

Equipment Type	Size Category	Path A Efficiency [a,b]	Path B Efficiency [a,b]	Test Procedure [c]
Air Cooled, With Condenser Electrically Operated	< 150 Tons	≥ 10.100 EER ≥ 13.700 IPLV	≥ 9.700 EER ≥15.800 IPLV	AHRI 550/590
	≥ 150 Tons	≥ 10.100 EER ≥ 14.000 IPLV	≥ 9.700 EER ≥16.100 IPLV	
Air Cooled, Without Condenser Electrically Operated	All Capacities	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements.		
Water Cooled, Electrically Operated, Reciprocating	All Capacities	Reciprocating units must comply with the water-cooled positive displacement efficiency requirements.		AHRI 550/590
Water Cooled, Electrically Operated Positive Displacement	< 75 Tons	≤0.750kW/ton ≤ 0.600 IPLV	≤ 0.780 kW/ton ≤ 0.500 IPLV	AHRI 550/590
	≥ 75 tons and < 150 tons	≤ 0.720 kW/ton ≤ 0.560 IPLV	≤ 0.750 kW/ton ≤ 0.490 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.660 kW/ton ≤ 0.540 IPLV	≤ 0.680 kW/ton ≤ 0.440 IPLV	
	≥ 300 Tons and < 600 tons	≤ 0.610kW/ton ≤ 0.520 IPLV	≤ 0.625 kW/ton ≤ 0.410 IPLV	
	≥ 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 Tons	≤ 0.610 kW/ton ≤ 0.550IPLV	≤ 0.695 kW/ton ≤ 0.440 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.610 kW/ton ≤ 0.550 IPLV	≤ 0.635 kW/ton ≤ 0.400 IPLV	
	≥ 300 tons and < 400 tons	≤ 0.560 kW/ton ≤ 0.520 IPLV	≤ 0.595 kW/ton ≤ 0.390 IPLV	
	≥ 400 tons and < 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	
	≥ 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	

CONTINUED: TABLE 110.2-D WATER CHILLING PACKAGES – MINIMUM EFFICIENCY REQUIREMENTS [a,b]

Equipment Type	Size Category	Path A Efficiency [a,b]	Path B Efficiency [a,b]	Test Procedure [c]
Air Cooled Absorption, Single Effect	All Capacities	≥0.600 COP	N.A. [d]	ANSI/AHRI 560
Water Cooled Absorption, Single Effect	All Capacities	≥ 0.700 COP	N.A. [d]	
Absorption Double Effect, Indirect-Fired	All Capacities	≥ 1.000 COP ≥ 1.050 IPLV	N.A. [d]	
Absorption Double Effect, Direct-Fired	All Capacities	≥ 1.000 COP ≥1.000 IPLV	N.A. [d]	
Water Cooled Gas Engine Driven Chiller	All Capacities	≥ 1.2 COP ≥ 2.0 IPLV	N.A. [d]	ANSI Z21.40.4A

[a] No requirements for:

- Centrifugal chillers with design leaving evaporator temperature < 36°F; or
- Positive displacement chillers with design leaving fluid temperature ≤ 32°F; or
- Absorption chillers with design leaving fluid temperature < 40°F

[b] Must meet the minimum requirements of Path A or Path B. However, both the full load (COP) and IPLV must be met to fulfill the requirements of the applicable Path.

[c] See Section 100.1 for definitions

[d] NA means not applicable

TABLE 110.2-E PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINAL HEAT PUMPS – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Efficiency		Test Procedure [c]
PTAC (Cooling mode) Newly constructed or newly conditioned buildings or additions	All Capacities	95°F db Outdoor Air		14.0 - (0.300 x Cap/1000) [a] EER	ANSI/AHRI/CSA 310/380
PTAC (Cooling mode) Replacements [b]	All Capacities	95°F db Outdoor Air		10.9 - (0.213 x Cap/1000) [a] EER	
PTHP (Cooling mode) Newly constructed or newly conditioned buildings or additions	All Capacities	95°F db Outdoor Air		14.0 - (0.300 x Cap/1000) [a] EER	
PTHP (Cooling mode) Replacements [b]	All Capacities	95°F db Outdoor Air		10.8 - (0.213 x Cap/1000) [a] EER	
PTHP (Heating Mode) Newly constructed or newly conditioned buildings or additions	All Capacities	-		3.7 - (0.052 x Cap/1000) [a] COP	
PTHP (Heating mode) Replacements [b]	All Capacities	-		2.9 - (0.026 x Cap/1000) [a] COP	

TABLE 110.2-E PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINAL HEAT PUMPS – MINIMUM EFFICIENCY REQUIREMENTS (CONTINUED)

Equipment Type	**Size Category (Input)**	**Subcategory or Rating Condition**	**Efficiency**		**Test Procedure [c]**
SPVAC (Cooling Mode)	<65,000 Btu/h	95°F db / 75°F wb Outdoor Air		10.0 EER	ANSI/AHRI 390
	≥65,000 Btu/h and <135,000 Btu/h	95°F db / 75°F wb Outdoor Air		10.0 EER	
	≥135,000 Btu/h and <240,000 Btu/h	95°F db / 75°F wb Outdoor Air		10.0 EER	
SPVAC (Cooling Mode) nonweatherized space constrained	≤ 30,000 Btu/h	"95^{0}F db / 75^{0}F wb outdoor air"		9.20 EER	
	> 30,000 Btu/h and ≤ 36,000 Btu/h	"95^{0}F db / 75^{0}F wb outdoor air"		9.00 EER	
SPVHP (Cooling Mode)	<65,000 Btu/h	95°F db / 75°F wb Outdoor Air		10.0 EER	
	≥65,000 Btu/h and <135,000 Btu/h	95°F db / 75°F wb Outdoor Air		10.0 EER	
	≥135,000 Btu/h and <240,000 Btu/h	95°F db / 75°F wb Outdoor Air		10.0 EER	
SPVHP (Cooling Mode) nonweatherized space constrained	≤ 30,000 Btu/h	95°F db / 75°F wb Outdoor Air		9.20 EER	
	> 30,000 Btu/h and ≤ 36,000 Btu/h	95°F db / 75°F wb Outdoor Air		9.00 EER	
SPVHP (Heating Mode)	<65,000 Btu/h	47°F db / 43°F wb Outdoor Air		3.0 COP	
	≥65,000 Btu/h and <135,000 Btu/h	47°F db / 43°F wb Outdoor Air		3.0 COP	
	≥135,000 Btu/h and <240,000 Btu/h	47°F db / 43°F wb Outdoor Air		3.0 COP	
SPVHP (Heating Mode) nonweatherized space constrained	≤ 30,000 Btu/h	47°F db / 43°F wb Outdoor Air		3.00 COP	
	> 30,000 Btu/h and ≤ 36,000 Btu/h	47°F db / 43°F wb Outdoor Air		3.00 COP	

[a] Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

[b] Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEWLY CONSTRUCTED BUILDINGS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches high or less than 42 inch wide and having a cross-sectional area less than 670 square inches.

[c] Applicable test procedure and reference year are provided under the definitions

TABLE 110.2-F HEAT TRANSFER EQUIPMENT

Equipment Type	**Subcategory**	**Minimum Efficiency[a]**	**Test Procedure [b]**
Liquid-to-liquid heat exchangers	Plate type	NR	ANSI/AHRI 400

[a] NR = no requirement

[b] Applicable test procedure and reference year are provided under the definitions

TABLE 110.2-G PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Subcategory or Rating Condition	Performance Required ,[a,b, c, d]	Test Procedure [e]
Propeller or axial fan Open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering air wb	≥ 42.1 gpm/hp	CTI ATC-105 and CTI STD-201
Centrifugal fan Open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering air wb	≥ 20.0 gpm/hp	
Propeller or axial fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering air wb	≥ 14.0 gpm/hp	
Centrifugal fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering air wb	≥ 7.0 gpm/hp	
Propeller or axial fan evaporative condensers	All	R-507A test fluid 165^{0}F entering gas temp 105^{0}F condensing temp 75^{0}F entering air wb"	≥ 157,000 Btu/h • hp	CTI ATC-106
	All	Ammonia test fluid 140^{0}F entering gas temp 96.3^{0}F condensing temp 75^{0}F entering air wb"	≥ 134,000 Btu/h • hp	
Centrifugal fan evaporative condensers	All	R-507A test fluid 165^{0}F entering gas temp 105^{0}F condensing temp 75^{0}F entering air wb"	≥ 135,000 Btu/h • hp	
	All	Ammonia test fluid 140^{0}F entering gas temp 96.3^{0}F condensing temp 75^{0}F entering air wb"	≥ 110,000 Btu/h • hp	
Air cooled condensers	All	125°F condensing temperature R22 test fluid 190°F entering gas temperature 15°F subcooling 95°F entering drybulb	≥ 176,000 Btu/h·hp	ANSI/AHRI 460

[a] For purposes of this table, open-circuit cooling tower performance is defined as the water flow rating of the tower at the given rated conditions divided by the fan motor nameplate power.

[b] For purposes of this table, closed-circuit cooling tower performance is defined as the process water flow rating of the tower at the given rated conditions divided by the sum of the fan motor nameplate rated power and the integral spray pump motor nameplate power .

[c] For purposes of this table air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan motor nameplate power.

[d] Open cooling towers shall be tested using the test procedures in CTI ATC-105. Performance of factory assembled open cooling towers shall be either certified as base models as specified in CTI STD-201 or verified by testing in the field by a CTI approved testing agency. Open factory assembled cooling towers with custom options added to a CTI certified base model for the purpose of safe maintenance or to reduce environmental or noise impact shall be rated at 90 percent of the CTI certified performance of the associated base model or at the manufacturer's stated performance, whichever is less. Base models of open factory assembled cooling towers are open cooling towers configured in exact accordance with the Data of Record submitted to CTI as specified by CTI STD-201. There are no certification requirements for field erected cooling towers.

[e] Applicable test procedure and reference year are provided under the definitions.

For refrigerated warehouses or commercial refrigeration applications, condensers shall comply with requirements specified by Section 120.6(a) or Section 120.6(b).

TABLE 110.2-H ELECTRICALLY OPERATED VARIABLE REFRIGERANT FLOW (VRF) AIR CONDITIONERS MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure[a]
VRF Air Conditioners, Air Cooled	<65,000 Btu/h	All	VRF Multi-split System	13.0 SEER	ANSI/AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	11.2 EER 13.1 IEER [b]	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	11.0 EER 12.9 IEER [b]	
	≥240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	10.0 EER 11.6 IEER [b]	

[a] Applicable test procedure and reference year are provided under the definitions.

[b] IEERs are only applicable to equipment with capacity control as specified by ANSI/AHRI 1230 test procedures.

TABLE 110.2-I ELECTRICALLY OPERATED VARIABLE REFRIGERANT FLOW AIR-TO-AIR AND APPLIED HEAT PUMPS - MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	**Size Category**	**Heating Section Type**	**Sub-Category or Rating Condition**	**Minimum Efficiency**	**Test Procedure** [b]
VRF Air Cooled, (cooling mode)	<65,000 Btu/h	All	VRF Multi-split System	13.0 SEER	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System [a]	11.0 EER 12.9 IEER [c]	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System [a]	10.6 EER 12.3 IEER [c]	
	≥240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System [a]	9.5 EER 11.0 IEER [c]	
VRF Water source (cooling mode)	<65,000 Btu/h	All	VRF Multi-split systems [a] 86ºF entering water	12.0 EER	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	All	VRF Multi-split System [a] 86ºF entering water	12.0 EER	
	≥135,000 Btu/h	All	VRF Multi-split System [a] 86ºF entering water	10.0 EER	
VRF Groundwater source (cooling mode)	<135,000 Btu/h	All	VRF Multi-split System [a] 59ºF entering water	16.2 EER	AHRI 1230
	≥135,000 Btu/h	All	VRF Multi-split System [a] 59ºF entering water	13.8 EER	
VRF Ground source (cooling mode)	<135,000 Btu/h	All	VRF Multi-split System [a] 77ºF entering water	13.4 EER	AHRI 1230
	≥135,000 Btu/h	All	VRF Multi-split System [a] 77ºF entering water	11.0 EER	

CONTINUED: TABLE 110.2-I ELECTRICALLY OPERATED VARIABLE REFRIGERANT FLOW AIR-TO-AIR AND APPLIED HEAT PUMPS - MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure [b]
VRF Air Cooled (heating mode)	<65,000 Btu/h (cooling capacity)	- - -	VRF Multi-split System	7.7 HSPF	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h (cooling capacity)	- - -	VRF Multi-split system 47ºF db/ 43ºF wb outdoor air	3.3 COP	
			VRF Multi-split system 17ºF db/15ºF wb outdoor air	2.25 COP	
	≥135,000 Btu/h (cooling capacity)	- - -	VRF Multi-split system 47ºF db/ 43ºF wb outdoor air	3.2 COP	
			VRF Multi-split system 17ºF db/15ºF wb outdoor air	2.05 COP	
VRF Water source (heating mode)	<135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 68ºF entering water	4.2 COP	AHRI 1230
	≥135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 68ºF entering water	3.9 COP	
VRF Groundwater source (heating mode)	<135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 50ºF entering water	3.6 COP	AHRI 1230
	≥135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 50ºF entering water	3.3 COP	
VRF Ground source (heating mode)	<135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 32ºF entering water	3.1 COP	AHRI 1230
	≥135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 32ºF entering water	2.8 COP	

[a] Deduct 0.2 from the required EERs and IEERs for Variable Refrigerant Flow (VRF) Multi-split system units with a heating recovery section.
[b] Applicable test procedure and reference year are provided under the definitions.
[c] IEERs are only applicable to equipment with capacity control as specified by ANSI/AHRI 1230 test procedures.

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TABLE 110.2-J WARM-AIR FURNACES AND COMBINATION WARM-AIR FURNACES/AIR-CONDITIONING UNITS, WARM-AIR DUCT FURNACES, AND UNIT HEATERS

Equipment Type	Size Category (Input)	Subcategory or Rating Condition[b]	Minimum Efficiency[d,e]	Test Procedure[a]
Warm-Air Furnace, Gas-Fired	< 225,000 Btu/h	Maximum Capacity[b]	78% AFUE or 80% E_t	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, ANSI Z21.47
	≥ 225,000 Btu/h	Maximum Capacity[b]	80% E_t	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-Air Furnace, oil-Fired	< 225,000 Btu/h	Maximum Capacity[b]	78% AFUE or 80% E_t	DOE 10 CFR Part 430 or Section 42, Combustion, UL 727
	≥ 225,000 Btu/h	Maximum Capacity[b]	81% E_t	Section 42, Combustion, UL 727
Warm-Air Duct Furnaces, Gas-Fired	All Capacities	Maximum Capacity[b]	80% E_c	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heaters, Gas-Fired	All Capacities	Maximum Capacity[b]	80% E_c	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heaters, Oil-Fired	All Capacities	Maximum Capacity[b]	81% E_c	Section 40, Combustion, UL 731

[a] Applicable test procedure and reference year are provided under the definitions.

[b] Compliance of multiple firing rate units shall be at maximum firing rate.

[c] Combustion units not covered by NAECA (3-phase power or cooling capacity greater than or equal to 19 kW) may comply with either rating.

[d] E_t= thermal efficiency. Units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75% of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.

[e] E_c= combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

[f] As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.

TABLE 110.2-K GAS- AND OIL-FIRED BOILERS, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Sub Category	Size Category (Input)	Minimum Efficiency [b,c]		Test Procedure [a]
			Before 3/2/2020	After 3/2/2020	
Boiler, hot water	Gas-Fired	< 300,000 Btu/h	82% AFUE	82% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h [d]	80% E_t	80% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h [e]	82% E_c	82% E_c	
	Oil-Fired	< 300,000 Btu/h	84% AFUE	84% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h [d]	82% E_t	82% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h [e]	84% E_c	84% E_c	
Boiler, steam	Gas-Fired	< 300,000 Btu/h	80% AFUE	80% AFUE	DOE 10 CFR Part 430
	Gas-Fired all, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h [d]	79% E_t	79% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h [e]	79% E_t	79% E_t	DOE 10 CFR Part 431
	Gas-Fired, natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h [d]	77% E_t	79% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h [e]	77% E_t	79% E_t	DOE 10 CFR Part 431
	Oil-Fired	< 300,000 Btu/h	82% AFUE	82% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h [d]	81% E_t	81% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h [e]	81% E_t	81% E_t	DOE 10 CFR Part 431

[a] Applicable test procedure and reference year are provided under the definitions.

[b] Ec = combustion efficiency (100% less flue losses) .See reference document for detailed information.

[c] Et= thermal efficiency. See test procedure for detailed information.

[d] Maximum capacity - minimum and maximum ratings as provided for and allowed by the unit's controls.

[e] Included oil-fired (residual).

SECTION 110.3 – MANDATORY REQUIREMENTS FOR SERVICE WATER-HEATING SYSTEMS AND EQUIPMENT

(a) Certification by Manufacturers. Any service water-heating system or equipment may be installed only if the manufacturer has certified that the system or equipment complies with all of the requirements of this subsection for that system or equipment.

1. Temperature controls for service water heating systems. Service water-heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use as listed in Table 3, Chapter 50 of the ASHRAE Handbook, HVAC Applications Volume.

   EXCEPTION to Section 110.3(a)1: Residential occupancies.

(b) **Efficiency.** Equipment shall meet the applicable requirements of the Appliance Efficiency Regulations as required by Section 110.1, subject to the following:

1. If more than one standard is listed in the Appliance Efficiency Regulations, the equipment shall meet all the standards listed; and
2. If more than one test method is listed in the Appliance Efficiency Regulations, the equipment shall comply with the applicable standard when tested with each test method; and
3. Where equipment can serve more than one function, such as both heating and cooling, or both space heating and water heating, it shall comply with all the requirements applicable to each function; and
4. Where a requirement is for equipment rated at its "maximum rated capacity" or "minimum rated capacity," the capacity shall be as provided for and allowed by the controls, during steady-state operation.

(c) **Installation.** Any service water-heating system or equipment may be installed only if the system or equipment complies with all of the applicable requirements of this subsection for the system or equipment.

1. **Outlet temperature controls.** On systems that have a total capacity greater than 167,000 Btu/hr, outlets that require higher than service water temperatures as listed in the ASHRAE Handbook, Applications Volume, shall have separate remote heaters, heat exchangers, or boosters to supply the outlet with the higher temperature.
2. **Controls for hot water distribution systems.** Service hot water systems with circulating pumps or with electrical heat trace systems shall be capable of automatically turning off the system.
3. **Temperature controls for public lavatories.** The controls shall limit the outlet temperature at the fixtures to 110°F.
4. **Insulation.** Unfired service water heater storage tanks and backup tanks for solar water-heating systems shall have:

   A. External insulation with an installed R-value of at least R-12; or

   B. Internal and external insulation with a combined R-value of at least R-16; or

   C. The heat loss of the tank surface based on an 80°F water-air temperature difference shall be less than 6.5 Btu per hour per square foot.
5. **Water Heating Recirculation Loops Serving Multiple Dwelling Units, High-Rise Residential, Hotel/Motel and Nonresidential Occupancies.** A water heating recirculation loop is a type of hot water distribution system that reduces the time needed to deliver hot water to fixtures that are distant from the water heater, boiler or other water heating equipment. The recirculation loop is comprised of a supply portion, connected to branches that serve multiple dwelling units, guest rooms, or fixtures and a return portion that completes the loop back to the water heating equipment. A water heating recirculation loop shall meet the following requirements:

A. **Air release valve or vertical pump installation.** An automatic air release valve shall be installed on the recirculation loop piping on the inlet side of the recirculation pump and no more than 4 feet from the pump. This valve shall be mounted on top of a vertical riser at least 12” in length and shall be accessible for replacement and repair. Alternatively, the pump shall be installed on a vertical section of the return line.

B. **Recirculation loop backflow prevention.** A check valve or similar device shall be located between the recirculation pump and the water heating equipment to prevent water from flowing backwards though the recirculation loop.

C. **Equipment for pump priming.** A hose bibb shall be installed between the pump and the water heating equipment. An isolation valve shall be installed between the hose bibb and the water heating equipment. This hose bibb is used for bleeding air out of the pump after pump replacement.

D. **Pump isolation valves.** Isolation valves shall be installed on both sides of the pump. These valves may be part of the flange that attaches the pump to the pipe. One of the isolation valves may be the same isolation valve as in Item C.

E. **Cold water supply and recirculation loop connection to hot water storage tank.** Storage water heaters and boilers shall be plumbed in accordance with the manufacturer’s specifications. The cold water piping and the recirculation loop piping shall not be connected to the hot water storage tank drain port.

F. **Cold water supply backflow prevention.** A check valve shall be installed on the cold water supply line between the hot water system and the next closest tee on the cold water supply line. The system shall comply with the expansion tank requirements as described in the California Plumbing Code Section 608.3.

6. **Service water heaters in state buildings.** Any newly constructed building constructed by the State shall derive its service water heating from a system that provides at least 60 percent of the energy needed for service water heating from site solar energy or recovered energy.

   EXCEPTION to Section 110.3(c)6: Buildings for which the state architect determines that service water heating from site solar energy or recovered energy is economically or physically infeasible.

7. **Isolation valves.** Instantaneous water heaters with an input rating greater than 6.8 kBTU/hr (2 kW) shall have isolation valves on both the cold water supply and the hot water pipe leaving the water heater, and hose bibbs or other fittings on each valve for flushing the water heater when the valves are closed.

SECTION 110.4 – MANDATORY REQUIREMENTS FOR POOL AND SPA SYSTEMS AND EQUIPMENT

(a) Certification by Manufacturers. Any pool or spa heating system or equipment may be installed only if the manufacturer has certified that the system or equipment has all of the following:

1. Efficiency. A thermal efficiency that complies with the Appliance Efficiency Regulations; and
2. On-off switch. A readily accessible on-off switch, mounted on the outside of the heater that allows shutting off the heater without adjusting the thermostat setting; and
3. Instructions. A permanent, easily readable, and weatherproof plate or card that gives instruction for the energy efficient operation of the pool or spa heater and for the proper care of pool or spa water when a cover is used; and
4. Electric resistance heating. No electric resistance heating; and

   EXCEPTION 1 to Section 110.4(a)4: Listed package units with fully insulated enclosures, and with tight-fitting covers that are insulated to at least R-6.

   EXCEPTION 2 to Section 110.4(a)4: Pools or spas deriving at least 60 percent of the annual heating energy from site solar energy or recovered energy.

(b) Installation. Any pool or spa system or equipment shall be installed with all of the following:

1. Piping. At least 36 inches of pipe shall be installed between the filter and the heater or dedicated suction and return lines, or built-in or built-up connections shall be installed to allow for the future addition of solar heating equipment; and
2. Covers. A cover for outdoor pools or outdoor spas that have a heat pump or gas heater.
3. Directional inlets and time switches for pools. If the system or equipment is for a pool:
   i. The pool shall have directional inlets that adequately mix the pool water; and
   ii. A time switch or similar control mechanism shall be installed as part of a pool water circulation control system that will allow all pumps to be set or programmed to run only during the off-peak electric demand period and for the minimum time necessary to maintain the water in the condition required by applicable public health standards.

SECTION 110.5 – NATURAL GAS CENTRAL FURNACES, COOKING EQUIPMENT, AND POOL AND SPA HEATERS: PILOT LIGHTS PROHIBITED

Any natural gas system or equipment listed below may be installed only if it does not have a continuously burning pilot light:

(a) Fan-type central furnaces.

(b) Household cooking appliances.

EXCEPTION to Section 110.5(b): Household cooking appliances without an electrical supply voltage connection and in which each pilot consumes less than 150 Btu/hr.

(c) Pool heaters.

(d) Spa heaters.

SECTION 110.6 – MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS

(a) **Certification of Fenestration Products and Exterior Doors other than Field-fabricated.** Any fenestration product and exterior door, other than field-fabricated fenestration products and field-fabricated exterior doors, may be installed only if the manufacturer has certified to the Commission, or if an independent certifying organization approved by the Commission has certified that the product complies with all of the applicable requirements of this subsection.

1. **Air leakage.** Manufactured fenestration products and exterior doors shall have air infiltration rates not exceeding 0.3 cfm/ft² of window area, 0.3 cfm/ft² of door area for residential doors, 0.3 cfm/ft² of door area for nonresidential single doors (swinging and sliding), and 1.0 cfm/ft² for nonresidential double doors (swinging), when tested according to NFRC-400 or ASTM E283 at a pressure differential of 75 pascals (or 1.57 pounds/ft²), incorporated herein by reference.

   NOTES TO SECTION 110.6(a)1:

   1. Pet doors must meet 0.3 cfm/ft² when tested according to ASTM E283 at 75 pascals (or 1.57 pounds/ft²).
   2. AAMA/WDMA/CSA 101/I.S.2/A440-2011 specification is equivalent to ASTM E283 at a pressure differential of 75 pascals (or 1.57 pounds/ft²) satisfies the air leakage certification requirements of this section.

   EXCEPTION to Section 110.6(a)1: Field-fabricated fenestration and field-fabricated exterior doors.

2. **U-factor.** The fenestration product's U-factor shall be rated in accordance with NFRC 100, or use the applicable default U-factor set forth in TABLE 110.6-A.

   EXCEPTION 1 to Section 110.6(a)2: If the fenestration product is a skylight or a vertical site-built fenestration product in a building covered by the nonresidential standards with less than 1,000 square feet of site-built fenestration, the default U-factor may be calculated as set forth in Reference Nonresidential Appendix NA6.

   EXCEPTION 2 to Section 110.6(a)2: If the fenestration product is an alteration consisting of any area replacement of glass in a skylight product or in a vertical site-built fenestration product, in a building covered by the nonresidential standards, the default U-factor may be calculated as set forth in Reference Nonresidential Appendix NA6.

3. **Solar Heat Gain Coefficient (SHGC).** The fenestration product's SHGC shall be rated in accordance with NFRC 200, or use the applicable default SHGC set forth in TABLE 110.6-B.

   EXCEPTION 1 to Section 110.6(a)3: If the fenestration product is a skylight or a vertical site-built fenestration product in a building covered by the nonresidential standards with less than 1,000 square feet of site-built fenestration, the default SHGC may be calculated as set forth in Reference Nonresidential Appendix NA6.

   EXCEPTION 2 to Section 110.6(a)3: If the fenestration product is an alteration consisting of any area replacement of glass in a skylight product or in a vertical site-built fenestration product, in a building covered by the nonresidential standards, the default SHGC may be calculated as set forth in Reference Nonresidential Appendix NA6.

4. **Visible Transmittance (VT).** The fenestration product's VT shall be rated in accordance with NFRC 200 or ASTM E972, for tubular skylights VT shall be rated using NFRC 203**.**

   EXCEPTION 1 to Section 110.6(a)4: If the fenestration product is a skylight or a vertical site-built fenestration product in a building covered by the nonresidential standards with less than 1,000 square feet of site-built fenestration, the default VT may be calculated as set forth in Reference Nonresidential Appendix NA6.

EXCEPTION 2 to Section 110.6(a)4: If the fenestration product is an alteration consisting of any area; replacement of glass in a skylight product or in a vertical site-built fenestration product in a building covered by the nonresidential standards, the default VT may be calculated as set forth in Reference Nonresidential Appendix NA6.

5. **Labeling.** Fenestration products shall:

   A. Have a temporary label for manufactured fenestration products or a label certificate when the Component Modeling Approach (CMA) is used and for site-built fenestration meeting the requirements of Section 10-111(a)1. The temporary label shall not be removed before inspection by the enforcement agency ; and

   B. Have a permanent label or a label certificate when the Component Modeling Approach (CMA) is used and for site-built fenestration meeting the requirements of Section 10-111(a)2 if the product is rated using NFRC procedures.

6. **Fenestration Acceptance Requirements.** Before an occupancy permit is granted, site-built fenestration products in other than low-rise residential buildings shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified in the Reference Nonresidential Appendix NA7 to ensure that site-built fenestration meet Standards requirements, including a matching label certificate for product(s) installed and be readily accessible at the project location. A Certificate of Acceptance certifying that the fenestration product meets the acceptance requirements shall be completed, signed and submitted to the enforcement agency.

   EXCEPTION to Section 110.6(a): Fenestration products removed and reinstalled as part of a building alteration or addition.

(b) **Installation of Field-fabricated Fenestration and Exterior Doors.** Field-fabricated fenestration and field-fabricated exterior doors may be installed only if the compliance documentation has demonstrated compliance for the installation using U-factors from TABLE 110.6-A and SHGC values from TABLE 110.6-B. Field-fabricated fenestration and field-fabricated exterior doors shall be caulked between the fenestration products or exterior door and the building, and shall be weatherstripped.

EXCEPTION to Section 110.6(b): Unframed glass doors and fire doors need not be weather stripped or caulked.

TABLE 110.6-A DEFAULT FENESTRATION PRODUCT U-FACTORS

FRAME	PRODUCT TYPE	SINGLE PANE [3, 4] U-FACTOR	DOUBLE PANE [1, 3, 4] U-FACTOR	GLASS BLOCK [2,3] U-FACTOR
Metal	Operable	1.28	0.79	0.87
	Fixed	1.19	0.71	0.72
	Greenhouse/garden window	2.26	1.40	N.A.
	Doors	1.25	0.77	N.A.
	Skylight	1.98	1.30	N.A.
Metal, Thermal Break	Operable	N.A.	0.66	N.A.
	Fixed	N.A.	0.55	N.A.
	Greenhouse/garden window	N.A.	1.12	N.A.
	Doors	N.A.	0.59	N.A.
	Skylight	N.A.	1.11	N.A.
Nonmetal	Operable	0.99	0.58	0.60
	Fixed	1.04	0.55	0.57
	Doors	0.99	0.53	N.A.
	Greenhouse/garden windows	1.94	1.06	N.A.
	Skylight	1.47	0.84	N.A.

[1] For all dual-glazed fenestration products, adjust the listed U-factors as follows:

a. Add 0.05 for products with dividers between panes if spacer is less than 7/16 inch wide.

b. Add 0.05 to any product with true divided lite (dividers through the panes).

[2] Translucent or transparent panels shall use glass block values when not rated by NFRC 100.

[3] Visible Transmittance (VT) shall be calculated by using Reference Nonresidential Appendix NA6.

[4] Windows with window film applied that is not rated by NFRC 100 shall use the default values from this table.

TABLE 110.6-B DEFAULT SOLAR HEAT GAIN COEFFICIENT (SHGC)

FRAME TYPE	PRODUCT	GLAZING	FENESTRATION PRODUCT SHGC		
			Single Pane[2,3] SHGC	Double Pane[2,3] SHGC	Glass Block[1,2] SHGC
Metal	Operable	Clear	0.80	0.70	0.70
	Fixed	Clear	0.83	0.73	0.73
	Operable	Tinted	0.67	0.59	N.A.
	Fixed	Tinted	0.68	0.60	N.A.
Metal, Thermal Break	Operable	Clear	N.A.	0.63	N.A.
	Fixed	Clear	N.A.	0.69	N.A.
	Operable	Tinted	N.A.	0.53	N.A.
	Fixed	Tinted	N.A.	0.57	N.A.
Nonmetal	Operable	Clear	0.74	0.65	0.70
	Fixed	Clear	0.76	0.67	0.67
	Operable	Tinted	0.60	0.53	N.A.
	Fixed	Tinted	0.63	0.55	N.A.

[1] Translucent or transparent panels shall use glass block values when not rated by NFRC 200.

[2] Visible Transmittance (VT) shall be calculated by using Reference Nonresidential Appendix NA6.

[3] Windows with window film applied that is not rated by NFRC 200 shall use the default values from this table

SECTION 110.7 – MANDATORY REQUIREMENTS TO LIMIT AIR LEAKAGE

All joints, penetrations and other openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, weather stripped, or otherwise sealed to limit infiltration and exfiltration.

SECTION 110.8 – MANDATORY REQUIREMENTS FOR INSULATION, ROOFING PRODUCTS AND RADIANT BARRIERS

(a) **Insulation Certification by Manufacturers.** Any insulation shall be certified by Department of Consumer Affairs, Bureau of Home Furnishing and Thermal Insulation that the insulation conductive thermal performance is approved pursuant to the California Code of Regulations, Title 24, Part 12, Chapters 12-13, Article 3, “Standards for Insulating Material.”

(b) **Installation of Urea Formaldehyde Foam Insulation.** Urea formaldehyde foam insulation may be applied or installed only if:

1. It is installed in exterior side walls; and
2. A four-mil-thick plastic polyethylene vapor retarder or equivalent plastic sheathing vapor retarder is installed between the urea formaldehyde foam insulation and the interior space in all applications.

(c) **Flame Spread Rating of Insulation.** All insulating material shall be installed in compliance with the flame spread rating and smoke density requirements of the CBC.

(d) **Installation of Insulation in Existing Buildings.** Insulation installed in an existing attic, or on an existing duct or water heater, shall comply with the applicable requirements of Subsections 1, 2, and 3 below. If a contractor installs the insulation, the contractor shall certify to the customer, in writing, that the insulation meets the applicable requirements of Subsections 1, 2, and 3 below.

1. **Attics.** If insulation is installed in the existing attic of a low-rise residential building, the R-value of the total amount of insulation (after addition of insulation to the amount, if any, already in the attic) shall meet the requirements of Section 150.0(a).

   EXCEPTION to Section 110.8(d)1: 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 1203.2 of Title 24, Part 2.

2. **Water heaters.** If external insulation is installed on an existing unfired water storage tank or on an existing back-up tank for a solar water-heating system, it shall have an R-value of at least R-12, or the heat loss of the tank surface based on an 80°F water-air temperature difference shall be less than 6.5 Btu per hour per square foot.

3. **Ducts.** If insulation is installed on an existing space-conditioning duct, it shall comply with Section 604.0 of the CMC.

(e) RESERVED

(f) RESERVED

(g) **Insulation Requirements for Heated Slab Floors.** Heated slab floors shall be insulated according to the requirements in Table 110.8-A.

1. Insulation materials in ground contact must:
   A. Comply with the certification requirements of Section 110.8(a); and
   B. Have a water absorption rate for the insulation material alone without facings that are no greater than 0.3 percent when tested in accordance with Test Method A – 24 Hour-Immersion of ASTM C272.
   C. Water vapor permeance no greater than 2.0 perm/inch when tested in accordance with ASTM E96.
2. Insulation installation must:
   A. Be covered with a solid guard that protects against damage from ultraviolet radiation, moisture, landscaping operation, equipment maintenance, and wind; and

B. Include a rigid plate, which penetrates the slab and blocks the insulation from acting as a conduit for insects from the ground to the structure above the foundation.

TABLE 110.8-A SLAB INSULATION REQUIREMENTS FOR HEATED SLAB FLOOR

Insulation Location	Insulation Orientation	Installation Requirements	Climate Zone	Insulation R-Value
Outside edge of heated slab, either inside or outside the foundation wall	Vertical	From the level of the top of the slab, down 16 inches or to the frost line, whichever is greater. Insulation may stop at the top of the footing where this is less than the required depth. For below grade slabs, vertical insulation shall be extended from the top of the foundation wall to the bottom of the foundation (or the top of the footing) or to the frost line, whichever is greater.	1 – 15	5
			16	10
Between heated slab and outside foundation wall	Vertical and Horizontal	Vertical insulation from top of slab at inside edge of outside wall down to the top of the horizontal insulation. Horizontal insulation from the outside edge of the vertical insulation extending 4 feet toward the center of the slab in a direction normal to the outside of the building in plan view.	1 – 15	5
			16	10 vertical and 7 horizontal

(h) **Wet Insulation Systems.** When insulation is installed on roofs above the roofing membrane or layer used to seal the roof from water penetration, the effective R-value of the insulation shall be as specified in Reference Joint Appendix JA4.

(i) **Roofing Products Solar Reflectance and Thermal Emittance.**

1. In order to meet the requirements of Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1H or 150.2(b)2, a roofing product's thermal emittance and an aged solar reflectance shall be certified and labeled according to the requirements of Section 10-113.

   EXCEPTION 1 to Section 110.8(i)1: Roofing products that are not certified according to Section 10-113 shall assume the following default aged solar reflectance/thermal emittance values:

   A. For asphalt shingles: 0.08/0.75

   B. For all other roofing products: 0.10/0.75

2. If CRRC testing for an aged solar reflectance is not available for any roofing products, the aged value shall be derived from the CRRC initial value using the equation ρ_{aged}=[0.2+β[$\rho_{initial}$-0.2], where $\rho_{initial}$ = the initial solar reflectance and soiling resistance β is listed by product type in TABLE 110.8-B.

TABLE 110.8-B VALUES OF SOILING RESISTANCE β BY PRODUCT TYPE

Product Type	CRRC Product Category	β
Field-Applied Coating	Field-Applied Coating	0.65
Other	Not A Field-Applied Coating	0.70

3. Solar Reflectance Index (SRI), calculated as specified by ASTM E 1980-01, may be used as an alternative to thermal emittance and an aged solar reflectance when complying with the requirements of Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1H,or 150.2(b)2. SRI calculations shall be based on moderate wind velocity of 2-6 meters per second. The SRI shall be calculated based on the aged reflectance value of the roofing products.

4. Liquid applied roof coatings applied to low-sloped roofs in the field as the top surface of a roof covering shall:

   A. Be applied across the entire roof surface to meet the dry mil thickness or coverage recommended by the coating manufacturer, taking into consideration the substrate on which the coating is applied, and

B. Meet the minimum performance requirements listed in TABLE 110.8-C or the minimum performance requirements of ASTM C836, D3468, or D6694, whichever are appropriate to the coating material.

EXCEPTION 1 to Section 110.8(i)4B: Aluminum-pigmented asphalt roof coatings shall meet the requirements of ASTM D2824 and be installed as specified by ASTM D3805.

EXCEPTION 2 to Section 110.8(i)4B: Cement-based roof coatings shall contain a minimum of 20 percent cement and shall meet the requirements of ASTM C1583, ASTM D822, and ASTM D5870.

TABLE 110.8-C MINIMUM PERFORMANCE REQUIREMENTS FOR LIQUID APPLIED ROOF COATINGS

Physical Property	ASTM Test Procedure	Requirement
Initial percent elongation (break)	D 2370	Minimum 200% @ 73° F (23° C)
Initial percent elongation (break) OR Initial Flexibility	D 2370 D522, Test B	Minimum 60% @ 0° F (-18° C) Minimum pass 1" mandrel @ 0° F (-18° C)
Initial tensile strength (maximum stress)	D 2370	Minimum 100 psi (1.38 Mpa) @ 73° F (23° C)
Initial tensile strength (maximum stress) OR Initial Flexibility	D 2370 D522, Test B	Minimum 200 psi (2.76 Mpa) @ 0° F (-18° C) Minimum pass 1" mandrel @ 0° F (-18° C)
Final percent elongation (break) after accelerated weathering 1000 h	D2370	Minimum 100% @ 73° F (23° C)
Final percent elongation (break) after accelerated weathering 1000 h OR Flexibility after accelerated weathering 1000h	D2370 D522, Test B	Minimum 40% @ 0° F (-18° C) Minimum pass 1" mandrel @ 0° F (-18° C)
Permeance	D 1653	Maximum 50 perms
Accelerated weathering 1000 h	D 4798	No cracking or checking[1]
[1] Any cracking or checking visible to the eye fails the test procedure.		

(j) **Radiant Barrier.** A radiant barrier shall have an emittance of 0.05 or less, tested in accordance with ASTM C1371 or ASTM E408, and shall be certified to the Department of Consumer Affairs as required by Title 24, Part12, Chapter 12-13, Standards for Insulating Material.

SECTION 110.9 – MANDATORY REQUIREMENTS FOR LIGHTING CONTROL DEVICES AND SYSTEMS, BALLASTS, AND LUMINAIRES

(a) All lighting control devices and systems, ballasts, and luminaires subject to the requirements of Section 110.9 shall meet the following requirements:

1. Shall be installed only if the lighting control device or system, ballast, or luminaire complies with all of the applicable requirements of Section 110.9.
2. Lighting controls may be individual devices (Self Contained Lighting Control) or systems (Lighting Control Systems) consisting of two or more components.
3. Self Contained Lighting Controls, as defined in Section 100.1, shall be certified by the Manufacturer as required by the Title 20 Appliance Efficiency Regulations.
4. Lighting Control Systems, as defined in Section 100.1, shall be a fully functional lighting control system complying with the applicable requirements in Section 110.9(b), and shall meet the Lighting Control Installation requirements in Section 130.4.
5. If indicator lights are integral to a lighting control system, they shall consume no more than one watt of power per indicator light.

(b) **All Installed Lighting Control Systems** listed in Section 110.9(b) shall comply with the requirements listed below; and all components of the system considered together as installed shall meet all applicable requirements for the application for which they are installed as required in Sections 130.0 through 130.5, Sections 140.6 through 140.8, Section 141.0, and Section 150.0(k).

1. **Time-Switch Lighting Controls**

   A. **Automatic Time-Switch Controls** shall meet all requirements for Automatic Time Switch Control devices in the Title 20 Appliance Efficiency Regulations.

   B. **Astronomical Time-Switch Controls** shall meet all requirements for Astronomical Time-Switch Control devices in the Title 20 Appliance Efficiency Regulations.

   C. **Multi-Level Astronomical Time-Switch Controls,** in addition to meeting all of the requirements for Astronomical Time-Switch Controls, shall include at least 2 separately programmable steps per zone.

   D. **Outdoor Astronomical Time-Switch Controls**, in addition to meeting all of the requirements for Astronomical Time-Switch Controls, shall have setback functions that allow the lighting on each controlled channel to be switched or dimmed to lower levels. The set back functions shall be capable of being programmed by the user for at least one specific time of day.

2. **Daylighting Controls**

   A. **Automatic Daylight Controls** shall meet all requirements for Automatic Daylight Control devices in the Title 20 Appliance Efficiency Regulations.

   B. **Photo Controls** shall meet all requirements for Photo Control devices in the Title 20 Appliance Efficiency Regulations.

3. **Dimmers** shall meet all requirements for Dimmer Control devices in the Title 20 Appliance Efficiency Regulations.

4. **Occupant Sensing Controls:** Occupant, Motion, and Vacancy Sensor Controls shall meet the following requirements:

   A. **Occupant Sensors** shall meet all applicable requirements for Occupant Sensor Control devices in the Title 20 Appliance Efficiency Regulations.

   B. **Motion Sensors** shall meet all applicable requirements for Motion Sensor Controls devices in the Title 20 Appliance Efficiency Regulations.

C. **Vacancy Sensors** shall meet all applicable requirements for Vacancy Sensor Controls devices in the Title 20 Appliance Efficiency Regulations.

D. **Partial-ON Sensors** shall meet all applicable requirements for partial on sensing devices in the Title 20 Appliance Efficiency Regulations.

E. **Partial-OFF Sensors** shall meet all applicable requirements for partial off sensing devices in the Title 20 Appliance Efficiency Regulations.

F. All Occupant Sensing Control types shall be programmed to turn OFF all or part of the lighting no longer than 20 minutes after the space is vacated of occupants, except as specified by Section 130.1(c)8.

EXCEPTION to Section 110.9(b)4: Occupant Sensing Control systems may consist of a combination of single or multi-level Occupant, Motion, or Vacancy Sensor Controls, provided that components installed to comply with manual-on requirements shall not be capable of conversion by the user from manual-on to automatic-on functionality.

5. **Part-Night Outdoor Lighting Controls**, as defined in Section 100.1, shall meet all of the following requirements:

A. Have sunrise and sunset prediction accuracy within +/- 15 minutes and timekeeping accuracy within five minutes per year; and

B. Have the ability to setback or turn off lighting at night as required in Section 130.2(c), by means of a programmable timeclock or motion sensing device; and

C. When controlled with a timeclock, shall be capable of being programmed to allow the setback or turning off of the lighting to occur from any time at night until any time in the morning, as determined by the user.

(c) **Track Lighting Integral Current Limiter.** An integral current limiter for line-voltage track lighting shall be recognized for compliance with Part 6 only if it meets all of the following requirements:

1. Shall be certified to the Energy Commission as meeting all of the applicable requirements in Section 110.9(c); and
2. Shall comply with the Lighting Control Installation requirements in accordance with Section 130.4; and
3. Shall be manufactured so that the current limiter housing is used exclusively on the same manufacturer's track for which it is designed; and
4. Shall be designed so that the current limiter housing is permanently attached to the track so that the system will be irreparably damaged if the current limiter housing were to be removed after installation into the track. Methods of attachment may include but are not limited to one-way barbs, rivets, and one-way screws; and
5. Shall employ tamper resistant fasteners for the cover to the wiring compartment; and
6. Shall have the identical volt-ampere (VA) rating of the current limiter, as installed and rated for compliance with Part 6 clearly marked as follows; and:

A. So that it is visible for the enforcement agency’s field inspection without opening coverplates, fixtures, or panels; and

B. Permanently marked on the circuit breaker; and

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

7. Shall have a conspicuous factory installed label permanently affixed to the inside of the wiring compartment warning against removing, tampering with, rewiring, or bypassing the device; and
8. Each electrical panel from which track lighting integral current limiters are energized shall have a factory printed label permanently affixed and prominently located, stating the following: "NOTICE: Current limiting devices installed in track lighting integral current limiters connected to this panel shall only be

replaced with the same or lower amperage. Adding track or replacement of existing current limiters with higher continuous ampere rating will void the track lighting integral current limiter certification, and will require re-submittal of compliance documentation to the enforcement agency responsible for compliance with the California Title 24, Part 6 Building Energy Efficiency Standards."

(d) **Track Lighting Supplementary Overcurrent Protection Panel.** A Track Lighting Supplementary Overcurrent Protection Panel shall be used only for line-voltage track lighting and shall be recognized for compliance with Part 6 only if it meets all of the following requirements:

1. Shall comply with the Lighting Control Installation requirements in accordance with Section 130.4; and
2. Shall be listed as defined in Section 100.1; and
3. Shall be used only for line voltage track lighting. No other lighting or building power shall be used in a Supplementary Overcurrent Protection Panel used to determine input wattage for track lighting; and
4. Be permanently installed in an electrical equipment room, or permanently installed adjacent to the lighting panel board providing supplementary overcurrent protection for the track lighting circuits served by the supplementary over current protection pane; and
5. Shall have a permanently installed label that is prominently located stating the following: "NOTICE: This Panel for Track Lighting Energy Code Compliance Only. The overcurrent protection devices in this panel shall only be replaced with the same or lower amperage. No other overcurrent protective device shall be added to this panel. Adding to, or replacement of existing overcurrent protective device(s) with higher continuous ampere rating, will void the panel listing and require re-submittal of compliance documentation to the enforcement agency responsible for compliance with the California Title 24, Part 6 Building Energy Efficiency Standards."

(e) **JA8 High Efficacy Light Sources.** To qualify as JA8 high efficacy light source for compliance with the residential lighting Standards in Section 150.0(k), a residential light source shall be certified to the Energy Commission according to Reference Joint Appendix JA8. Nonresidential light sources are not required to be certified to the Energy Commission.

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

1. Be rated by the ballast manufacturer to have a minimum rated life of 30,000 hours when operated at or below a specified maximum case temperature. This maximum ballast case temperature specified by the ballast manufacturer shall not be exceeded when tested in accordance to UL 1598 Section 19.15; and
2. Have a ballast factor of not less than 0.90 for non-dimming ballasts and a ballast factor of not less than 0.85 for dimming ballasts.

SECTION 110.10 – MANDATORY REQUIREMENTS FOR SOLAR READY BUILDINGS

(a) **Covered Occupancies.**

1. **Single Family Residences.** Single family residences located in subdivisions with ten or more single family residences and where the application for a tentative subdivision map for the residences has been deemed complete by the enforcement agency shall comply with the requirements of Section 110.10(b) through 110.10(e).
2. **Low-rise Multi-family Buildings.** Low-rise multi-family buildings shall comply with the requirements of Section 110.10(b) through 110.10(d).
3. **Hotel/Motel Occupancies and High-rise Multi-family Buildings.** Hotel/motel occupancies and high-rise multi-family buildings with ten habitable stories or fewer shall comply with the requirements of Section 110.10(b) through 110.10(d).
4. **All Other Nonresidential Buildings.** All other nonresidential buildings with three habitable stories or fewer shall comply with the requirements of Section 110.10(b) through 110.10(d).

(b) **Solar Zone.**

1. **Minimum Area.** The solar zone shall have a minimum total area as described below. The solar zone shall comply with access, pathway, smoke ventilation, and spacing requirements as specified in Title 24, Part 9 or other Parts of Title 24 or in any requirements adopted by a local jurisdiction. The solar zone total area shall be comprised of areas that have no dimension less than five feet and are no less than 80 square feet each for buildings with roof areas less than or equal to 10,000 square feet or no less than 160 square feet each for buildings with roof areas greater than 10,000 square feet.

   A. **Single Family Residences.** The solar zone shall be located on the roof or overhang of the building and have a total area no less than 250 square feet.

   EXCEPTION 1 to Section 110.10(b)1A: Single family residences with a permanently installed solar electric system having a nameplate DC power rating, measured under Standard Test Conditions, of no less than 1000 watts.

   EXCEPTION 2 to Section 110.10(b)1A: Single family residences with a permanently installed domestic solar water-heating system meeting the installation criteria specified in the Reference Residential Appendix RA4 and with a minimum solar savings fraction of 0.50.

   EXCEPTION 3 to Section 110.10(b)1A: Single family residences with three habitable stories or more and with a total floor area less than or equal to 2000 square feet and having a solar zone total area no less than 150 square feet.

   EXCEPTION 4 to Section 110.10(b)1A: Single family residences located in Climate zones 8-14 and the Wildland-Urban Interface Fire Area as defined in Title 24, Part 2 and having a whole house fan and having a solar zone total area no less than 150 square feet.

   EXCEPTION 5 to Section 110.10(b)1A: Buildings with a designated solar zone area that is no less than 50 percent of the potential solar zone area. The potential solar zone area is the total area of any low-sloped roofs where the annual solar access is 70 percent or greater and any steep-sloped roofs oriented between 110 degrees and 270 degrees of true north where the annual solar access is 70 percent or greater. Solar access is the ratio of solar insolation including shade to the solar insolation without shade. Shading from obstructions located on the roof or any other part of the building shall not be included in the determination of annual solar access.

   EXCEPTION 6 to Section 110.10(b)1A: Single family residences having a solar zone total area no less than 150 square feet and where all thermostats comply with Reference Joint Appendix JA5 and are capable of receiving and responding to Demand Response Signals prior to granting of an occupancy permit by the enforcing agency.

   EXCEPTION 7 to Section 110.10(b)1A: Single family residences meeting the following conditions:

A. All thermostats comply with Reference Joint Appendix JA5 and are capable of receiving and responding to Demand Response Signals prior to granting of an occupancy permit by the enforcing agency.

B. Comply with one of the following measures:

i. Install a dishwasher that meets or exceeds the ENERGY STAR Program requirements with either a refrigerator that meets or exceeds the ENERGY STAR Program requirements or a whole house fan driven by an electronically commutated motor; or

ii. Install a home automation system capable of, at a minimum, controlling the appliances and lighting of the dwelling and responding to demand response signals; or

iii. Install alternative plumbing piping to permit the discharge from the clothes washer and all showers and bathtubs to be used for an irrigation system in compliance with the *California Plumbing Code* and any applicable local ordinances; or

iv. Install a rainwater catchment system designed to comply with the *California Plumbing Code* and any applicable local ordinances, and that uses rainwater flowing from at least 65 percent of the available roof area.

B. **Low-rise and High-rise Multi-family Buildings, Hotel/Motel Occupancies, and Nonresidential Buildings.** The solar zone shall be located on the roof or overhang of the building or on the roof or overhang of another structure located within 250 feet of the building or on covered parking installed with the building project and have a total area no less than 15 percent of the total roof area of the building excluding any skylight area.

EXCEPTION 1 to Section 110.10(b)1B: Buildings with a permanently installed solar electric system having a nameplate DC power rating, measured under Standard Test Conditions, of no less than one watt per square foot of roof area.

EXCEPTION 2 to Section 110.10(b)1B: Buildings with a permanently installed domestic solar water-heating system complying with Section 150.1(c)8Ciii.

EXCEPTION 3 to Section 110.10(b)1B: Buildings with a designated solar zone area that is no less than 50 percent of the potential solar zone area. The potential solar zone area is the total area of any low-sloped roofs where the annual solar access is 70 percent or greater and any steep-sloped roofs oriented between 110 degrees and 270 degrees of true north where the annual solar access is 70 percent or greater. Solar access is the ratio of solar insolation including shade to the solar insolation without shade. Shading from obstructions located on the roof or any other part of the building shall not be included in the determination of annual solar access.

EXCEPTION 4 to Section 110.10(b)1B: Low-rise and high-rise multifamily buildings meeting the following conditions:

A. All thermostats in each dwelling unit comply with Reference Joint Appendix JA5 and are capable of receiving and responding to Demand Response Signals prior to granting of an occupancy permit by the enforcing agency.

B. In each dwelling unit, comply with one of the following measures:

i. Install a dishwasher that meets or exceeds the ENERGY STAR Program requirements with either a refrigerator that meets or exceeds the ENERGY STAR Program requirements or a whole house fan driven by an electronically commutated motor; or

ii. Install a home automation system capable of, at a minimum, controlling the appliances and lighting of the dwelling and responding to demand response signals; or

iii. Install alternative plumbing piping to permit the discharge from the clothes washer and all showers and bathtubs to be used for an irrigation system in compliance with the *California Plumbing Code* and any applicable local ordinances; or

iv. Install a rainwater catchment system designed to comply with the *California Plumbing Code* and any applicable local ordinances, and that uses rainwater flowing from at least 65 percent of the available roof area.

EXCEPTION 5 to Section 110.10(b)1B: Buildings where the roof is designed and approved to be used for vehicular traffic or parking or for a heliport.

2. **Orientation.** All sections of the solar zone located on steep-sloped roofs shall be oriented between 110 degrees and 270 degrees of true north.

3. **Shading.**

   A. No obstructions, including but not limited to, vents, chimneys, architectural features, and roof mounted equipment, shall be located in the solar zone.

   B. Any obstruction, located on the roof or any other part of the building that projects above a solar zone shall be located at least twice the distance, measured in the horizontal plane, of the height difference between the highest point of the obstruction and the horizontal projection of the nearest point of the solar zone, measured in the vertical plane.

   EXCEPTION to Section 110.10(b)3: Any roof obstruction, located on the roof or any other part of the building, that is oriented north of all points on the solar zone.

4. **Structural Design Loads on Construction Documents.** For areas of the roof designated as solar zone, the structural design loads for roof dead load and roof live load shall be clearly indicated on the construction documents.

   NOTE: Section 110.10(b)4 does not require the inclusion of any collateral loads for future solar energy systems.

(c) **Interconnection Pathways.**

1. The construction documents shall indicate a location for inverters and metering equipment and a pathway for routing of conduit from the solar zone to the point of interconnection with the electrical service. For single family residences the point of interconnection will be the main service panel.

2. The construction documents shall indicate a pathway for routing of plumbing from the solar zone to the water-heating system.

(d) **Documentation.** A copy of the construction documents or a comparable document indicating the information from Sections 110.10(b) through 110.10(c) shall be provided to the occupant.

(e) **Main Electrical Service Panel.**

1. The main electrical service panel shall have a minimum busbar rating of 200 amps.

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 solar electric installation.

   A. **Location.** The reserved space shall be positioned at the opposite (load) end from the input feeder location or main circuit location.

   B. **Marking.** The reserved space shall be permanently marked as “For Future Solar Electric”.

SECTION 110.11 – MANDATORY REQUIREMENTS FOR ELECTRICAL POWER DISTRIBUTION SYSTEM

Certification by Manufacturers. Any electrical power distribution system equipment listed in this section may be installed only if the manufacturer has certified to the Commission that the equipment complies with all the applicable requirements of this section.

(a) **Low-voltage dry-type distribution transformer** shall be certified by the Manufacturer as required by the Title 20 Appliance Efficiency Regulations.

EXCEPTION to Section 110.11(a):

1. autotransformer;
2. drive (isolation) transformer;
3. grounding transformer;
4. machine-tool (control) transformer;
5. nonventilated transformer;
6. rectifier transformer;
7. regulating transformer;
8. sealed transformer;
9. special-impedance transformer;
10. testing transformer;
11. transformer with tap range of 20 percent or more;
12. uninterruptible power supply transformer; or
13. welding transformer.

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SUBCHAPTER 3
NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, HOTEL/MOTEL OCCUPANCIES, AND COVERED PROCESSES—MANDATORY REQUIREMENTS

SECTION 120.0— GENERAL

Sections 120.1 through 120.9 establish requirements for the design and installation of building envelopes, ventilation, space-conditioning and service water-heating systems and equipment in nonresidential, high-rise residential, and hotel/motel buildings as well as covered processes that are within the scope of Section 100.0(a).

NOTE: The requirements of Sections 120.1 through 120.9 apply to newly constructed buildings. Section 141.0 specifies which requirements of Sections 120.1 through 120.9 also apply to additions or alterations to existing buildings.

SECTION 120.1 – REQUIREMENTS FOR VENTILATION

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the requirements of Section 120.1(a) through 120.1(e).

(a) **General Requirements.**

1. All enclosed spaces in a building shall be ventilated in accordance with the requirements of this section and the California Building Code.

   EXCEPTION to Section 120.1(a)1: Refrigerated warehouses and other spaces or buildings that are not normally used for human occupancy and work.

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

(b) **Design Requirements for Minimum Quantities of Outdoor Air.** Every space in a building shall be designed to have outdoor air ventilation according to Item 1 or 2 below:

1. **Natural ventilation.**

   A. Naturally ventilated spaces shall be permanently open to and within 20 feet of operable wall or roof openings to the outdoors, the openable area of which is not less than 5 percent of the conditioned floor area of the naturally ventilated space. Where openings are covered with louvers or otherwise obstructed, openable area shall be based on the free unobstructed area through the opening.

   EXCEPTION to Section 120.1(b)1A: Naturally ventilated spaces in high-rise residential dwelling units and hotel/motel guest rooms shall be open to and within 25 feet of operable wall or roof openings to the outdoors.

   B. The means to open required operable openings shall be readily accessible to building occupants whenever the space is occupied.

2. **Mechanical ventilation.** Each space that is not naturally ventilated under Item 1 above shall be ventilated with a mechanical system capable of providing an outdoor air rate no less than the larger of:

   A. The conditioned floor area of the space times the applicable ventilation rate from TABLE 120.1-A; or

   B. 15 cfm per person times the expected number of occupants.

   For meeting the requirement in Section 120.1(b)2B for spaces without fixed seating, the expected number of occupants shall be either the expected number specified by the building designer or one half of the maximum occupant load assumed for egress purposes in the CBC, whichever is greater. For spaces with fixed seating, the expected number of occupants shall be determined in accordance with the CBC.

   EXCEPTION to Section 120.1(b)2: Transfer air. The rate of outdoor air required by Section 120.1(b)2 may be provided with air transferred from other ventilated spaces if:

   A. None of the spaces from which air is transferred have any unusual sources of indoor air contaminants; and

   B. The outdoor air that is supplied to all spaces combined, is sufficient to meet the requirements of Section 120.1(b)2 for each space individually.

(c) **Operation and Control Requirements for Minimum Quantities of Outdoor Air.**

1. **Times of occupancy.** The minimum rate of outdoor air required by Section 120.1(b)2 shall be supplied to each space at all times when the space is usually occupied.

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

EXCEPTION 2 to Section 120.1(c)1: Temporary reduction. The rate of outdoor air provided to a space may be reduced below the level required by Section 120.1(b)2 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.

2. **Pre-occupancy.** The lesser of the minimum rate of outdoor air required by Section 120.1(b)2 or three complete air changes shall be supplied to the entire building during the 1-hour period immediately before the building is normally occupied.

3. **Required Demand Control Ventilation.** HVAC systems with the following characteristics shall have demand ventilation controls complying with 120.1(c)4:

   A. They have an air economizer; and

   B. They serve 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); and

   C. They are either:

      i. Single zone systems with any controls; or

      ii. Multiple zone systems with Direct Digital Controls (DDC) to the zone level.

   EXCEPTION 1 to Section 120.1(c)3: Classrooms, call centers, office spaces served by multiple zone systems that are continuously occupied during normal business hours with occupant density greater than 25 people per 1000 ft² as specified by Section 120.1(b)2B, healthcare facilities and medical buildings, and public areas of social services buildings are not required to have demand control ventilation.

   EXCEPTION 2 to Section 120.1(c)3: Where space exhaust is greater than the design ventilation rate specified in Section 120.1(b)2B minus 0.2 cfm per ft² of conditioned area.

   EXCEPTION 3 to Section 120.1(c)3: 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, or beauty salons shall not install demand control ventilation.

   EXCEPTION 4 to Section 120.1(c)3: Spaces with an area of less than 150 square feet, or a design occupancy of less than 10 people as specified by Section 120.1(b)2B.

   EXCEPTION 5 to Section 120.1(c)3: Spaces with an area of less than 1,500 square feet complying with Section 120.1(c)5.

4. **Demand Control Ventilation Devices.**

   A. For each system with demand control ventilation, CO_2 sensors shall be installed in each room that meets the criteria of Section 120.1(c)3 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, signal from any sensor indicating that CO_2 is near or at the setpoint within a space, shall trigger an increase in ventilation to the space;

   B. CO_2 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;

   C. Demand ventilation controls shall maintain CO_2 concentrations less than or equal to 600 ppm plus the outdoor air CO_2 concentration in all rooms with CO_2 sensors;

      EXCEPTION to Section 120.1(c)4C: The outdoor air ventilation rate is not required to be larger than the design outdoor air ventilation rate required by Section 120.1(b)2 regardless of CO_2 concentration.

   D. Outdoor air CO_2 concentration shall be determined by one of the following:

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

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

E. When the system is operating during hours of expected occupancy, the controls shall maintain system outdoor air ventilation rates no less than the rate listed in TABLE 120.1-A times the conditioned floor area for spaces with CO_2 sensors, plus the rate required by Section 120.1(b)2 for other spaces served by the system, or the exhaust air rate whichever is greater;

F. CO_2 sensors shall be certified by the manufacturer to be accurate within plus or minus 75 ppm at a 600 and 1000 ppm concentration when measured at sea level and 25°C, factory calibrated, and certified by the manufacturer to require calibration no more frequently than once every 5 years. Upon detection of sensor failure, the system shall provide a signal which resets to supply the minimum quantity of outside air to levels required by Section 120.1(b)2 to the zone serviced by the sensor at all times that the zone is occupied.

G. The CO_2 sensor(s) reading for each zone shall be displayed continuously, and shall be recorded on systems with DDC to the zone level.

5. **Occupant Sensor Ventilation Control Devices.** When occupancy sensor ventilation devices are required by Section 120.2(e)3 or when meeting EXCEPTION 5 to Section 120.1(c)3, occupant sensors shall be used to reduce the rate of outdoor air flow when occupants are not present in accordance with the following:

A. 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. Occupant sensors controlling lighting may be used for ventilation as long as the ventilation signal is independent of daylighting, manual lighting overrides or manual control of lighting. When a single zone damper or a single zone system serves multiple rooms, there shall be an occupancy sensor in each room and the zone is not considered vacant until all rooms in the zone are vacant.

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

C. Within 30 minutes after being vacant for all rooms served by a zone damper on a multiple zone system, and the space temperature is between the heating and cooling setpoints, then no outside air is required and supply air shall be zero.

D. Within 30 minutes after being vacant for all rooms served by a single zone system, the single zone system shall cycle off the supply fan when the space temperature is between the heating and cooling setpoints.

E. In spaces equipped with an occupant sensor, when vacant during hours of expected occupancy and the occupied ventilation rate required by Section 120.1(b)2 is not provided, then the system or zone controls shall cycle or operate to maintain the average outdoor air rate over an averaging period of 120 minutes equal to 25percent of the rate listed in TABLE 120.1-A.

Exception to 120.1(c)5: If Demand Control Ventilation is implemented as required by Section 120.1(4).

(d) **Ducting for Zonal Heating and Cooling Units.** Where a return plenum is used to distribute outdoor air to a zonal heating or cooling unit which then supplies the air to a space in order to meet the requirements of Section 120.1(b)2, the outdoor air shall be ducted to discharge either:

1. Within 5 feet of the unit; or

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

(e) **Design and Control Requirements for Quantities of Outdoor Air.**

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

2. 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.

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

TABLE 120.1-A MINIMUM VENTILATION RATES

TYPE OF USE	**CFM PER SQUARE FOOT OF CONDITIONED FLOOR AREA**
Auto Repair Workshops	1.50
Barber Shops	0.40
Bars, cocktail lounges, and casinos	0.20
Beauty shops	0.40
Coin-operated dry cleaning	0.30
Commercial dry cleaning	0.45
High-rise residential	Ventilation Rates Specified by the CBC
Hotel guest rooms (less than 500 ft^2)	30 cfm/guest room
Hotel guest rooms (500 ft^2 or greater)	0.15
Retail stores	0.20
All others	0.15

SECTION 120.2 – REQUIRED CONTROLS FOR SPACE-CONDITIONING SYSTEMS

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.2(a) through 120.2(k).

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

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

1. All zones are also served by an interior cooling system;
2. The perimeter system is designed solely to offset envelope heat losses or gains;
3. The perimeter system has at least one thermostatic control for each building orientation of 50 feet or more; and
4. The perimeter system is controlled by at least one thermostat located in one of the zones served by the system.

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

1. Where used to control comfort heating, the thermostatic controls shall be capable of being set, locally or remotely, down to 55°F or lower.
2. Where used to control comfort cooling, the thermostatic controls shall be capable of being set, locally or remotely, up to 85°F or higher.
3. Where used to control both comfort heating and comfort cooling, the thermostatic controls shall meet Items 1 and 2 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 120.2(b)3: Systems with thermostats that require manual changeover between heating and cooling modes.
4. Thermostatic controls for all single zone air conditioners and heat pumps, shall comply with the requirements of Section 110.2(c) and Reference Joint Appendix JA5 or, if equipped with DDC to the Zone level, with the Automatic Demand Shed Controls of Section 120.2(h).

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

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

(c) **Hotel/Motel Guest Room and High-rise Residential Dwelling Unit Thermostats.**

1. Hotel/motel guest room thermostats shall:

   A. Have numeric temperature setpoints in °F and °C; and

   B. Have setpoint stops, which are accessible only to authorized personnel, such that guest room occupants cannot adjust the setpoint more than ±5°F (±3°C); and

   C. Meet the requirements of Section 150.0(i).

   EXCEPTION to Section 120.2(c)1: Thermostats that are integrated into the room heating and cooling equipment.

2. High-rise residential dwelling unit thermostats shall meet the requirements of Section 150.0(i).

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

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

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

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

   B. An occupancy sensor; or

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

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

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

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

   EXCEPTION to Section 120.2(e)2A: Thermostat setback controls are not required in nonresidential buildings in areas where the Winter Median of Extremes outdoor air temperature determined in accordance with Section 140.4(b)4 is greater than 32°F.

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

   EXCEPTION to Section 120.2(e)2B: Thermostat setup controls are not required in nonresidential buildings in areas where the Summer Design Dry Bulb 0.5 percent temperature determined in accordance with Section 140.4(b)4 is less than 100°F.

3. Multipurpose room less than 1000 square feet, classrooms greater than 750 square feetand conference, convention, auditorium and meeting center rooms greater than 750 square feet that do not have processes or operations that generate dusts, fumes, vapors or gasses shall be equipped with occupant sensor(s) to accomplish the following during unoccupied periods:

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

   B. Automatically reset the minimum required ventilation rate with an occupant sensor ventilation control device according to Section 120.1(c)5.

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

   EXCEPTION 2 to Sections 120.2(e)1, 2, and 3: Where it can be demonstrated to the satisfaction of the enforcing agency that shutdown, setback, and setup will not result in a decrease in overall building source energy use.

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

   EXCEPTION 4 to Sections 120.2(e)1 and 2: Systems serving hotel/motel guest rooms, if they have a readily accessible manual shut-off switch.

   EXCEPTION 5 to Sections 120.2(e)3:. If Demand Control Ventilation is implemented as required by Section 120.1(c)3 and 120.1(c)(4).

4. Hotel and motel guest rooms shall have captive card key controls, occupancy sensing controls, or automatic controls such that, no longer than 30 minutes after the guest room has been vacated, setpoints are setup at least +5°F (+3°C) in cooling mode and set-down at least -5°F (-3°C) in heating mode.

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

EXCEPTION 1 to Section 120.2(f): Where it can be demonstrated to the satisfaction of the enforcing agency that the equipment serves an area that must operate continuously.

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

EXCEPTION 3 to Section 120.2(f): At combustion air intakes and shaft vents.

EXCEPTION 4 to Section 120.2(f): Where prohibited by other provisions of law.

(g) **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.

1. Each zone, or any combination of zones not exceeding 25,000 square feet, shall be a separate isolation area.
2. 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.
3. Each isolation area shall be controlled by a device meeting the requirements of Section 120.2(e)1.

EXCEPTION to Section 120.2(g): A zone need not be isolated if it can be demonstrated to the satisfaction of the enforcement agency that the zone must be heated or cooled continuously.

(h) **Automatic Demand Shed Controls.** HVAC systems with DDC to the Zone level shall be programmed to allow centralized demand shed for non-critical zones as follows:

1. The controls shall have a capability to remotely setup the operating cooling temperature set points by 4 degrees or more in all non-critical zones on signal from a centralized contact or software point within an Energy Management Control System (EMCS).
2. The controls shall have a capability to remotely setdown the operating heating temperature set points by 4 degrees or more in all non-critical zones on signal from a centralized contact or software point within an EMCS.
3. The controls shall have capabilities to remotely reset the temperatures in all non-critical zones to original operating levels on signal from a centralized contact or software point within an EMCS.
4. The controls shall be programmed to provide an adjustable rate of change for the temperature setup and reset.
5. The controls shall have the following features:
   A. Disabled. Disabled by authorized facility operators; and
   B. Manual control. Manual control by authorized facility operators to allow adjustment of heating and cooling set points globally from a single point in the EMCS; and
   C. Automatic Demand Shed Control. Upon receipt of a demand response signal, the space-conditioning systems shall conduct a centralized demand shed, as specified in Sections 120.2(h)1 and 120.2(h)2, for non-critical zones during the demand response period.

(i) **Economizer Fault Detection and Diagnostics (FDD).** All newly installed air-cooled packaged direct-expansion units with an air handler mechanical cooling capacity greater than 54,000 Btu/hr with an installed air economizer shall include a stand alone or integrated Fault Detection and Diagnostics (FDD) system in accordance with Subsections 120.2(i)1 through 120.2(i)8.

1. 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
2. Temperature sensors shall have an accuracy of ±2°F over the range of 40°F to 80°F; and
3. The controller shall have the capability of displaying the value of each sensor; and
4. 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.

5. The unit controller shall manually initiate each operating mode so that the operation of compressors, economizers, fans, and heating systems can be independently tested and verified; and

6. 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.

7. The FDD system shall detect the following faults:

   A. Air temperature sensor failure/fault;

   B. Not economizing when it should;

   C. Economizing when it should not;

   D. Damper not modulating; and

   E. Excess outdoor air.

8. The FDD System shall be certified by the Energy Commission as meeting requirements of Sections 120.2(i)1 through 120.2(i)7 in accordance with Section 110.0 and JA6.3.

(j) Direct Digital Controls (DDC). Direct Digital Controls to the zone shall be provided as specified by Table 120.2-A. The provided DDC system shall meet the control logic requirements of Sections 120.1(c) and 120.2(h), and be capable of the following:

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

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

3. 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;

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

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

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

TABLE 120.2-A *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

(k) **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.

SECTION 120.3 – REQUIREMENTS FOR PIPE INSULATION

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.3(a) through 120.3(c).

(a) **General Requirements.** The piping conditions listed below for space-conditioning and service water-heating systems with fluid temperatures listed in TABLE 120.3-A, shall have the amount of insulation specified in Subsection (c):

1. **Space Cooling Systems.** All refrigerant suction, chilled water and brine lines.
2. **Space Heating Systems.** All steam, steam condensate and hot water lines.
3. **Service water-heating systems.**

    A. Recirculating system piping, including the supply and return piping of the water heater.

    B. The first 8 feet of hot and cold outlet piping for a nonrecirculating storage system.

    C. The inlet pipe between the storage tank and a heat trap in a nonrecirculating storage system.

    D. Pipes that are externally heated.

Insulation conductivity shall be determined in accordance with ASTM C335 at the mean temperature listed in TABLE 120.3-A, and shall be rounded to the nearest 1/100 Btu-inch per hour per square foot per °F.

(b) **Insulation Protection**Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind, including but not limited to, the following:

1. Insulation exposed to weather shall be installed with a cover suitable for outdoor service. The cover shall be water retardant and provides shielding from solar radiation that can cause degradation of the material.
2. Insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall have a Class I or Class II vapor retarder. All penetrations and joints of which shall be sealed.

(c) **Insulation Thickness**

1. For insulation with a conductivity in the range shown in TABLE 120.3-A for the applicable fluid temperature range, the insulation shall have the applicable thickness shown in TABLE 120.3-A.
2. For insulation with a conductivity outside the range shown in TABLE 120.3-A for the applicable fluid temperature range, the insulation shall have a minimum thickness as calculated with:

INSULATION THICKNESS EQUATION

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

WHERE:

T	=	Minimum insulation thickness for material with conductivity *K*, inches.
PR	=	Pipe actual outside radius, inches.
t	=	Insulation thickness from TABLE 120.3-A, inches.
K	=	Conductivity of alternate material at the mean rating temperature indicated in TABLE 120.3-A 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 TABLE 120.3-A for the applicable fluid temperature range, Btu-inch per hour per square foot per °F.

TABLE 120.3-A PIPE INSULATION THICKNESS

FLUID TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)				
			< 1	**1 to <1.5**	**1.5 to < 4**	**4 to < 8**	**8 and larger**
			INSULATION THICKNESS REQUIRED (in inches)				
Space heating, Hot Water systems (steam, steam condensate and hot water) and Service Water Heating Systems (recirculating sections, all piping in electric trace tape systems, and the first 8 feet of piping from the storage tank for nonrecirculating systems)							
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.32	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)							
40-60	0.21-0.27	75	Nonres 0.5 / Res 0.75	Nonres 0.5 / Res 0.75	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0	1.5	1.5	1.5	1.5

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

EXCEPTION 2 to Section 120.3: Piping that conveys fluids with a design operating temperature range between 60°F and 105°F.

EXCEPTION 3 to Section 120.3: Gas piping, cold domestic water piping, condensate drains, roof drains, vents, or waste piping.

EXCEPTION 4 to Section 120.3: Where the heat gain or heat loss to or from piping without insulation will not increase building source energy use.

EXCEPTION 5 to Section 120.3: 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.

SECTION 120.4 – REQUIREMENTS FOR AIR DISTRIBUTION SYSTEM DUCTS AND PLENUMS

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.4(a) through 120.4(f).

(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 be installed, sealed and insulated to 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.

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:

1. Outdoors; or
2. In a space between the roof and an insulated ceiling; or
3. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces; or
4. In an unconditioned crawlspace; or
5. 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 any higher level required by CMC Section 605.0) or be enclosed in directly conditioned space.

(b) **Duct and Plenum Materials.**

1. **Factory-fabricated duct systems.**

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

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

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

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

2. **Field-fabricated duct systems.**

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

   B. Mastic sealants and mesh.

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

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

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

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

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

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

E. Drawbands used with flexible duct.

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

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

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

F. Aerosol-sealant closures.

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

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

(c) 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.

(d) The installed thickness of duct insulation used to determine its R-value shall be determined as follows:

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

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

3. 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.

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

(f) **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.

SECTION 120.5 – REQUIRED NONRESIDENTIAL MECHANICAL SYSTEM ACCEPTANCE

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.5(a) and 120.5(b).

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

1. Outdoor air ventilation systems shall be tested in accordance with NA7.5.1
2. Constant volume, single zone air conditioning and heat pump unit controls shall be tested in accordance with NA7.5.2.
3. Duct systems shall be tested in accordance with NA7.5.3 where either:

   A. They are new duct systems that meet the criteria of Sections 140.4(l)1, 140.4(l)2, and 140.4(l)3; or

   B. They are part of a system that meets the criteria of Section 141.0(b)2D.
4. Air economizers shall be tested in accordance with NA7.5.4.

   EXCEPTION to Section 120.5(a)4: 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.
5. Demand control ventilation systems required by Section 120.1(c)3 shall be tested in accordance with NA7.5.5
6. Supply fan variable flow controls shall be tested in accordance with NA7.5.6
7. Hydronic system variable flow controls shall be tested in accordance with NA7.5.7 and NA7.5.9
8. Boiler or chillers that require isolation controls as specified by Section 140.4(k)2 or 140.4(k)3 shall be tested in accordance with NA7.5.7
9. Hydronic systems with supply water temperature reset controls shall be tested in accordance with NA7.5.8
10. Automatic demand shed controls shall be tested in accordance with NA7.5.10.
11. Fault Detection and Diagnostics (FDD) for Packaged Direct-Expansion Units shall be tested in accordance with NA7.5.11.
12. Automatic Fault Detection and Diagnostics (FDD) for air handling units and zone terminal units shall be tested in accordance with NA7.5.12.
13. Distributed Energy Storage DX AC Systems shall be tested in accordance with NA7.5.13.
14. Thermal Energy Storage (TES) Systems shall be tested in accordance with NA7.5.14.
15. Supply air temperature reset controls shall be tested in accordance with NA7.5.15.
16. Water-cooled chillers served by cooling towers with condenser water reset controls shall be tested in accordance with NA7.5.16.
17. When an Energy Management Control System is installed, it shall functionally meet all of the applicable requirements of Part 6.

(b) When certification is required by Title 24, Part 1, Section 10-103.2, the acceptance testing specified by Section 120.5(a) 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.

NOTE: Authority: Sections 25402, 25402.1, and 25213, Public Resources Code. Reference: Sections 25007, 25402(a)-(b), 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code.

SECTION 120.6 – MANDATORY REQUIREMENTS FOR COVERED PROCESSES

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.6(a) through 120.6(g).

(a) **Mandatory Requirements for Refrigerated Warehouses**

Refrigerated Warehouses that are greater than or equal to 3,000 square feet shall meet the requirements of Subsections 1, 2, 3, 6 and 7 of Section 120.6(a).

Refrigerated Spaces that are less than 3,000 square feet shall meet the requirements of the Appliance Efficiency Regulations for walk-in coolers or freezers contained in the Appliance Efficiency Regulations (California Code of Regulations, Title 20, Sections 1601 through 1608).

Refrigerated Spaces that (i) comprise a total of 3,000 square feet or more; and (ii) are collectively served by the same refrigeration system compressor(s) and condenser(s) shall meet the requirements of Subsections 4, 5 and 7 of Section 120.6(a).

1. **Insulation Requirements.** Exterior surfaces of refrigerated warehouses shall be insulated at least to the R-values in TABLE 120.6-A.

TABLE 120.6-A REFRIGERATED WAREHOUSE INSULATION

SPACE	SURFACE	MINIMUM R-VALUE (°F·hr·sf/Btu)
Freezers	Roof/Ceiling	R-40
	Wall	R-36
	Floor	R-35
	Floor with all heating from productive refrigeration capacity[1]	R-20
Coolers	Roof/Ceiling	R-28
	Wall	R-28

[1.] All underslab heating is provided by a heat exchanger that provides refrigerant subcooling or other means that result in productive refrigeration capacity on the associated refrigerated system.

2. **Underslab heating.** Electric resistance heat shall not be used for the purposes of underslab heating.

   EXCEPTION to Section 120.6(a)2: Underslab heating systems controlled such that the electric resistance heat is thermostatically controlled and disabled during the summer on-peak period defined by the local electric utility.

3. **Evaporators.** New fan-powered evaporators used in coolers and freezers shall conform to the following:

   A. Single phase fan motors less than 1 hp and less than 460 Volts in newly installed evaporators 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.

   B. Evaporator fans served either by a suction group with multiple compressors, or by a single compressor with variable capacity capability shall be variable speed and the speed shall be controlled in response to space temperature or humidity.

      EXCEPTION 1 to Section 120.6(a)3B: Addition, alteration or replacement of less than all of the evaporators in an existing refrigerated space that does not have speed-controlled evaporators.

      EXCEPTION 2 to Section 120.6(a)3B: Coolers within refrigerated warehouses that maintain a Controlled Atmosphere for which a licensed engineer has certified that the types of products stored will require constant operation at 100 percent of the design airflow.

      EXCEPTION 3 to Section 120.6(a)3B: Areas within refrigerated warehouses that are designed solely for the purpose of quick chilling/freezing of products, including but not limited to spaces with design cooling capacities of greater than 240 Btu/hr-ft^2 (2 tons per 100 ft^2).

C. Evaporator fans served by a single compressor that does not have variable capacity shall utilize controls to reduce airflow by at least 40 percent for at least 75 percent of the time when the compressor is not running.

EXCEPTION to Section 120.6(a)3C: Areas within refrigerated warehouses that are designed solely for the purpose of quick chilling/freezing of products (space with design cooling capacities of greater than 240 Btu/hr-ft² (2 tons per 100 ft²)).

4. **Condensers.** New fan-powered condensers on new refrigeration systems shall conform to the following:

A. Design saturated condensing temperatures for evaporative-cooled condensers and water-cooled condensers served by fluid coolers or cooling towers shall be less than or equal to:

i. The design wetbulb temperature plus 20°F in locations where the design wetbulb temperature is less than or equal to 76°F; or

ii. The design wetbulb temperature plus 19°F in locations where the design wetbulb temperature is between 76°F and 78°F; or

iii. The design wetbulb temperature plus 18°F in locations were the design wetbulb temperature is greater than or equal to 78°F.

EXCEPTION to Section 120.6(a)4A: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

B. Design saturated condensing temperatures for air-cooled condensers shall be less than or equal to the design drybulb temperature plus 10°F for systems serving freezers and shall be less than or equal to the design drybulb temperature plus 15°F for systems serving coolers.

EXCEPTION 1 to Section 120.6(a)4B: Condensing units with a total compressor horsepower less than 100 HP.

EXCEPTION 2 to Section 120.6(a)4B: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

C. All condenser fans for evaporative-cooled condensers or fans on cooling towers or fluid coolers shall be continuously variable speed, and the condensing temperature control system shall control the speed of all fans serving a common condenser high side in unison. The minimum condensing temperature setpoint shall be less than or equal to 70°F.

D. All condenser fans for air-cooled condensers shall be continuously variable speed and the condensing temperature or pressure control system shall control the speed of all condenser fans serving a common condenser high side in unison. The minimum condensing temperature setpoint shall be less than or equal to 70°F.

E. Condensing temperature reset. The condensing temperature set point of systems served by air-cooled condensers shall be reset in response to ambient drybulb temperature. The condensing temperature set point of systems served by evaporative-cooled condensers or water-cooled condensers (via cooling towers or fluid coolers) shall be reset in response to ambient wetbulb temperatures.

EXCEPTION to Section 120.6(a)4E: Condensing temperature control strategies approved by the Executive Director that have been demonstrated to provide at least equal energy savings.

F. Fan-powered condensers shall meet the condenser efficiency requirements listed in TABLE 120.6-B. Condenser efficiency is defined as the Total Heat of Rejection (THR) capacity divided by all electrical input power including fan power at 100 percent fan speed, and power of spray pumps for evaporative condensers.

G. Air-cooled condensers shall have a fin density no greater than 10 fins per inch.

EXCEPTION to Section 120.6(a)4G: Micro-channel condensers.

TABLE 120.6-B FAN-POWERED CONDENSERS – MINIMUM EFFICIENCY REQUIREMENTS

CONDENSER TYPE	REFRIGERANT TYPE	MINIMUM EFFICIENCY	RATING CONDITION
Outdoor Evaporative-Cooled with THR Capacity > 8,000 MBH	All	350 Btuh/Watt	100°F Saturated Condensing Temperature (SCT), 70°F Outdoor Wetbulb Temperature
Outdoor Evaporative-Cooled with THR Capacity < 8,000 MBH and Indoor Evaporative-Cooled	All	160 Btuh/Watt	
Outdoor Air-Cooled	Ammonia	75 Btuh/Watt	105°F Saturated Condensing Temperature (SCT), 95°F Outdoor Drybulb Temperature
	Halocarbon	65 Btuh/Watt	
Indoor Air-Cooled	All	Exempt	

5. **Compressors.** Compressor systems utilized in refrigerated warehouses shall conform to the following:

   A. Compressors shall be designed to operate at a minimum condensing temperature of 70°F or less.

   B. New open-drive screw compressors in new refrigeration systems with a design saturated suction temperature (SST) of 28°F or lower that discharges to the system condenser pressure shall control compressor speed in response to the refrigeration load.

   EXCEPTION 1 to Section 120.6(a)5B: Refrigeration plants with more than one dedicated compressor per suction group.

   EXCEPTION 2 to Section 120.6(a)5B: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

   C. New screw compressors with nominal electric motor power greater than 150 HP shall include the ability to automatically vary the compressor volume ratio (Vi) in response to operating pressures.

6. **Infiltration Barriers.** Passageways between freezers and higher-temperature spaces, and passageways between coolers and nonrefrigerated spaces, shall have an infiltration barrier consisting of strip curtains, an automatically-closing door, or an air curtain designed by the manufacturer for use in the passageway and temperature for which it is applied.

   EXCEPTION 1 to Section 120.6(a)6: Openings with less than 16 square feet of opening area.

   EXCEPTION 2 to Section 120.6(a)6: Dock doorways for trailers.

7. **Refrigeration System Acceptance.** Before an occupancy permit is granted for a new refrigerated warehouse, or before a new refrigeration system serving a refrigerated warehouse is operated for normal use, the following equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements:

   A. Electric resistance underslab heating systems shall be tested in accordance with NA7.10.1.

   B. Evaporators fan motor controls shall be tested in accordance with NA7.10.2.

   C. Evaporative condensers shall be tested in accordance with NA7.10.3.1.

   D. Air-cooled condensers shall be tested in accordance with NA7.10.3.2.

   E. Variable speed compressors shall be tested in accordance with NA7.10.4.

(b) **Mandatory Requirements for Commercial Refrigeration**

Retail food stores with 8,000 square feet or more of conditioned area, and that utilize either: refrigerated display cases, or walk-in coolers or freezers connected to remote compressor units or condensing units, shall meet the requirements of Subsections 1 through 4.

1. **Condensers serving refrigeration systems.** Fan-powered condensers shall conform to the following requirements:

   A. All condenser fans for air-cooled condensers, evaporative-cooled condensers, air or water-cooled fluid coolers or cooling towers shall be continuously variable speed, with the speed of all fans serving a common condenser high side controlled in unison.

   B. The refrigeration system condenser controls for systems with air-cooled condensers shall use variable-setpoint control logic to reset the condensing temperature setpoint in response to ambient drybulb temperature.

   C. The refrigeration system condenser controls for systems with evaporative-cooled condensers shall use variable-setpoint control logic to reset the condensing temperature setpoint in response to ambient wetbulb temperature.

   EXCEPTION to Section 120.6(b)1B and C: Condensing temperature control strategies approved by the executive director that have been demonstrated to provide equal energy savings.

   D. The minimum condensing temperature setpoint shall be less than or equal to 70°F.

   E. Fan-powered condensers shall meet the specific efficiency requirements listed in Table 120.6-C.

TABLE 120.6-C FAN-POWERED CONDENSERS –SPECIFIC EFFICIENCY REQUIREMENTS

CONDENSER TYPE	MINIMUM SPECIFIC EFFICIENCY[a]	RATING CONDITION
Evaporative-Cooled	160 Btuh/W	100°F Saturated Condensing Temperature (SCT), 70°F Entering Wetbulb Temperature
Air-Cooled	65 Btuh/W	105°F Saturated Condensing Temperature (SCT), 95°F Entering Drybulb Temperature

[a] See Section 100.1 for definition of condenser specific efficiency.

   EXCEPTION 1 to Section 120.6(b)1E: Condensers with a Total Heat Rejection capacity of less than 150,000 Btuh at the specific efficiency rating condition.

   EXCEPTION 2 to Section 120.6(b)1E: Stores located in Climate Zone 1.

   EXCEPTION 3 to Section 120.6(b)1E: Existing condensers that are reused for an addition or alteration.

   F. Air-cooled condensers shall have a fin density no greater than 10 fins per inch.

   EXCEPTION 1 to Section 120.6(b)1F: Microchannel condensers.

   EXCEPTION 2 to Section 120.6(b)1F: Existing condensers that are reused for an addition or alteration.

   EXCEPTION to Section 120.6(b)1: New condensers replacing existing condensers when the attached compressor system Total Heat of Rejection does not increase and less than 25 percent of both the attached compressors and the attached display cases are new.

2. **Compressor Systems.** Refrigeration compressor systems and condensing units shall conform to the following requirements.

   A. Compressors and multiple-compressor suction groups shall include control systems that use floating suction pressure logic to reset the target saturated suction temperature based on the temperature requirements of the attached refrigeration display cases or walk-ins.

   EXCEPTION 1 to Section 120.6(b)2A: Single compressor systems that do not have continuously variable capacity capability.

EXCEPTION 2 to Section 120.6(b)2A: Suction groups that have a design saturated suction temperature of 30°F or higher, or suction groups that comprise the high stage of a two-stage or cascade system or that primarily serve chillers for secondary cooling fluids.

B. Liquid subcooling shall be provided for all low temperature compressor systems with a design cooling capacity equal or greater than 100,000 Btu/hr with a design saturated suction temperature of -10°F or lower, with the subcooled liquid temperature maintained continuously at 50°F or less at the exit of the subcooler, using compressor economizer port(s) or a separate medium or high temperature suction group operating at a saturated suction temperature of 18°F or higher.

EXCEPTION to Section 120.6(b)2B: Low temperature cascade systems that condense into another refrigeration system rather than condensing to ambient temperature.

EXCEPTION to Section 120.6(b)2A and 2B: Existing compressor systems that are reused for an addition or alteration.

3. **Refrigerated Display Cases.** Lighting in refrigerated display cases, and lights on glass doors installed on walk-in coolers and freezers shall be controlled by one of the following:

A. Automatic time switch controls to turn off lights during nonbusiness hours. Timed overrides for any line-up or walk-in case may only be used to turn the lights on for up to one hour. Manual overrides shall time-out automatically to turn the lights off after one hour.

B. Motion sensor controls on each case that reduce display case lighting power by at least 50 percent within 30 minutes after the area near the case is vacated.

4. **Refrigeration Heat Recovery.**

A. HVAC systems shall utilize heat recovery from refrigeration system(s) for space heating, using no less than 25 percent of the sum of the design Total Heat of Rejection of all refrigeration systems that have individual Total Heat of Rejection values of 150,000 Btu/h or greater at design conditions.

EXCEPTION 1 to Section 120.6(b)4A: Stores located in Climate Zone 15.

EXCEPTION 2 to Section 120.6(b)4A: HVAC systems or refrigeration systems that are reused for an addition or alteration.

B. The increase in hydrofluorocarbon refrigerant charge associated with refrigeration heat recovery equipment and piping shall be no greater than 0.35 lbs per 1,000 Btu/h of heat recovery heating capacity.

(c) **Mandatory Requirements for Enclosed Parking Garages.** Mechanical ventilation systems for enclosed parking garages where the total design exhaust rate for the garage is greater than or equal to 10,000 cfm shall conform to all of the following:

1. Automatically detect contaminant levels and stage fans or modulate fan airflow rates to 50 percent or less of design capacity provided acceptable contaminant levels are maintained.

2. Have controls and/or devices that will result in fan motor demand of no more than 30 percent of design wattage at 50 percent of design airflow.

3. CO shall be monitored with at least one sensor per 5,000 square feet, with the sensor located in the highest expected concentration locations, with at least two sensors per proximity zone. A proximity zone is defined as an area that is isolated from other areas either by floor or other impenetrable obstruction.

4. CO concentration at all sensors is maintained at 25 ppm or less at all times.

5. The ventilation rate shall be at least 0.15 cfm/ft^2 when the garage is scheduled to be occupied.

6. The system shall maintain the garage at negative or neutral pressure relative to other occupiable spaces when the garage is scheduled to be occupied.

7. CO sensors shall be:

A. Certified by the manufacturer to be accurate within plus or minus 5 percent of measurement.

B. Factory calibrated.

C. Certified by the manufacturer to drift no more than 5 percent per year.

D. Certified by the manufacturer to require calibration no more frequently than once a year.

E. Monitored by a control system. The system shall have logic that automatically checks for sensor failure by the following means. Upon detection of a failure, the system shall reset to design ventilation rates and transmit an alarm to the facility operators.

i. If any sensor has not been calibrated according to the manufacturer's recommendations within the specified calibration period, the sensor has failed.

ii. During unoccupied periods the system compares the readings of all sensors, e.g. if any sensor is more than 15 ppm above or below the average of all sensors for longer than four hours, the sensor has failed.

iii. During occupied periods the system compares the readings of sensors in the same proximity zone, e.g. if the 30 minute rolling average for any sensor in a proximity zone is more than 15 ppm above or below the 30 minute rolling average for other sensor(s) in that proximity zone, the sensor has failed.

8. **Parking Garage Ventilation System Acceptance.** Before an occupancy permit is granted for a parking garage system subject to Section 120.6(c), the following equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.12.

EXCEPTION 1 to Section 120.6(c): Any garage, or portion of a garage, where more than 20 percent of the vehicles expected to be stored have non gasoline combustion engines.

EXCEPTION 2 to Section 120.6(c): Additions and alterations to existing garages where less than 10,000 cfm of new exhaust capacity is being added.

(d) **Mandatory Requirements for Process Boilers**

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

A. All process 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 non-positive vent static pressure.

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

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

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

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

3. Newly installed process boilers with an input capacity of 5 MMBtu/h (5,000,000 Btu/h) to 10 MMBtu/h (10,000,000 Btu/h) shall maintain excess (stackgas) 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 measured flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

4. Newly installed process boilers with an input capacity greater than 10 MMBtu/h (10,000,000 Btu/h) shall maintain excess (stack-gas) oxygen concentrations at less than or equal to 3.0 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 measured flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

(e) **Mandatory Requirements for Compressed Air Systems.** All new compressed air systems, and all additions or alterations of compressed air systems where the total combined online horsepower (hp) of the compressor(s) is 25 horsepower or more shall meet the requirements of Subsections 1 through 3. These requirements apply to the compressors and related controls that provide compressed air and do not apply to any equipment or controls that use or process the compressed air.

EXCEPTION to Section 120.6(e): Alterations of existing compressed air systems that include one or more centrifugal compressors.

1. **Trim Compressor and Storage. .** The compressed air system shall be equipped with an appropriately sized trim compressor and primary storage to provide acceptable performance across the range of the system and to avoid control gaps. The compressed air system shall comply with Subsection A or B below:

   A. The compressed air system shall include one or more variable speed drive (VSD) compressors. For systems with more than one compressor, the total combined capacity of the VSD compressor(s) acting as trim compressors must be at least 1.25 times the largest net capacity increment between combinations of compressors. The compressed air system shall include primary storage of at least one gallon per actual cubic feet per minute (acfm) of the largest trim compressor; or,

   B. The compressed air system shall include a compressor or set of compressors with total effective trim capacity at least the size of the largest net capacity increment between combinations of compressors, or the size of the smallest compressor, whichever is larger. The total effective trim capacity of single compressor systems shall cover at least the range from 70 percent to 100 percent of rated capacity. The effective trim capacity of a compressor is the size of the continuous operational range where the specific power of the compressor (kW/100 acfm) is within 15 percent of the specific power at its most efficient operating point. The total effective trim capacity of the system is the sum of the effective trim capacity of the trim compressors. The system shall include primary storage of at least 2 gallons per acfm of the largest trim compressor.

   EXCEPTION 1 to Section 120.6(e)1: Compressed air systems in existing facilities that are adding or replacing less than 50 percent of the online capacity of the system.

   EXCEPTION 2 to Section 120.6(e)1: Compressed air systems that have been approved by the Energy Commission Executive Director as having demonstrated that the system serves loads for which typical air demand fluctuates less than 10 percent.

2. **Controls.** Compressed air systems with more than one compressor online, having a combined horsepower rating of more than 100 hp, must operate with a controller that is able to choose the most energy efficient combination of compressors within the system based on the current air demand as measured by a sensor.

3. **Compressed Air System Acceptance.** Before an occupancy permit is granted for a compressed air system subject to Section 120.6(e), the following equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA 7.13.

(f) **Mandatory Requirements for Elevators**

1. The light power density for the luminaires inside the elevator cab shall be no greater than 0.6 watts per square foot.

2. Elevator cab ventilation fans for cabs without space conditioning shall not exceed 0.33 watts per CFM as measured at maximum speed.

3. When the elevator cab is stopped and unoccupied with doors closed for over 15 minutes, the cab interior lighting and ventilation fans shall be switched off until elevator cab operation resumes.

4. Lighting and ventilation shall remain operational in the event that the elevator cabin gets stuck when passengers are in the cabin.

5. Elevator Lighting and Ventilation Control Acceptance. Before an occupancy permit is granted for elevators subject to 120.6(f), the following equipment and systems shall be certified as meeting the Acceptance Requirement for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.14.

   EXCEPTION 1 to Section 120.6(f)1: Interior signal lighting and interior display lighting are not included in the calculation of lighting power density.

(g) **Mandatory Requirements for Escalators and Moving Walkways**

1. Escalators and moving walkways located in airports, hotels, and transportation function areas shall automatically slow to the minimum permitted speed in accordance with ASME A17.1/CSA B44 when not conveying passengers.
2. Escalators and Moving Walkways Acceptance. Before an occupancy permit is granted for escalators and moving walkways subject to 120.6(g), the following equipment and systems shall be certified as meeting the Acceptance Requirement for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.15.

SECTION 120.7 –MANDATORY INSULATION REQUIREMENTS

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements in Sections 120.7(a) through 120.7(c).

(a) **Roof/Ceiling Insulation.** The opaque portions of the roof/ceiling that separates conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 3 below:

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

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

3. **Insulation Placement-** Insulation installed to limit heat loss and gain from conditioned spaces to unconditioned spaces shall comply with the following:

   A. Insulation shall be installed in direct contact with a continuous roof or ceiling, which is sealed to limit infiltration and exfiltration as specified in Section 110.7, including but not limited to placing insulation either above or below the roof deck or on top of the finished ceiling; and

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

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

   EXCEPTION to Section 120.7(a)3: When there are conditioned spaces with a combined floor area no greater than 2,000 square feet in an otherwise unconditioned building, and when the average height of the space between the ceiling and the roof over these spaces is greater than 12 feet, insulation placed in direct contact with a suspended ceiling with removable ceiling panels shall be an acceptable method of reducing heat loss from a conditioned space and shall be accounted for in heat loss calculations.

   NOTE: Vents, that do not penetrate the roof deck, that are designed for wind resistance for roof membranes are not within the scope of Section 120.7(a)3B.

(b) **Wall Insulation.** The opaque portions of walls that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 7 below:

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

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

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

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

5. **Wood Framed and Others-** The weighted average U-factor of the wall assembly shall not exceed 0.110.

6. **Spandrel Panels and Opaque Curtain Wall-** The weighted average U-factor of the spandrel panels and opaque 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.

(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 and 2 below:

1. **Raised Mass Floors-** Shall have a minimum of 3 inches of lightweight concrete over a metal deck or the weighted average U-factor of the floor assembly shall not exceed 0.269.
2. **Other Floors-**The weighted average U-factor of the floor assembly shall not exceed 0.071.
3. **Heated Slab Floor-**A heated slab floor shall be insulated to meet the requirements of Section 110.8(g)

EXCEPTION to Section 120.7: A dedicated building used solely as a data center that has a total covered process load exceeding 750 kW.

SECTION 120.8 NONRESIDENTIAL BUILDING COMMISSIONING

Nonresidential buildings with conditioned space of 10,000 square feet or more shall comply with the applicable requirements of Sections 120.8(a) through 120.8(i) in the building design and construction processes. All building systems and components covered by Sections 110.0, 120.0, 130.0, and 140.0 shall be included in the scope of the commissioning requirements in this Section, excluding those related solely to covered processes.

Nonresidential buildings with conditioned space of less than 10,000 square feet shall comply with the design review requirements specified in Sections 120.8(d), and shall include any measures or requirements necessary for completing this review in the construction documents in a manner consistent with Section 120.8(e).

NOTE: Nonresidential buildings include nonresidential spaces such as nonresidential function areas within hotel/motel and highrise residential buildings. The requirements of Section 120.8 apply based on the square footage of the nonresidential spaces.

The commissioning described in this Section is in addition to any commissioning required by Title 24, Part 11, Section 5.410.2, 5.410.4, and subsections.

(a) **Summary of Commissioning Requirements.** Commissioning shall include completion of the following items:

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

(b) **Owner's or Owner Representative's Project Requirements (OPR).** The energy-related expectations and requirements of the building shall be documented before the design phase of the project begins. This documentation shall include the following:

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

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

1. Heating, ventilation, air conditioning (HVAC) systems and controls;
2. Indoor lighting system and controls;
3. Water heating systems and controls; and
4. Any building envelope component considered in the OPR.

(d) **Design Phase Design Review.**

1. **Design Reviewer Requirements.** The design reviewer shall be the signer of the Design Review Kickoff Certificate(s) of Compliance and Construction Document Design Review Checklist Certificate(s) of Compliance as specified in Part 1 Section 10-103(a)1.

2. **Design Review Kickoff.** During the schematic design phase of the building project, the owner or owner's representative, design team and design reviewer must meet to discuss the project scope, schedule and how the design reviewer will coordinate with the project team. The building owner or owner's representative shall include the Design Review Kickoff Certificate of Compliance form in the Certificate of Compliance documentation as specified in Part 1 Section 10-103.

3. **Construction Documents Design Review.** The Construction Document Design Review Checklist Certificate of Compliance shall list the items checked by the design reviewer during the construction document review. The completed form shall be returned to the owner and design team for review and sign-off. The building owner or owner's representative shall include this form in the Certificate of Compliance documentation as specified in Part 1 Section 10-103.

(e) **Commissioning measures shown in the construction documents.** Complete descriptions of all measures or requirements necessary for commissioning shall be included in the construction documents (plans and specifications). Commissioning measures or requirements shall be clear, detailed and complete to clarify the commissioning process.

(f) **Commissioning Plan.** Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started during the design phase of the building project. The Commissioning Plan shall include the following:

1. General project information; and

2. Commissioning goals; and

3 Systems to be commissioned; and

4. Plans to test systems and components, which shall include:

   A. An explanation of the original design intent; and

   B. Equipment and systems to be tested, including the extent of tests; and

   C. Functions to be tested; and

   D. Conditions under which the test shall be performed; and

   E. Measurable criteria for acceptable performance; and

   F. Commissioning team information; and

   G. Commissioning process activities, schedules and responsibilities. Plans for the completion of commissioning requirements listed in Sections 120.8(g) through 120.8(i) shall be included.

(g) **Functional performance testing.** Functional performance tests shall demonstrate the correct installation and operation of each component, system and system-to-system interface in accordance with the acceptance test requirements in Sections 120.5, 130.4 and 140.9. Functional performance testing reports shall contain information addressing each of the building components tested, the testing methods utilized, and include any readings and adjustments made.

(h) **Documentation and training.** A Systems Manual and Systems Operations Training shall be completed.

1. **Systems manual.** Documentation of the operational aspects of the building shall be completed within the Systems Manual and delivered to the building owner or representative and facilities operator. The Systems Manual shall include the following:

   A. Site information, including facility description, history and current requirements; and

   B. Site contact information; and

C. Instructions for basic operations and maintenance, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, and a site events log; and

D. Description of major systems; and

E. Site equipment inventory and maintenance notes; and

F. A copy of all special inspection verifications required by the enforcing agency or the Standards.

2. **Systems operations training**. The training of the appropriate maintenance staff for each equipment type or system shall be documented in the commissioning report. Training materials shall include the following:

A. System and equipment overview (i.e., what the equipment is, what it does and with what other systems or equipment it interfaces)

B. Review and demonstration of operation, servicing and preventive maintenance procedures

C. Review of the information in the Systems Manual

D. Review of the record drawings on the systems and equipment

(i) **Commissioning report.** A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for post-construction phases of the building project shall be completed and provided to the owner or owner's representative.

SECTION 120.9 – MANDATORY REQUIREMENTS FOR COMMERCIAL BOILERS.

(a) Combustion air positive shut-off shall be provided on all newly installed boilers as follows:

1. 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.
2. 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).

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

1. The fan motor shall be driven by a variable speed drive, or
2. 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.

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

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

SUBCHAPTER 4
NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—MANDATORY REQUIREMENTS FOR LIGHTING SYSTEMS AND EQUIPMENT, AND ELECTRICAL POWER DISTRIBUTION SYSTEMS

SECTION 130.0 – LIGHTING SYSTEMS AND EQUIPMENT, AND ELECTRICAL POWER DISTRIBUTION SYSTEMS —GENERAL

(a) The design and installation of all lighting systems and equipment in nonresidential, high-rise residential, hotel/motel buildings, outdoor lighting, and electrical power distribution systems within the scope of Section 100.0(a) shall comply with the applicable provisions of Sections 130.0 through 130.5.

NOTE: The requirements of Sections 130.0 through 130.5 apply to newly constructed buildings. Section 141.0 specifies which requirements of Sections 130.0 through 130.5 also apply to additions and alterations to existing buildings.

(b) **Functional areas where compliance with the residential lighting Standards is required.** The design and installation of all lighting systems, lighting controls, and equipment in the following functional areas shall comply with the applicable provisions of Section 150.0(k). In buildings containing these functional areas, all other functional areas, such as common areas, shall comply with the applicable nonresidential lighting Standards and the applicable nonresidential controlled receptacle requirements in Section 130.5(d).

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

NOTE: The requirements of Section 130.0(b) also apply to additions and alterations to functional areas of existing buildings as specified in Section 130.0(b).

(c) **Luminaire classification and power.** Luminaires shall be classified and wattage determined as follows:

1. **Luminaire labeling.** Luminaire wattage shall be labeled as follows:

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

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

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

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

ii. Low-voltage luminaires (except low voltage track systems), ≤ 24 volts, with a maximum relamping rated wattage of 50 watts.

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

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

   A. The maximum relamping rated wattage of the luminaire; and

   B. For recessed luminaires with line-voltage medium screw base sockets, wattage shall not be less than 50 watts per socket.

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

4. Screwbased adaptors shall not be used to convert an incandescent luminaire to any type of nonincandescent technology. Screw-based adaptors, including screw-base adaptors classified as permanent by the manufacturer, shall not be recognized for compliance with Part 6.

5. Luminaires and luminaire housings with incandescent screw base sockets shall be classified only as incandescent. Field modifications, including but not limited to hard wiring of an LED module, shall not be recognized as converting an incandescent luminaire or luminaire housing to a nonincandescent technology for compliance with Part 6 unless such sockets are removed.

6. Luminaires with permanently installed or remotely installed ballasts or drivers. The wattage of such luminaries shall be determined as follows:
   A. The operating input wattage of the rated lamp/ballast combination published in ballast manufacturer's catalogs based on independent testing lab reports as specified by UL 1598.

   B. The maximum input wattage of the rated driver published in driver's manufacturer catalogs based on independent testing lab reports as specified by UL 8750 or LM-79.

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

   A. The wattage of line voltage busway and track rated for more than 20 amperes shall be the total volt-ampere rating of the branch circuit feeding the busway and track.

   B. The wattage of line voltage busway and track rated for 20 amperes or less shall be determined by one of the following methods:

      i. The volt-ampere rating of the branch circuit feeding the track or busway; or

      ii. The higher of the rated wattage of all of the luminaires included in the system, where luminaire classification and wattage is determined according to the applicable provisions in Section 130.0(c), or 45 watts per linear foot; or

      iii. When using a line-voltage track lighting integral current limiter, the higher of the volt-ampere rating of an integral current limiter controlling the track or busway, or 12.5 watts per linear foot of track or busway. An Integral current limiter shall be certified to the Energy Commission in accordance with Section 110.9, and shall comply with the Lighting Control Installation Requirements in accordance with Section 130.4, to qualify to use Subsection Biii to determine luminaire power; or

iv. When using a dedicated track lighting supplementary overcurrent protection panel, the sum of the ampere (A) rating of all of the overcurrent protection devices times the branch circuit voltages. Track lighting supplementary overcurrent protection panels shall comply with the applicable requirements in Section 110.9, and shall comply with the Lighting Control Installation Requirements in accordance with Section 130.4, to qualify to use Subsection Biv to determine luminaire power.

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

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

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

9. Light emitting diode (LED) Luminaires, and LED Light Engine.

   A. The wattage of such luminaires shall be the maximum rated input wattage of the system when tested in accordance with IES LM-79-08.

   B. The maximum rated input wattage shall be labeled in accordance with Section 130.0(c)1.

   C. An LED lamp, integrated or nonintegrated type in accordance with the definition in ANSI/IES RP-16-2010, shall not be classified as a LED lighting system for compliance with Part 6. LED modules having screw bases, including but not limited to screw based pig-tails, screw-based sockets, or screw-based adaptors, shall not be recognized as a LED lighting system for compliance with Part 6.

   D. Luminaires manufactured or rated for use with low-voltage incandescent lamps, into which have been installed LED modules or LED lamps, shall not be recognized as a LED lighting system for compliance with Part 6.

   E. For LED lighting systems that allow the addition of luminaires or light engines without rewiring, the wattage of such luminaires shall be the maximum rated input wattage of the power supply, labeled in accordance with Section 130.0(c)1 or published in the power supply manufacturer's catalog.

   EXCEPTION to Section 130.0(c)9: Luminaires in areas that must comply with Section 150.0(k), as specified by Section 130.0(b).

10. The wattage of all other miscellaneous lighting equipment shall be the maximum rated wattage of the lighting equipment, or operating input wattage of the system, labeled in accordance with Section 130.0(c)1, or published in manufacturer's catalogs, based on independent testing lab reports as specified by UL 1574 or UL 1598. Lighting technologies listed in Subsections 2 through 9 shall be determined in accordance with the applicable requirements in Subsections 1 through 9.

(d) **Lighting Controls**. All lighting controls and equipment shall comply with the applicable requirements in Section 110.9, and shall be installed in accordance with the manufacturer's instructions.

(e) **Energy Management Control System (EMCS)**.

1. 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 Section 110.9; and

   B. Complies with all applicable Lighting Control Installation Requirements in accordance with Section 130.4 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.

SECTION 130.1 – MANDATORY INDOOR LIGHTING CONTROLS

Nonresidential, high-rise residential and hotel/motel buildings shall comply with the applicable requirements of Sections 130.1(a) through 130.1(e).

(a) Area Controls.

1. All luminaires shall be functionally controlled with manual ON and OFF lighting controls. Each area enclosed by ceiling-height partitions shall be independently controlled.

   EXCEPTION to Section 130.1(a)1: Up to 0.2 watts per square foot of lighting in any area within a building may be continuously illuminated to allow for means of egress illumination, if:

   A. 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

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

2. The lighting controls shall meet the following requirements:

   A. Be readily accessible; and

   B. Be operated with a manual control that is located in the same room or area with the lighting that is controlled by that lighting control.

   EXCEPTION 1 to Section 130.1(a)2: In malls and atria, auditorium areas, retail merchandise sales areas, wholesale showroom areas, commercial and industrial storage areas, general commercial and industrial work areas, convention centers, and arenas, the lighting control shall be located so that a person using the lighting control can see the lights or area controlled by that lighting control, or so that the area being lit is annunciated.

   EXCEPTION 2 to Section 130.1(a)2: Public restrooms having two or more stalls, parking areas, stairwells, and corridors may use a manual control not accessible to unauthorized personnel.

3. **Other Lighting Controls.**

   A. Other lighting controls may be installed in addition to the manual lighting controls provided they do not override the functionality of controls installed in accordance with Section 130.1(a)1, 2, or 4.

4. **Separately Controlled Lighting Systems.** In addition to the requirements in Section 130.1(a)1, 2, and 3:

   A. General lighting shall be separately controlled from all other lighting systems in an area.

   B. Floor and wall display, window display, case display, ornamental, and special effects lighting shall each be separately controlled on circuits that are 20 amps or less.

   C. When track lighting is used, general, display, ornamental, and special effects lighting shall each be separately controlled.

(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 control that meets the following requirements:

1. Lighting shall have the required number of control steps and meet the uniformity requirements in accordance with TABLE 130.1-A;

2. Multi-level lighting controls shall not override the functionally of other lighting controls required for compliance with Sections 130.1(a), and (c) through (e); and

3. Dimmable luminaires shall be controlled by a dimmer control that is capable of controlling lighting through all required lighting control steps and that allows the manual ON and OFF functionality required by Section 130.1(a).

EXCEPTION 1 to Section 130.1(b): Classrooms with a connected general lighting load of 0.7 watts per square feet or less and public restrooms shall have at least one control step between 30-70 percent of full rated power.

EXCEPTION 2 to Section 130.1(b): An area enclosed by ceiling height partitions that has only one luminaire with no more than two lamps.

EXCEPTION 3 to Section 130.1(b): The areas specified in Sections 130.1(c)6 and 7 are not also required to meet the requirements of Section 130.1(b).

(c) **Shut-OFF Controls**

1. In addition to lighting controls installed to comply with Sections 130.1(a) 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 to Section 130.1(c)1C: In the following function areas the area controlled may not exceed 20,000 square feet: Malls, auditoriums, single tenant retail, industrial, convention centers, and arenas,

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

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

   EXCEPTION 2 to Section 130.1(c)1: Lighting complying with Section 130.1(c)5 or 7.

   EXCEPTION 3 to Section 130.1(c)1: Up to 0.1 watts per square foot of lighting in any area within a building may be continuously illuminated, provided that the area is designated for means of egress on the plans and specifications submitted to the enforcement agency under Section 10-103(a)2 of Part 1.

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

   EXCEPTION 5 to Section 130.1(c): 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.

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

   EXCEPTION 1 to Section 130.1(c)2: Single-stall bathrooms less than 70 square feet, and closets less than 70 square feet may use countdown timer switches with a maximum setting capability of ten minutes to comply with the automatic shut-Off requirements.

   EXCEPTION 2 to Section 130.1(c)2: Lighting in a Server Aisle in a Server Room, as defined in Section 100.1, may use countdown timer switches with a maximum setting capability of 30 minutes to comply with the automatic shut-OFF requirements.

3. If an automatic time-switch control, other than an occupant sensing control, is installed to comply with Section 130.1(c)1, it shall incorporate an override lighting control that:

   A. Complies with Section 130.1(a); and

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

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

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

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

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

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

   A. Partial-ON Occupant Sensor capable of automatically activating between 50-70 percent of controlled lighting power, or

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

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

   A. Occupant Sensor; or

   B. Partial-ON Occupant Sensor, or

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

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

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

   A. In aisle ways and open areas in warehouses, lighting shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls shall independently control lighting in each aisle way, and shall not control lighting beyond the aisle way being controlled by the sensor.

      EXCEPTION 1 to Section 130.1(c)6A: In aisle ways and open areas in warehouses in which the installed lighting power is 80 percent or less of the value allowed under the Area Category Method, occupant sensing controls shall reduce lighting power by at least 40 percent.

      EXCEPTION 2 to Section 130.1(c)6A: When metal halide lighting or high pressure sodium lighting is installed in warehouses, occupant sensing controls shall reduce lighting power by at least 40 percent.

   B. In library book stack aisles 10 feet or longer that are accessible from only one end, and library book stack aisles 20 feet or longer that are accessible from both ends, lighting shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls shall independently control lighting in each aisle way, and shall not control lighting beyond the aisle way being controlled by the sensor.

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

7. **Areas where partial OFF occupant sensing controls are required.** Lighting installed in the following areas shall meet the following requirements instead of complying with Section 130.1(c)1.

   A. Lighting in stairwells and common area corridors that provide access to guestrooms and dwelling units of high-rise residential buildings and hotel/motels shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress.

      EXCEPTION to Section 130.1(c)7A: In corridors and stairwells in which the installed lighting power is 80 percent or less of the value allowed under the Area Category Method, occupant sensing controls shall reduce power by at least 40 percent.

   B. In parking garages, parking areas and loading and unloading areas, general lighting shall be controlled by occupant sensing controls having at least one control step between 20 percent and 50 percent of design lighting power. No more than 500 watts of rated lighting power shall be controlled together as a single zone. A reasonably uniform level of illuminance shall be achieved in accordance with the applicable requirements in TABLE 130.1-A. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress.

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

EXCEPTION to Section 130.1(c)7B: 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.

8. Hotel motel guest rooms shall have captive card key controls, occupancy sensing controls, or automatic controls such that, no longer than 30 minutes after the guest room has been vacated, lighting power is switched off.

   EXCEPTION to Section 130.1(c)8: One high efficacy luminaire as defined in TABLE 150.0-A that is switched separately and where the switch is located within 6 feet of the entry door.

(d) **Automatic Daylighting Controls.**

1. Daylit Zones shall be defined as follows:

   A. **SKYLIT DAYLIT ZONE** is the rough area in plan view under each skylight, plus 0.7 times the average ceiling height in each direction from the edge of the rough opening of the skylight, minus any area on a plan beyond a permanent obstruction that is taller than the following: A permanent obstruction that is taller than one-half the distance from the floor to the bottom of the skylight. The bottom of the skylight is measured from the bottom of the skylight well for skylights having wells, or the bottom of the skylight if no skylight well exists.

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

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

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

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

2. Luminaires providing general lighting that are in or are partially in the Skylit Daylit Zones or the Primary Sidelit Daylit Zones shall be controlled independently by fully functional automatic daylighting controls that meet the applicable requirements of Section 110.9, and the applicable requirements below:

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

   B. Luminaires in the Skylit Daylit Zone shall be controlled separately from those in the Primary Sidelit Daylit Zones.

   C. Luminaires that fall in both a Skylit and Primary Sidelit Daylit Zone shall be controlled as part of the Skylit Daylit Zone.

D. **Automatic Daylighting Control Installation and Operation**. For luminaires in daylight zones, automatic daylighting controls shall be installed and configured to operate according to all of the following requirements:

i. Photosensors shall be located so that they are not readily accessible to unauthorized personnel. The location where calibration adjustments are made to automatic daylighting controls shall be readily accessible to authorized personnel and may be inside a locked case or under a cover which requires a tool for access.

ii. Automatic daylighting controls shall provide functional multilevel lighting having at least the number of control steps specified in TABLE 130.1-A.

EXCEPTION 1 to Section 130.1(d)2Dii: Controlled lighting having a lighting power density less than 0.3 W/ft^2 is not required to provide multilevel lighting controls.

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

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

EXCEPTION 1 to Section 130.1(d)2: Rooms in which the combined total installed general lighting power in the Skylit Daylit Zone and Primary Sidelit Daylit Zone is less than 120 Watts.

EXCEPTION 2 to Section 130.1(d)2: Rooms that have a total glazing area of less than 24 square feet.

EXCEPTION 3 to Section 130.1(d)2: Parking garages complying with Section 130.1(d)3.

3. **Parking Garage Daylighting Requirements**. In a parking garage area with a combined total of 36 square feet or more of glazing or opening, luminaires providing general lighting that are in the combined primary and secondary sidelit daylit zones shall be controlled independently from other lighting in the parking garage by automatic daylighting controls, and shall meet the following requirements as applicable:

A. All primary and secondary sidelit daylit zones shall be shown on the plans.

B. Automatic Daylighting Control Installation and Operation. Automatic daylighting control shall be installed and configured to operate according to all of the following requirements:

i. Automatic daylighting controls shall have photosensors that are located so that they are not readily accessible to unauthorized personnel. The location where calibration adjustments are made to the automatic daylighting controls shall be readily accessible to authorized personnel but may be inside a locked case or under a cover which requires a tool for access.

ii. Automatic daylighting controls shall be multilevel, continuous dimming or ON/OFF.

iii. The combined illuminance from the controlled lighting and daylight shall not be less than the illuminance from controlled lighting when no daylight is available.

iv. When illuminance levels measured at the farthest edge of the secondary sidelit zone away from the glazing or opening are greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power consumption shall be zero.

EXCEPTION 1 to Section 130.1(d)3: Luminaires located in the daylight transition zone and luminaires for only dedicated ramps. Daylight transition zone and dedicated ramps are defined in Section 100.1.

EXCEPTION 2 to Section 130.1(d)3: The total combined general lighting power in the primary sidelit daylight zones is less than 60 watts.

(e) **Demand Responsive Controls.**

1. Buildings larger than 10,000 square feet, excluding spaces with a lighting power density of 0.5 watts per square foot or less, shall be capable of automatically reducing lighting power in response to a Demand Response Signal; so that the total lighting power of non-excluded spaces can be lowered by a minimum of 15 percent below the total installed lighting power when a Demand Response Signal is received. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in TABLE 130.1-A.

EXCEPTION to Section 130.1(e): Lighting not permitted by a health or life safety statute, ordinance, or regulation to be reduced shall not be counted toward the total lighting power.

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

TABLE 130.1-A *MULTI-LEVEL LIGHTING CONTROLS AND UNIFORMITY REQUIREMENTS*

Luminaire Type	Minimum Required Control Steps (percent of full rated power[1])	Uniform level of illuminance shall be achieved by:
Line-voltage sockets except GU-24	Continuous dimming 10-100 percent	
Low-voltage incandescent systems		
LED luminaires and LED source systems		
GU-24 rated for LED		
GU-24 sockets rated for fluorescent > 20 watts	Continuous dimming 20-100 percent	
Pin-based compact fluorescent > 20 watts[2]		
GU-24 sockets rated for fluorescent ≤ 20 watts	Minimum one step between 30-70 percent	Stepped dimming; or Continuous dimming; or Switching alternate lamps in a luminaire
Pin-based compact fluorescent ≤ 20 watts[2]		
Linear fluorescent and U-bent fluorescent ≤ 13 watts		
Linear fluorescent and U-bent fluorescent > 13 watts	Minimum one step in each range: 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 area and in the same manner
Track Lighting	Minimum one step between 30 – 70 percent	Step dimming; or Continuous dimming; or Separately switching circuits in multi-circuit track with a minimum of two circuits.
HID > 20 watts	Minimum one step between 50 - 70 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.
Induction > 25 watts		
Other light sources		

1. Full rated input power of ballast and lamp, corresponding to maximum ballast factor
2. Includes only pin based lamps: twin tube, multiple twin tube, and spiral lamps

SECTION 130.2 – OUTDOOR LIGHTING CONTROLS AND EQUIPMENT

Nonresidential, high-rise residential and hotel/motel buildings shall comply with the applicable requirements of Sections 130.2(a) through 130.2(c).

(a) **Outdoor Incandescent Lighting.** All outdoor incandescent luminaires rated over 100 watts, determined in accordance with Section 130.0(c)2, shall be controlled by a motion sensor.

(b) **Luminaire Cutoff Requirements.** All outdoor luminaires rated for use with lamps greater than 150 lamp watts, determined in accordance with Section 130.0(c), shall comply with Backlight, Uplight, and Glare (collectively referred to as "BUG" in accordance with IES TM-15-11, Addendum A) requirements as follows:

1. There are no Backlight requirements in Section 130.2 of Part 6; and
2. Maximum zonal lumens for Uplight shall be in accordance with TABLE 130.2-A; and
3. Maximum zonal lumens for Glare shall be in accordance with TABLE 130.2-B.

NOTE: Title 24, Part 11, Section 5.106.8 includes additional restrictions on backlight, uplight and glare that may apply.

EXCEPTION 1 to Section 130.2(b): Signs.

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

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

EXCEPTION 4 to Section 130.2(b): Temporary outdoor lighting**.**

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

A. Where the existing luminaire does not meet the luminaire BUG requirements in Section 130.2(b); and
B. Spacing between existing poles is greater than six times the mounting height of the existing luminaires; and
C. Where no additional poles are being added to the site; and
D. Where new wiring to the luminaires is not being installed; and
E. Provided that the connected lighting power wattage is not increased.

EXCEPTION 6 to Section 130.2(b): Luminaires that illuminate the public right of way on publicly maintained roadways, sidewalks, and bikeways.

(c) **Controls for Outdoor Lighting.** Outdoor lighting controls shall be installed that meet the following requirements as applicable:

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

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

1. All installed outdoor lighting shall be controlled by a photocontrol or outdoorastronomical time-switch control, or other control capable of automatically shutting OFF the outdoor lighting when daylight is available.
2. All installed outdoor lighting shall be independently controlled from other electrical loads by an automatic scheduling control.
3. All installed outdoor lighting, where the bottom of the luminaire is mounted 24 feet or less above the ground, shall be controlled with automatic lighting controls that meet all of the following requirements:

A. Shall be motion sensors or other lighting control systems that automatically controls lighting in accordance with Item B in response to the area being vacated of occupants; and

B. Shall be capable of automatically reducing the lighting power of each luminaire by at least 40 percent but not exceeding 90 percent, or provide continuous dimming through a range that includes 40 percent through 90 percent, and

C. Shall employ auto-ON functionality when the area becomes occupied; and

D. No more than 1,500 watts of lighting power shall be controlled together.

EXCEPTION 1 to Section 130.2(c)3: Lighting for Outdoor Sales Frontage complying with Section 130.2(c)4.

EXCEPTION 2 to Section 130.2(c)3: Lighting for Building Facades, Ornamental Hardscape and Outdoor Dining complying with Section 130.2(c)5.

EXCEPTION 3 to Section 130.2(c)3:, Outdoor lighting, where luminaire rated wattage is determined in accordance with Section 130.0(c), and which meet one of the following conditions:

A. Pole-mounted luminaires each with a maximum rated wattage of 75 watts; or

B. Non-pole mounted luminaires with a maximum rated wattage of 30 watts each; or

C. Linear lighting with a maximum wattage of 4 watts per linear foot of luminaire.

EXCEPTION 4 to Section 130.2(c)3: Applications listed as Exceptions to Section 140.7(a) shall not be required to meet the requirements of Section 130.2(c)3.

4. For Outdoor Sales Frontage lighting, an automatic lighting control shall be installed that meets the following requirements:

A. A part-night outdoor lighting control as defined in Section 100.1; or

B. Motion sensors capable of automatically reducing lighting power by at least 40 percent but not exceeding 90 percent, and which have auto-ON functionality.

5. For Building Facade, Ornamental Hardscape and Outdoor Dining lighting, an automatic lighting control shall be installed that meets one or more of the following requirements:

A. A part-night outdoor lighting control as defined in Section 100.1; or

B. Motion sensors capable of automatically reducing lighting power by at least 40 percent but not exceeding 90 percent, and which have auto-ON functionality; or

C. A centralized time-based zone lighting control capable of automatically reducing lighting power by at least 50 percent.

D. Outdoor wall mounted luminaires having a bilaterally symmetric distribution as described in the IES Handbook (typically referred to as "wall packs") where the bottom of the luminaire is mounted 24 feet or less above the ground shall comply with the applicable requirements in Section 130.2(c)3.

TABLE 130.2-A UPLIGHT RATINGS (MAXIMUM ZONAL LUMENS)

Secondary Solid Angle	Maximum Zonal Lumens per Outdoor Lighting Zone				
	LZ0	LZ 1	LZ 2	LZ 3	LZ 4
Uplight High (UH) 100 to 180 degrees	0	10	50	500	1,000
Uplight Low (UL) 90 to <100 degrees	0	10	50	500	1,000

TABLE 130.2-B GLARE RATINGS (MAXIMUM ZONAL LUMENS)

	Glare Rating for Asymmetrical Luminaire Types (Type 1, Type II, Type III, Type IV)				
Secondary Solid Angle		**Maximum Zonal Lumens per Outdoor Lighting Zone**			
	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Forward Very High (FVH) 80 to 90 degrees	10	100	225	500	750
Backlight Very High (BVH) 80 to 90 degrees	10	100	225	500	750
Forward High (FH) 60 to <80 degrees	660	1,800	5,000	7,500	12,000
Backlight High (BH) 60 to <80 degrees	110	500	1,000	2,500	5,000
	Glare Rating for Quadrilateral Symmetrical Luminaire Types (Type V, Type V Square)				
Secondary Solid Angle		**Maximum Zonal Lumens per Outdoor Lighting Zone**			
	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Forward Very High (FVH) 80 to 90 degrees	10	100	225	500	750
Backlight Very High (BVH) 80 to 90 degrees	10	100	225	500	750
Forward High (FH) 60 to <80 degrees	660	1,800	5,000	7,500	12,000
Backlight High (BH) 60 to <80 degrees	660	1,800	5,000	7,500	12,000

SECTION 130.3 – SIGN LIGHTING CONTROLS

Nonresidential, high-rise residential and hotel/motel buildings shall comply with the applicable requirements of Section 130.3(a)1 through 130.3(a)3.

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

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

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

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

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

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

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

3. **Demand Responsive Electronic Message Center Control.** An Electronic Message Center (EMC) having a new connected lighting power load greater than 15 kW shall have a control installed that is capable of reducing the lighting power by a minimum of 30 percent when receiving a demand response signal.

EXCEPTION to Section 130.3(a)3: Lighting for EMCs that is not permitted by a health or life safety statute, ordinance, or regulation to be reduced by 30 percent.

SECTION 130.4 –LIGHTING CONTROL ACCEPTANCE AND INSTALLATION CERTIFICATE REQUIREMENTS

Nonresidential, high-rise residential and hotel/motel buildings shall comply with the applicable requirements of Sections 130.4(a) through 130.4(c).

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

1. Certifies that all of the lighting acceptance testing necessary to meet the requirements of Part 6 is completed;
2. Certifies that the applicable procedures in Reference Nonresidential Appendix NA7.6 and NA7.8 have been followed;
3. Certifies that automatic daylight controls comply with Section 130.1(d) and Reference Nonresidential Appendix NA7.6.1;
4. Certifies that lighting shut-OFF controls comply with Section 130.1(c) and Reference Nonresidential Appendix NA7.6.2;
5. Certifies that demand responsive controls comply with Section 130.1(e) and Reference Nonresidential Appendix NA7.6.3; and
6. Certifies that outdoor lighting controls comply with the applicable requirements of Section 130.2(c) and Reference Nonresidential Appendix NA7.8; and
7. Certifies that lighting systems receiving the Institutional Tuning Power Adjustment Factor comply with Section 140.6(a)2J and Reference Nonresidential Appendix NA7.7.6.2.

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

1. 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.
2. Certification that when an Energy Management Control System is installed to function as a lighting control required by Part 6 it functionally meets all applicable requirements for each application for which it is installed, in accordance with Sections 110.9, 130.0 through 130.5, 140.6 through 150.0, and 150.2; and complies with Reference Nonresidential Appendix NA7.7.2.
3. Certification that line-voltage track lighting integral current limiters comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.3.
4. Certification that line-voltage track lighting supplementary overcurrent protection panels comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.4.
5. Certification that interlocked lighting systems used to serve an approved area comply with Section 140.6(a)1; and comply with Reference Nonresidential Appendix NA7.7.5.
6. Certification that lighting controls installed to earn a lighting Power Adjustment Factor (PAF) comply with Section 140.6(a)2; and comply with Reference Nonresidential Appendix NA7.7.6.

7. Certification that additional lighting wattage installed for a videoconference studio complies with Section 140.6(c)2Gvii; and complies with Reference Nonresidential Appendix NA7.7.7.

(c) When certification is required by Title 24, Part 1, Section 10-103.1, the acceptance testing specified by Section 130.4 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 25402, 25402.1, 25213, Public Resources Code. Reference: Sections 25007, 25402(a)-(b), 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code

SECTION 130.5 –ELECTRICAL POWER DISTRIBUTION SYSTEMS

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

(a) **Service Electrical Metering.** Each electrical service or feeder shall have a permanently installed metering system which measures electrical energy use in accordance with TABLE 130.5-A.

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

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

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

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

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

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

1. Install a control capable of automatically shutting OFF the controlled receptacles when the space is typically unoccupied, either at the receptacle or circuit level.When an automatic time switch control is installed it shall incorporate an override control that allows the controlled receptacle to remain ON for no more than 2 hours when an override is initiated and an automatic holiday “shut-OFF” feature that turns OFF all loads for at least 24 hours and then resumes the normally scheduled operation. Countdown timer switches shall not be used to comply with the automatic time switch control requirements; and
2. Install at least one controlled receptacle within 6 feet from each uncontrolled receptacle, or install a splitwired receptacle with at least one controlled and one uncontrolled receptacle. Where receptacles are installed in modular furniture in open office areas, at least one controlled receptacle shall be installed at each workstation; and
3. Provide a permanent and durable marking for controlled receptacles or circuits to differentiate them from uncontrolled receptacles or circuits; and
4. For hotel and motel guest rooms, install controlled receptacles for at least one-half of the 120-volt receptacles in each guestroom. Electric circuits serving controlled receptacles in guestrooms shall have captive card key controls, occupancy sensing controls, or automatic controls so the power is switched off no longer than 30 minutes after the guestroom has been vacated.

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

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

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

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

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

iv. Receptacles on circuits rated more than 20 amperes.

v. 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.

(e) **Demand responsive controls and equipment.** Demand responsive controls and equipment, where installed, shall be capable of receiving and automatically responding to at least one standards-based messaging protocol which enables demand response after receiving a demand response signal.

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

TABLE 130.5-A MINIMUM REQUIREMENTS FOR METERING OF ELECTRICAL LOAD

Metering Functionality	Electrical Services rated 50 kVA or less	Electrical Services rated more than 50kVA and less than or equal to 250 kVA	Electrical Services rated more than 250 kVA and less than or equal to 1000kVA	Electrical Services 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

TABLE 130.5-B MINIMUM REQUIREMENTS FOR SEPARATION OF ELECTRICAL LOAD

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

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SUBCHAPTER 5
NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR ACHIEVING ENERGY EFFICIENCY

SECTION 140.0 – PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

Nonresidential, high-rise residential and hotel/motel buildings shall comply with all of the following:

(a) The requirements of Sections 100.0 through 110.11 applicable to the building project (mandatory measures for all buildings).

(b) The requirements of Sections 120.0 through 130.5 (mandatory measures for nonresidential, high-rise residential and hotel/motel buildings).

(c) Either the performance compliance approach (energy budgets) specified in Section 140.1 or the prescriptive compliance approach specified in Section 140.2 for the Climate Zone in which the building will be located. Climate zones are shown in FIGURE 100.1-A.

NOTE to Section 140.0(c): The Commission periodically updates, publishes, and makes available to interested persons and local enforcement agencies precise descriptions of the Climate Zones, which is available by zip code boundaries depicted in the Reference Joint Appendices along with a list of the communities in each zone.

NOTE to Section 140.0: The requirements of Sections 140.1 through 140.9 apply to newly constructed buildings. Section 141.0 specifies which requirements of Sections 140.1 through 140.9 also apply to additions or alterations to existing buildings.

SECTION 140.1 – PERFORMANCE APPROACH: ENERGY BUDGETS

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

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

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

SECTION 140.2 – PRESCRIPTIVE APPROACH

In order to comply with the prescriptive approach under this section, a building shall be designed with and shall have constructed and installed:

(a) A building envelope that complies with Section 140.3(a);

(b) A minimum daylighting requirement for large enclosed spaces complying with Section 140.3(c);

(c) A space-conditioning system that complies with Section 140.4;

(d) A service water-heating system that complies with Section 140.5;

(e) An indoor lighting system that complies with Section 140.6;

(f) An outdoor lighting system that complies with Section 140.7;

(g) Interior and exterior signs that comply with Section 140.8; and

(h) Covered processes that comply with Section 140.9.

SECTION 140.3 – PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES

A building complies with this section by being designed with and having constructed to meet all prescriptive requirements in Subsection (a) and the requirements of Subsection (c) where they apply.

(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.** Shall meet the requirements of Section 110.8 and the applicable requirements of Subsections i through ii:

i. Nonresidential buildings:

a. Low-sloped roofs in Climate Zones 1 through 16 shall have:

1. A minimum aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75; or

2. A minimum Solar Reflectance Index (SRI) of 75.

EXCEPTION 1 to Section 140.3(a)1Aia: Wood-framed roofs in Climate Zones 3 and 5 are exempt from the requirements of Section 140.3(a)1Aia if the roof assembly has a U-factor of 0.034 or lower.

EXCEPTION 2 to Section 140.3(a)1Aia: Roof constructions that have thermal mass with a weight of at least 25 lb/ft² over the roof membrane are exempt from the requirements of Section 140.3(a)1Aia.

EXCEPTION 3 to SECTION 140.3(a)1Aia: An aged solar reflectance less than 0.63 is allowed provided the maximum roof/ceiling U-factor in TABLE 140.3 is not exceeded.

b. Steep-sloped roofs in Climate Zones 1 through 16 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

ii. High-rise residential buildings and hotels and motels:

a. Low-sloped roofs in Climate Zones 9, 10, 11, 13, 14 and 15 shall have a minimum aged solar reflectance of 0.55 and a minimum thermal emittance of 0.75, or a minimum SRI of 64.

EXCEPTION to Section 140.3(a)1Aiia: Roof constructions that have thermal mass with a weight of at least 25 lb/ft² over the roof membrane .

b. Steep-sloped roofs in Climate Zones 2 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

TABLE 140.3 ROOF/CEILING INSULATION TRADEOFF FOR AGED SOLAR REFLECTANCE

Nonresidential			
Aged Solar Reflectance	Metal Building Climate Zone 1-16 U-factor	Wood framed and Other Climate Zone 6 & 7 U-factor	Wood Framed and Other All Other Climate Zones U-factor
0.62-0.56	0.038	0.045	0.032
0.55-0.46	0.035	0.042	0.030
0.45-0.36	0.033	0.039	0.029
0.35-0.25	0.031	0.037	0.028

EXCEPTION to Section 140.3(a)1A: Roof area covered by building integrated photovoltaic panels and building integrated solar thermal panels are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

B. **Roof Insulation.** Roofs shall have an overall assembly U-factor no greater than the applicable value in Table 140.3- B, C or D, and where required by Section 110.8(e), insulation shall be placed in direct contact with a continuous roof or drywall ceiling.

2. **Exterior Walls.** Exterior walls shall have an overall assembly U-factor no greater than the applicable value in TABLE 140.3-B, C or D.

3. **Demising Walls.** Demising walls shall meet the requirements of Section 120.7(b)7.

4. **Exterior Floors and Soffits.** Exterior floors and soffits shall have an overall assembly U-factor no greater than the applicable value in TABLE 140.3-B, C or D.

5. **Fenestration.** Vertical Windows shall:

A. have (1) a west-facing area no greater than 40 percent of the gross west-facing exterior wall area, or 6 feet times the west-facing display perimeter, whichever is greater; and (2) a total area no greater than 40 percent of the gross exterior wall area, or 6 feet times the display perimeter, whichever is greater; and

EXCEPTION to Section 140.3(a)5A: Window area in demising walls is not counted as part of the window area for this requirement. Demising wall area is not counted as part of the gross exterior wall area or display perimeter for this requirement.

B. Have an area-weighted average U-factor no greater than the applicable value in TABLE140.3 -B, C or D.

EXCEPTION to Section 140.3(a)5B: For vertical fenestration containing chromogenic type glazing:

i. the lower-rated labeled U-factor 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 fenestration; and

iii. area-weighted averaging with other fenestration that is not chromogenic shall not be permitted.

C. Have an area-weighted average Relative Solar Heat Gain Coefficient, RSHGC, excluding the effects of interior shading, no greater than the applicable value in TABLE 140.3-B, C or D.

For purposes of this paragraph, the Relative Solar Heat Gain Coefficient, RSHGC, of a vertical window is:

i. the Solar Heat Gain Coefficient of the window; or

ii. Relative Solar Heat Gain Coefficient is calculated using EQUATION 140.3-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 140.3(a)5C: An area-weighted average Relative Solar Heat Gain CoefficientCoefficient of 0.56 or less shall be used for windows:

a. that are in the first story of exterior walls that form a display perimeter; and
b. for which codes restrict the use of overhangs to shade the windows.

EXCEPTION 2 to Section 140.3(a)5C: For vertical fenestration containing chromogenic type glazing:

i. the lower-rated 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 fenestration; and

iii. area-weighted averaging with other fenestration that is not chromogenic shall not be permitted.

D. Have an area-weighted average Visible Transmittance (VT) no less than the applicable value in TABLE 140.3-B and C, or EQUATION 140.3-B, as applicable.

EXCEPTION 1 to Section 140.3(a)5D: When the fenestration's primary and secondary sidelit daylit zones are completely overlapped by one or more skylit daylit zones, then the fenestration need not comply with Section 140.3(a)5D.

EXCEPTION 2 to Section 140.3(a)5D: If the fenestration's visible transmittance 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 140.3(a)5D: For vertical fenestration containing chromogenic type glazing:

i. the higher rated labeled VT shall be used with automatic controls to modulate the amount of light transmitted into the space in multiple steps in response to daylight levels or solar intensity; and

ii. chromogenic glazing shall be considered separately from other fenestration; and

iii. area-weighted averaging with other fenestration that is not chromogenic shall not be permitted.

EQUATION 140.3-A RELATIVE SOLAR HEAT GAIN COEFFICIENT, RSHGC

$$RSHGC = SHGC_{win} \times \left[1 + \frac{aH}{V} + b\left(\frac{H}{V}\right)^2\right]$$

WHERE:

RSHGC	=	Relative Solar Heat Gain Coefficient.
$SHGC_{win}$	=	Solar Heat Gain Coefficient of the window.
H	=	Horizontal projection of the overhang from the surface of the window in feet, but no greater than V.
V	=	Vertical distance from the window sill to the bottom of the overhang in feet.
a	=	-0.41 for north-facing windows, -1.22 for south-facing windows, and -0.92 for east and west-facing windows.
b	=	0.20 for north-facing windows, 0.66 for south-facing windows, and 0.35 for east and west-facing windows.

EQUATION 140.3-B VERTICAL FENESTRATION MINIMUM VT

$$VT \geq 0.11/ WWR$$

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 140.3-B.

VT = Visible Transmittance of framed window.

6. **Skylights.** Skylights shall:

   A. Have an area no greater than 5 percent of the gross exterior roof area (SRR); and

      EXCEPTION to Section 140.3(a)6A: Atria over 55 feet high shall have a skylight area no greater than 10 percent of the gross exterior roof area.

   B. Have an Area-Weighted Performance Rating U-factor no greater than the applicable value in TABLE 140.3-B, C or D.

      EXCEPTION to Section 140.3(a)6B: For skylights containing chromogenic type glazing:

      i. the lower-rate labeled U-factor shall be used with automatic controls to modulate the amount of U-factor heat flow into the space in multiple steps in response to daylight levels or solar intensity; and

      ii. chromogenic glazing shall be considered separately from other skylights; and

      iii. area-weighted averaging with other skylights that is not chromogenic shall not be permitted.

   C. Have an area-weighted performance rating Solar Heat Gain Coefficient no greater than the applicable value in TABLE 140.3-B, C or D.

      EXCEPTION to Section 140.3(a)6C: For skylights containing chromogenic type glazing:

      i. 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

      ii. chromogenic glazing shall be considered separately from other skylights; and

      iii. area-weighted averaging with other skylights that are not chromogenic shall not be permitted.

   D. Have an Area-Weighted Performance Rating VT no less than the applicable value in TABLE 140.3-B or C; and

      EXCEPTION to Section 140.3(a)6D: For skylights containing chromogenic type glazing:

      i. the higher-rated labeled VT shall be used with automatic controls to modulate the amount of light transmitted into the space in multiple steps in response to daylight levels or solar intensity and;

      ii. chromogenic glazing shall be considered separately from other skylights; and

      iii. area-weighted averaging with other skylights that are not chromogenic shall not be permitted.

   E. Have a glazing material or diffuser that has a measured haze value greater than 90 percent, determined according to ASTM D1003, or other test method approved by the Energy Commission.

      EXCEPTION to Section 140.3(a)6E: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of the skylight and light well.

7. **Exterior doors.** All exterior doors that separate conditioned space from unconditioned space or from ambient air shall have a U-factor not greater than the applicable value in TABLE 140.3-B, C or D. Doors that are more than one-half glass in area are considered Glazed Doors.

8. **Relocatable Public School Buildings.** In complying with Sections 140.3(a)1 to 7 shall meet the following:

A. Relocatable public school buildings shall comply with TABLE 140.3-B for a specific Climate Zone when the manufacturer or builder of the relocatable public school building certifies that the building is intended for use only in a specific Climate Zone; or

B. Relocatable public school buildings shall comply with TABLE 140.3-D for any Climate Zone when the manufacturer or builder of the relocatable public school building certifies that the building is intended for use in any Climate Zone; and

C. The manufacturer or builder of a relocatable public school building shall certify that components of the building comply with requirements of this section by:

i. The placement of two (2) metal identification labels on the building, one mechanically fastened and visible from the exterior and the other mechanically fastened to the interior frame above the ceiling at the end of the module., both labels stating (in addition to any other information by the Division of the State Architect or other law) "Complies with Title 24, Part 6 for all Climate Zones; and

ii. Identification of the location of the 2 labels on the plans submitted to the enforcing agency.

9. **Air Barrier**. To meet the requirement of TABLE 140.3-B, all buildings shall have a continuous air barrier that is designed and constructed to control air leakage into, and out of, the building’s conditioned space. The air barrier shall be sealed at all joints for its entire length and shall be composed of:

A. Materials that have an air permeance not exceeding 0.004 cfm/ft^2, under a pressure differential of 0.3 in. w.g. (1.57 psf) (0.02 L/m^2 at 75 pa), when tested in accordance with ASTM E2178; or

EXCEPTION to Section 140.3(a)9A: Materials in TABLE 140.3-A shall be deemed to comply with Section 140.3(a)9A provided if all joints are sealed and all of the materials are installed as air barriers in accordance with the manufacturer's instructions.

TABLE 140.3-A *MATERIALS DEEMED TO COMPLY WITH SECTION 140.3(a)9A*

	MATERIALS AND THICKNESS		MATERIALS AND THICKNESS
1	Plywood – min. 3/8 inches thickness	9	Built up roofing membrane
2	Oriented strand board – min. 3/8 inches thickness	10	Modified bituminous roof membrane
3	Extruded polystyrene insulation board – min. ½ inches thickness	11	Fully adhered single-ply roof membrane
4	Foil-back polyisocyanurate insulation board – min. ½ inches thickness	12	A Portland cement or Portland sand parge, or a gypsum plaster, each with min. 5/8 inches thickness
5	Closed cell spray foam with a minimum density of 2.0 pcf and a min. 2.0 inches thickness	13	Cast-in-place concrete, or precast concrete
6	Open cell spray foam with a density no less than 0.4 pcf and no greater than 1.5 pcf, and a min. 5½ inches thickness	14	Fully grouted concrete block masonry
7	Exterior or interior gypsum board min. 1/2 inches thickness	15	Sheet steel or sheet aluminum
8	Cement board – min. 1/2 inches thickness	---	---------------------------------

B. Assemblies of materials and components that have an average air leakage not exceeding 0.04 cfm/ft^2, under a pressure differential of 0.3 in. w.g (1.57 psf) (0.2 L/m^2 at 75 pa), when tested in accordance with ASTM E2357, ASTM E1677, ASTM E1680, or ASTM E283; or

EXCEPTION to Section 140.3(a)9B: The following materials shall be deemed to comply with Section 140.3(a)9B if all joints are sealed and all of the materials are installed as air barriers in accordance with the manufacturer's instructions:

i. Concrete masonry walls that have at least two coatings of paint or at least two coatings of sealer coating.

ii. Concrete masonry walls with integral rigid board insulation.

iii. Structurally Insulated Panels.

iv. Portland cement or Portland sand parge, or stucco, or a gypsum plaster, each with min. 1/2 inches thickness

C. The entire building has an air leakage rate not exceeding 0.40 cfm/ft^2 at a pressure differential of 0.3 in w.g. (1.57 psf) (2.0 L/ m^2 at 75 pa), when the entire building is tested, after completion of construction, in accordance with ASTM E779 or another test method approved by the Commission.

EXCEPTION to Section 140.3(a)9: Relocatable Public School Buildings.

TABLE 140.3-B – PRESCRIPTIVE ENVELOPE CRITERIA FOR NONRESIDENTIAL BUILDINGS (INCLUDING RELOCATABLE PUBLIC SCHOOL BUILDINGS WHERE MANUFACTURER CERTIFIES USE ONLY IN SPECIFIC CLIMATE ZONE; NOT INCLUDING HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS)

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Envelope	Maximum U-factor	Roofs/ Ceilings	Metal Building	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
			Wood Framed and Other	0.034	0.034	0.034	0.034	0.034	0.049	0.049	0.049	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034
		Walls	Metal Building	0.113	0.061	0.113	0.061	0.061	0.113	0.113	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.061
			Metal-framed	0.069	0.062	0.082	0.062	0.062	0.069	0.069	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
			Mass Light[1]	0.196	0.170	0.278	0.227	0.440	0.440	0.440	0.440	0.440	0.170	0.170	0.170	0.170	0.170	0.170	0.170
			Mass Heavy[1]	0.253	0.650	0.650	0.650	0.650	0.690	0.690	0.690	0.690	0.650	0.184	0.253	0.211	0.184	0.184	0.160
			Wood-framed and Other	0.095	0.059	0.110	0.059	0.102	0.110	0.110	0.102	0.059	0.059	0.045	0.059	0.059	0.059	0.042	0.059
		Floors/ Soffits	Raised Mass	0.092	0.092	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.092	0.092	0.092	0.092	0.092	0.058
			Other	0.048	0.039	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.039	0.071	0.071	0.039	0.039	0.039
	Roofing Products	Low-sloped	Aged Solar Reflectance	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
			Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		Steep-Sloped	Aged Solar Reflectance	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
			Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0. 75	0.75	0.75	0.75	0.75	0.75	0.75
	Air Barrier			NR	NR	NR	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ
	Exterior Doors, Maximum U-factor		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
			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

CONTINUED: TABLE 140.3-B – PRESCRIPTIVE ENVELOPE CRITERIA FOR NONRESIDENTIAL BUILDINGS (INCLUDING RELOCATABLE PUBLIC SCHOOL BUILDINGS WHERE MANUFACTURER CERTIFIES USE ONLY IN SPECIFIC CLIMATE ZONE; NOT INCLUDING HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS)

					All Climate Zones			
					Fixed Window	Operable Window	Curtainwall or Storefront	Glazed Doors[2]
Envelope	**Fenestration**	**Vertical**	Area-Weighted Performance Rating	Max U-factor	0.36	0.46	0.41	0.45
				Max RSHGC	0.25	0.22	0.26	0.23
			Area-Weighted Performance Rating	Min VT	0.42	0.32	0.46	0.17
			Maximum WWR%	40%				
		Skylights			Glass, Curb Mounted	Glass, Deck Mounted	Plastic, Curb Mounted	
			Area-Weighted Performance Rating	Max U-factor	0.58	0.46	0.88	
				Max SHGC	0.25	0.25	NR	
			Area-Weighted Performance Rating	Min VT	0.49	0.49	0.64	
			Maximum SRR%	5%				

TABLE 140.3-C – PRESCRIPTIVE ENVELOPE CRITERIA FOR HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Envelope	Maximum U-factor	Roofs/ Ceilings	Metal Building	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
			Wood Framed and Other	0.028	0.028	0.034	0.028	0.034	0.034	0.039	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
		Walls	Metal Building	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.057	0.057	0.057	0.057	0.057
			Metal-framed	0.069	0.069	0.069	0.069	0.069	0.069	0.105	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.048	0.069
			Mass Light[1]	0.170	0.170	0.170	0.170	0.170	0.227	0.227	0.227	0.196	0.170	0.170	0.170	0.170	0.170	0.170	0.170
			Mass Heavy[1]	0.160	0.160	0.160	0.184	0.211	0.690	0.690	0.690	0.690	0.690	0.184	0.253	0.211	0.184	0.184	0.160
			Wood-framed and Other	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.042	0.059	0.059	0.042	0.042	0.042
		Floors/ Soffits	Raised Mass	0.045	0.045	0.058	0.058	0.058	0.069	0.092	0.092	0.092	0.069	0.058	0.058	0.058	0.045	0.058	0.037
			Other	0.034	0.034	0.039	0.039	0.039	0.039	0.071	0.039	0.039	0.039	0.039	0.039	0.039	0.034	0.039	0.034
	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	0.55	0.55	0.55	NR	0.55	0.55	0.55	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	NR	0.75	0.75	0.75	NR
		Steep-Sloped	Aged Solar Reflectance	NR	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	NR
			Thermal Emittance	NR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0. 75	0.75	0.75	0.75	0.75	0.75	NR
	Exterior Doors, Maximum U-factor		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
			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

CONTINUED: TABLE 140.3-C – PRESCRIPTIVE ENVELOPE CRITERIA FOR HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS

					All Climate Zones			
					Fixed Window	Operable Window	Curtainwall/ Storefront	Glazed Doors[2]
Envelope	Fenestration	Vertical	Area-Weighted Performance Rating	Max U-factor	0.36	0.46	0.41	0.45
				Max RSHGC	0.25	0.22	0.26	0.23
			Area-Weighted Performance Rating	Min VT	0.42	0.32	0.46	0.17
			Maximum WWR%		40%			
		Skylights			Glass, Curb Mounted	Glass, Deck Mounted	Plastic, Curb Mounted	
			Area-Weighted Performance Rating	Max U-factor	0.58	0.46	0.88	
				Max SHGC	0.25	0.25	NR	
			Area-Weighted Performance Rating	Min VT	0.49	0.49	0.64	
			Maximum SRR%		5%			

Notes:

1. Light mass walls are walls with a heat capacity of at least 7.0 Btu/ft²-oF and less than 15.0 Btu/ft²-oF. Heavy mass walls are walls with a heat capacity of at least 15.0 Btu/ft²-oF.

2. Glazed Doors applies to both site-built and to factory-assembled glazed doors.

TABLE 140.3-D PRESCRIPTIVE ENVELOPE CRITERIA FOR RELOCATABLE PUBLIC SCHOOL BUILDINGS FOR USE IN ALL CLIMATE ZONES

<table>
<tr><td rowspan="2">Roofs/ Ceilings</td><td>Metal Buildings</td><td colspan="3" rowspan="8">Maximum U-factor</td><td>0.041</td></tr>
<tr><td>Non-Metal Buildings</td><td>0.034</td></tr>
<tr><td rowspan="5">Walls</td><td>Wood frame buildings</td><td>0.042</td></tr>
<tr><td>Metal frame buildings</td><td>0.057</td></tr>
<tr><td>Metal buildings</td><td>0.057</td></tr>
<tr><td>Mass/7.0≤ HC</td><td>0.170</td></tr>
<tr><td>All Other Walls</td><td>0.059</td></tr>
<tr><td>Floors and Soffits</td><td>Floors and Soffits</td><td>0.048</td></tr>
<tr><td rowspan="4">Roofing Products</td><td rowspan="2">Low-Sloped</td><td colspan="3">Aged Solar Reflectance</td><td>0.63</td></tr>
<tr><td colspan="3">Thermal Emittance</td><td>0.75</td></tr>
<tr><td rowspan="2">Steep-Sloped</td><td colspan="3">Aged Solar Reflectance</td><td>0.20</td></tr>
<tr><td colspan="3">Thermal Emittance</td><td>0.75</td></tr>
<tr><td rowspan="11">Fenestration</td><td rowspan="2">Windows</td><td colspan="3">Maximum U-factor</td><td>0.47</td></tr>
<tr><td colspan="3">Maximum SHGC</td><td>0.26</td></tr>
<tr><td rowspan="2">Glazed Doors (Site-Built and Factory Assembled)</td><td colspan="3">Maximum U-factor</td><td>0.45</td></tr>
<tr><td colspan="3">Maximum SHGC</td><td>0.23</td></tr>
<tr><td rowspan="7">Skylights</td><td colspan="2">Glass with Curb</td><td rowspan="3">Maximum U-factor</td><td>0.99</td></tr>
<tr><td colspan="2">Glass without Curb</td><td>0.57</td></tr>
<tr><td colspan="2">Plastic with Curb</td><td>0.87</td></tr>
<tr><td rowspan="2">Glass Type</td><td>0-2% SRR</td><td rowspan="4">Maximum SHGC</td><td>0.46</td></tr>
<tr><td>2.1-5% SRR</td><td>0.36</td></tr>
<tr><td rowspan="2">Plastic Type</td><td>0-2% SRR</td><td>0.69</td></tr>
<tr><td>2.1-5% SRR</td><td>0.57</td></tr>
<tr><td rowspan="2">Exterior Doors</td><td>Non-Swinging doors</td><td colspan="3" rowspan="2">Maximum U-factor</td><td>0.50</td></tr>
<tr><td>Swinging doors</td><td>0.70</td></tr>
</table>

(b) **RESERVED**

(c) **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 ft^2 and that are directly under a roof with ceiling heights greater than 15 feet, shall meet the following requirements:

1. A combined total of at least 75 percent of the floor area, as determined in building floor plan (drawings) view, shall be within one or more of the following:

   A. Primary Sidelight Daylight Zone in accordance with Section 130.1(d)1B, or

   B. The total floor area in the space within a horizontal distance of 0.7 times the average ceiling height from the edge of rough opening of skylights..

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

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

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

5. All skylights shall have a glazing material or diffuser that has a measured haze value greater than 90 percent, tested according to ASTM D1003 (notwithstanding its scope) or another test method approved by the Commission.

6. Skylights for conditioned and unconditioned spaces shall have an area-weighted average Visible Transmittance (VT) no less than the applicable value required by Section 140.3(a)6D.

EXCEPTION 1 to Section 140.3(c): Auditoriums, churches, movie theaters, museums, and refrigerated warehouses.

EXCEPTION 2 to Section 140.3(c): In buildings with unfinished interiors, future enclosed spaces for which there are plans to have:

A. A floor area of less than or equal to 5,000 square feet; or

B. Ceiling heights of less than or equal to 15 feet. This exception shall not be used for S-1 or S-2 (storage), or for F-1 or F-2 (factory) occupancies.

EXCEPTION 3 to Section 140.3(c): Enclosed spaces having a designed general lighting system with a lighting power density less than 0.5 watts per square foot.

EXCEPTION 4 to Section 140.3(c): 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.

SECTION 140.4 – PRESCRIPTIVE REQUIREMENTS FOR 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) **Sizing and Equipment Selection.** Mechanical heating and mechanical cooling equipment shall be the smallest size, within the available options of the desired equipment line, necessary to meet the design heating and cooling loads of the building, as calculated according to Subsection (b).

EXCEPTION 1 to Section 140.4(a): Where it can be demonstrated to the satisfaction of the enforcing agency that oversizing will not increase building TDV energy use.

EXCEPTION 2 to Section 140.4(a): Standby equipment with controls that allow the standby equipment to operate only when the primary equipment is not operating.

EXCEPTION 3 to Section 140.4(a): 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.

(b) **Calculations.** In making equipment sizing calculations under Subsection (a), all of the following rules shall apply:

1. **Methodology.** The methodologies, computer programs, inputs, and assumptions approved by the Commission shall be used.

2. **Heating and cooling loads.** Heating and cooling system design loads shall be determined in accordance with the procedures described in the ASHRAE Handbook, Fundamentals Volume, or as specified in a method approved by the Commission.

3. **Indoor design conditions.** Indoor design temperature and humidity conditions for general comfort applications shall be determined in accordance with ASHRAE Standard 55 or the ASHRAE Handbook, Fundamentals Volume, Chapter 8, except that winter humidification and summer dehumidification shall not be required.

4. **Outdoor design conditions.** Outdoor design conditions shall be selected 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 140.4(b)4: Cooling design temperatures for cooling towers shall be no greater than the 0.5 percent Cooling Design Wet bulb values.

5. **Ventilation.** Outdoor air ventilation loads shall be calculated using the ventilation rates required in Section 120.1.

6. **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.

7. **Lighting.** Lighting loads shall be based on actual design lighting levels or power densities as specified in Section 140.6.

8. **People.** Occupant density shall be based on the expected occupancy of the building and shall be the same as determined under Section 120.1(b)2B, if used. Sensible and latent heat gains shall be as listed in the 2005 ASHRAE Handbook- Fundamentals, Chapter 30, Table 1.

9. **Process loads.** Loads caused by a process shall be based upon actual information on the intended use of the building.

10. **Miscellaneous equipment.** Equipment loads other than process loads shall be calculated using design data compiled from one or more of the following sources:

A. Actual information based on the intended use of the building; or

B. Published data from manufacturer's technical publications or from technical societies, such as the ASHRAE Handbook, Applications Volume; or

C. Other data based on the designer's experience of expected loads and occupancy patterns.

11. **Internal heat gains.** Internal heat gains may be ignored for heating load calculations.

12. **Safety factor.** Design loads may be increased by up to 10 percent to account for unexpected loads or changes in space usage.

13. **Other loads.** Loads such as warm-up or cool-down shall be calculated from principles based on the heat capacity of the building and its contents, the degree of setback, and desired recovery time; or may be assumed to be no more than 30 percent for heating and 10 percent for cooling of the steady-state design loads. In addition, the steady-state load may include a safety factor in accordance with Section 140.4(b)12.

(c) **Power Consumption of Fans.** Each fan system used for space conditioning shall meet the requirements of Items 1, 2, 3 and 4 below. Total fan system power demand equals the sum of the power demand of all fans in the system that are required to operate at design conditions in order to supply air from the heating or cooling source to the conditioned space, and to return it back to the source or to exhaust it to the outdoors; however, total fan system power demand need not include (i) the additional power demand caused solely by air treatment or filtering systems with final pressure drops more than 245 pascals or one-inch water column (only the energy accounted for by the amount of pressure drop that is over 1 inch may be excluded), or (ii) fan system power caused solely by exempt process loads.

1. **Constant volume fan systems.** The total fan power index at design conditions of each fan system with total horsepower over 25 hp shall not exceed 0.8 watts per cfm of supply air.

2. **Variable air volume (VAV) systems.**

A. The total fan power index at design conditions of each fan system with total horsepower over 25 hp shall not exceed 1.25 watts per cfm of supply air; and

B. 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 Section140.4(c)2C. 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

C. 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.

3. **Air-treatment or filtering systems.** For systems with air-treatment or filtering systems, calculate the total adjusted fan power index using Equation 140.4-A:

EQUATION 140.4-A ADJUSTED TOTAL FAN POWER INDEX

Adjusted total fan power index = Fan power index x Fan Adjustment

$$\text{Fan Adjustment} = 1-\left(\frac{SP_a - 1}{SP_f}\right)$$

WHERE:

SP_a = Air pressure drop across the air-treatment or filtering system.

SP_f = Total pressure drop across the fan.

4. **Fractional HVAC Motors for Fans.** HVAC motors for fans that are less than1 hp and 1/12 hp or greater shall be electronically-commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with NEMA Standard MG 1-2006 at full load rating conditions. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of a varying motor speed.

   EXCEPTION 1 to Section 140.4(c)4: Motors in fan-coils and terminal units that operate only when providing heating to the space served.

   EXCEPTION 2 to Section 140.4(c)4: Motors in space conditioning equipment certified under Section 110.1 or 110.2.

(d) **Space-conditioning Zone Controls.** Each space-conditioning zone shall have controls that prevent:

1. Reheating; and
2. Recooling; and
3. 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.

EXCEPTION 1 to Section 140.4(d): Zones served by variable air-volume systems that are designed and controlled to reduce, to a minimum, the volume of reheated, recooled, or mixed air are allowed only if the controls meet all of the following requirements:

A. For each zone with direct digital controls (DDC):

   i. The volume of primary air that is reheated, recooled or mixed air supply shall not exceed the larger of:

      a. 50 percent of the peak primary airflow; or

      b. The design zone outdoor airflow rate as specified by Section 120.1.

   ii. The volume of primary air in the deadband shall not exceed the larger of:

      a. 20 percent of the peak primary airflow; or

      b. The design zone outdoor airflow rate as specified by Section 120.1.

   iii. The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint no higher than 95ºF while the airflow is maintained at the dead band flow rate.

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

B. For each zone without DDC, the volume of primary air that is reheated, re-cooled, or mixed air supply shall not exceed the larger of the following:

   i. 30 percent of the peak primary airflow; or

   ii. The design zone outdoor airflow rate as specified by Section 120.1.

EXCEPTION 2 to Section 140.4(d): Zones with special pressurization relationships or cross-contamination control needs.

EXCEPTION 3 to Section 140.4(d): 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 4 to Section 140.4(d): Zones in which specific humidity levels are required to satisfy exempt process loads. ComputerComputer rooms or other spaces where the only process load is from IT equipment may not use this exception.

EXCEPTION 5 to Section 140.4(d): Zones with a peak supply-air quantity of 300 cfm or less.

(e) **Economizers.**

1. Each cooling air handler that has a design total mechanical cooling capacity over 54,000 Btu/hr 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 as calculated in accordance with a method approved by the Commission, at outside air temperatures of 50°F dry-bulb and 45°F wet-bulb and below.

   EXCEPTION 1 to Section 140.4(e)1: Where special outside air filtration and treatment, for the reduction and treatment of unusual outdoor contaminants, makes compliance infeasible.

   EXCEPTION 2 to Section 140.4(e)1: Where the use of outdoor air for cooling will affect other systems, such as humidification, dehumidification, or supermarket refrigeration systems, so as to increase overall building TDV energy use.

   EXCEPTION 3 to Section 140.4(e)1: Systems serving high-rise residential living quarters and hotel/motel guest rooms.

   EXCEPTION 4 to Section 140.4(e)1: Where comfort cooling systems have the cooling efficiency that meets or exceeds the cooling efficiency improvement requirements in TABLE 140.4-A.

   EXCEPTION 5 to Section 140.4(e)1: Fan systems primarily serving computer rooms. See Section 140.9(a) for computer room economizer requirements.

TABLE 140.4-A 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 IPLV, IEER or SEER, then to eliminate the required air or water economizer, the applicable minimum cooling efficiency of the HVAC unit must be increased by the percentage shown. If the HVAC unit is only rated with a full load metric, such as EER or COP cooling, then that metric must be increased by the percentage shown.

2. If an economizer is required by Section 140.4(e)1 it shall be:

   A. Designed and equipped with controls so that economizer operation does not increase the building heating energy use during normal operation; and

   EXCEPTION to Section 140.4(e)2A: 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.

3. If an economizer is required by Section 140.4(e)1, and an air economizer is used to meet the requirement, then it shall be a type listed in, and shall have high limit shutoff controls complying with TABLE 140.4-B,

TABLE 140.4-B AIR ECONOMIZER HIGH LIMIT SHUT OFF CONTROL REQUIREMENTS

Device Type[a]	**Climate Zones**	**Required High Limit (Economizer Off When):**	
		Equation[b]	**Description**
Fixed Dry Bulb	1, 3, 5, 11-16	$T_{OA} > 75°F$	Outdoor air temperature exceeds 75°F
	2, 4, 10	$T_{OA} > 73°F$	Outdoor air temperature exceeds 73°F
	6, 8, 9	$T_{OA} > 71°F$	Outdoor air temperature exceeds 71°F
	7	$T_{OA} > 69°F$	Outdoor air temperature exceeds 69°F
Differential Dry Bulb	1, 3, 5, 11-16	$T_{OA} > T_{RA}°F$	Outdoor air temperature exceeds return air temperature
	2, 4, 10	$T_{OA} > T_{RA}\text{-}2°F$	Outdoor air temperature exceeds return air temperature minus 2°F
	6, 8, 9	$T_{OA} > T_{RA}\text{-}4°F$	Outdoor air temperature exceeds return air temperature minus 4°F
	7	$T_{OA} > T_{RA}\text{-}6°F$	Outdoor air temperature exceeds return air temperature minus 6°F
Fixed Enthalpy[c] + Fixed Drybulb	All	h_{OA} > 28 Btu/lb[c] or $T_{OA} > 75°F$	Outdoor air enthalpy exceeds 28 Btu/lb of dry air[c] or Outdoor air temperature exceeds 75°F

[a] Only the high limit control devices listed are allowed to be used and at the setpoints listed. Others such as Dew Point, Fixed Enthalpy, Electronic Enthalpy, and Differential Enthalpy Controls, may not be used in any Climate Zone for compliance with Section 140.4(e)1 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.

4. If an economizer is required by Section 140.4(e)1, and an air economizer is used to meet the requirement, then 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. w.g.) 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 20percent 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.

5. Systems that include an air economizer to meet Section 140.4(e)1 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 45°F.

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 140.4(e)5,B shall (i) comply with the requirements in TABLE 140.4-C, and (ii) shall have controls that do not false load the mechanical cooling system by limiting or disabling the economizer or by any other means except at the lowest stage of mechanical cooling capacity.

TABLE 140.4-C DIRECT EXPANSION (DX) UNIT REQUIREMENTS FOR COOLING STAGES AND COMPRESSOR DISPLACEMENT

Cooling Capacity	Minimum Number of Mechanical Cooling Stages	Minimum Compressor Displacement
≥ 65,000 Btu/h and < 240,000 Btu/h	3 stages	≤ 35% full load
≥ 240,000 Btu/h	4 stages	≤ 25% full load

(f) **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, such as interior zones, shall be designed for the air flows resulting from the fully reset supply air temperature. Supply air temperature reset controls shall be:

1. In response to representative building loads or to outdoor air temperature; and
2. At least 25 percent of the difference between the design supply-air temperature and the design room air temperature.

EXCEPTION 1 to Section 140.4(f): Systems that meet the requirements of Section 140.4(d), without using Exception 1 or 2 to that section.

EXCEPTION 2 to Section 140.4(f): Where supply-air temperature reset would increase overall building energy use.

EXCEPTION 3 to Section 140.4(f): Systems supplying zones in which specific humidity levels are required to satisfy exempt process loads. Computer Rooms or other spaces with only IT equipment may not use this exception.

(g) **Electric Resistance Heating.** Electric resistance heating systems shall not be used for space heating.

EXCEPTION 1 to Section 140.4(g): Where an electric-resistance heating system supplements a heating system in which at least 60 percent of the annual energy requirement is supplied by site-solar or recovered energy.

EXCEPTION 2 to Section 140.4(g): Where an electric-resistance heating system supplements a heat pump heating system, and the heating capacity of the heat pump is more than 75 percent of the design heating load calculated in accordance with Section 140.4(a) at the design outdoor temperature specified in Section 140.4(b)4.

EXCEPTION 3 to Section 140.4(g): Where the total capacity of all electric-resistance heating systems serving the entire building is less than 10 percent of the total design output capacity of all heating equipment serving the entire building.

EXCEPTION 4 to Section 140.4(g): Where the total capacity of all electric-resistance heating systems serving the entire building, excluding those allowed under Exception 2, is no more than 3 kW.

EXCEPTION 5 to Section 140.4(g): Where an electric resistance heating system serves an entire building that is not a high-rise residential or hotel/motel building; and has a conditioned floor area no greater than 5,000 square feet; and has no mechanical cooling; and is in an area where natural gas is not currently available and an extension of a natural gas system is impractical, as determined by the natural gas utility.

(h) **Heat Rejection Systems.**

1. **Scope.** Subsection 140.4(h) applies to heat rejection equipment used in comfort cooling systems such as air-cooled condensers, open cooling towers, closed-circuit cooling towers, and evaporative condensers.

2. **Fan Speed Control.** Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at 2/3 of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature or pressure of the heat rejection device.

   EXCEPTION 1 to Section 140.4(h)2: Heat rejection devices included as an integral part of the equipment listed in TABLE 110.2-A through TABLE 110.2-I.

   EXCEPTION 2 to Section 140.4(h)2: Condenser fans serving multiple refrigerant circuits.

   EXCEPTION 3 to Section 140.4(h)2: Condenser fans serving flooded condensers.

   EXCEPTION 4 to Section 140.4(h)2: 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.

3. **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.

4. **Limitation on Centrifugal Fan Cooling Towers.** Open cooling towers with a combined rated capacity of 900 gpm and greater at 95°F condenser water return, 85°F condenser water supply, and 75°F outdoor wet-bulb temperature, shall use propeller fans and shall not use centrifugal fans.

   EXCEPTION 1 to Section 140.4(h)4: Cooling towers that are ducted (inlet or discharge) or have an external sound trap that requires external static pressure capability.

   EXCEPTION 2 to Section 140.4(h)4: Cooling towers that meet the energy efficiency requirement for propeller fan towers in Section 110.2, TABLE 110.2-G.

5. **Multiple Cell Heat Rejection Equipment.** Multiple cell heat rejection equipment with variable speed fan drives shall:

   A. Operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components, and

   B. Control all operating fans to the same speed. Minimum fan speed shall comply with the minimum allowable speed of the fan drive as specified by the manufactures recommendation. Staging of fans is allowed once the fans are at their minimum operating speed.

(i) **Minimum Chiller Efficiency.** Chillers shall meet or exceed Path B from TABLE 110.2-D

EXCEPTION 1 to Section 140.4(i): Chillers with electrical service > 600V.

EXCEPTION 2 to Section 140.4(i): Chillers attached to a heat recovery system with a design heat recovery capacity > 40 percent of the design chiller cooling capacity.

EXCEPTION 3 to Section 140.4(i): Chillers used to charge thermal energy storage systems where the charging temperature is < 40 °F.

EXCEPTION 4 to Section 140.4(i): In buildings with more than 3 chillers, only 3 chillers are required to meet the Path B efficiencies.

(j) **Limitation of Air-Cooled Chillers.** Chilled water plants shall not have more than 300 tons provided by air-cooled chillers.

EXCEPTION 1 to Section 140.4(j): Where the water quality at the building site fails to meet manufacturer's specifications for the use of water-cooled chillers.

EXCEPTION 2 to Section 140.4(j): Chillers that are used to charge a thermal energy storage system with a design temperature of less than 40 degrees F (4 degrees C).

EXCEPTION 3 to Section 140.4(j): Air cooled chillers with minimum efficiencies approved by the Commission pursuant to Section 10-109(d).

(k) **Hydronic System Measures**

1. **Hydronic Variable Flow Systems.** HVAC chilled and hot water pumping shall be designed for variable fluid flow and shall be capable of reducing pump flow rates to no more than the larger of: a) 50 percent or less of the design flow rate; or b) the minimum flow required by the equipment manufacturer for the proper operation of equipment served by the system.

   EXCEPTION 1 to Section 140.4(k)1: Systems that include no more than three control valves.

   EXCEPTION 2 to Section 140.4(k)1: Systems having a total pump system power less than or equal to 1.5 hp.

2. **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.

3. **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).

4. **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 140.4(k)4: Hydronic systems that use variable flow to reduce pumping energy in accordance with Section 140.4(k)1.

5. **Water-Cooled Air Conditioner and Hydronic Heat Pump Systems.** Water circulation systems serving water-cooled air conditioners, hydronic heat pumps, or both, that have total pump system power exceeding 5 hp shall have flow controls that meet the requirements of Section 140.4(k)6. 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.

6. **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.

      i. 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.

      ii. For systems with direct digital control of individual coils with a central control panel, the static pressure set point shall be reset based on the valve requiring the most pressure, and the setpoint shall be no less than 80 percent open. Pressure sensors may be mounted anywhere.

   EXCEPTION 1 to Section 140.4(k)6: Heating hot water systems.

EXCEPTION 2 to Section 140.4(k)6: Condenser water systems serving only water-cooled chillers.

7. **Hydronic Heat Pump (WLHP) Controls.** Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are capable of providing a heat pump water supply temperature deadband of at least 20°F between initiation of heat rejection and heat addition by the central devices.

   EXCEPTION to Section 140.4(k)7: 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.

(l) **Air Distribution System Duct Leakage Sealing.** Duct systems shall be sealed to a leakage rate not to exceed 6 percent of the nominal air handler airflow rate as confirmed through field verification and diagnostic testing, in accordance with the applicable procedures in Reference Nonresidential Appendices NA1 and NA2 if the criteria in Subsections 1, 2 and 3 below are met:

1. The duct system provides conditioned air to an occupiable space for a constant volume, single zone, space-conditioning system; and
2. The space conditioning system serves less than 5,000 square feet of conditioned floor area; and
3. The combined surface area of the ducts located in the following spaces is more than 25 percent of the total surface area of the entire duct system:
   A. Outdoors; or
   B. In a space directly under a roof that
      i. Has a U-factor greater than the U-factor of the ceiling, or if the roof does not meet the requirements of Section 140.3(a)1B, or
      ii. Has fixed vents or openings to the outside or unconditioned spaces; or
   C. In an unconditioned crawlspace; or
   D. In other unconditioned spaces.

(m) **Fan Control.** Each cooling system listed in TABLE 140.4-D shall be designed to vary the indoor fan airflow as a function of load and shall comply with the following requirements:

1. 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.
2. 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.
3. Systems that include an air side economizer to meet 140.4(e)1 shall have a minimum of two speeds of fan control during economizer operation.

EXCEPTION to Section 140.4(m): 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.

TABLE 140.4-D FAN CONTROL SYSTEMS

Cooling System Type	Fan Motor Size	Cooling Capacity
DX Cooling	any	≥ 65,000 Btu/hr
Chilled Water and Evaporative	≥ 1/4 HP	any

(n) **Mechanical System Shut-off.** Any directly conditioned space with operable wall or roof openings to the outdoors shall be provided with interlock controls that disable or reset the temperature setpoint to 55°F for mechanical heating and disable or reset the temperature setpoint to 90°F for mechanical cooling to that space when any such opening is open for more than 5 minutes.

EXCEPTION 1 to Section 140.4(n): Interlocks are not required on doors with automatic closing devices.

EXCEPTION 2 to Section 140.4(n): Any space without a thermostatic control (thermostat or a space temperature sensor used to control heating or cooling to the space).

SECTION 140.5 – PRESCRIPTIVE REQUIREMENTS FOR SERVICE WATER HEATING SYSTEMS

(a) **Nonresidential Occupancies.** A service water heating system installed in a nonresidential building complies with this section if it complies with the applicable requirements of Sections 110.1, 110.3 and 120.3.

(b) **High-Rise Residential and Hotel/Motel Occupancies.** A service water heating system installed in a high-rise residential or hotel/motel building complies with this section if it meets the requirements of Section 150.1(c)8.

SECTION 140.6 – PRESCRIPTIVE REQUIREMENTS FOR INDOOR LIGHTING

A building complies with this section if:

i. The Calculation of Actual Indoor Lighting Power of all proposed building areas combined, calculated under Subsection (a) is no greater than the Calculation of Allowed Indoor Lighting Power, Specific Methodologies calculated under Subsection (c); and

ii. The Calculation of Allowed Indoor Lighting Power, General Rules comply with Subsection (b); and

iii. General lighting complies with the Automatic Daylighting Controls in Secondary Daylit Zone requirements in Subsection (d).

(a) **Calculation of Actual Indoor Lighting Power.** The actual indoor Lighting Power of all proposed building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building; subject to the applicable adjustments under Subdivisions 1 through 3 of this subsection and the requirements of Subdivision 4 of this subsection.

EXCEPTION to Section 140.6(a): Up to 0.3 watts per square foot of portable lighting for office areas shall not be required to be included in the calculation of actual indoor Lighting Power.

1. **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 actual indoor Lighting Power if:

   A. An Installation Certificate detailing compliance with Section 140.6(a)1 is submitted in accordance with Section 10-103 and Section 130.4; and

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

   C. The two lighting systems are interlocked with a Nonprogrammable Double-Throw Switch to prevent simultaneous operation of both systems.

   For compliance with Part 6 a Nonprogrammable Double-Throw Switch is an electrical switch commonly called a "single pole double throw" or "three-way" switch that is wired as a selector switch allowing one of two loads to be enabled. It can be a line voltage switch or a low voltage switch selecting between two relays. It cannot be overridden or changed in any manner that would permit both loads to operate simultaneously.

2. **Reduction of wattage through controls.** In calculating actual indoor Lighting Power, the installed watts of a luminaire providing general lighting in an area listed in TABLE 140.6-A may be reduced by the product of (i) the number of watts controlled as described in TABLE 140.6-A, times (ii) the applicable Power Adjustment Factor (PAF), if all of the following conditions are met:

   A. An Installation Certificate is submitted in accordance with Section 130.4(b); and

   B. Luminaires and controls meet the applicable requirements of Section 110.9, and Sections 130.0 through 130.5; and

   C. The controlled lighting is permanently installed general lighting systems and the controls are permanently installed nonresidential-rated lighting controls.

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

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

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

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

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

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

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

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

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

G. Lighting controls used to qualify for a PAF shall be designed and installed in addition to manual, multilevel, and automatic lighting controls required in Section 130.1, and in addition to any other lighting controls required by any provision of Part 6. PAFs shall not be available for lighting controls required by Part 6.

H. To qualify for the PAF for daylight dimming plus OFF control, the daylight control and controlled luminaires shall comply with Section 130.1(d), 130.4(a)3 and 130.4(a)7, and shall additionally turn lights completely OFF when the daylight available in the daylit zone is greater than 150 percent of the illuminance received from the general lighting system at full power. The PAF shall apply only to the luminaires in the primary sidelit daylit zone and the skylit daylit zone.

I. To qualify for the PAF for an occupant sensing control controlling the general lighting in large open plan office areas above workstations, in accordance with TABLE 140.6-A, the following requirements shall be met:

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

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

iii. Controlled luminaires shall only be those that provide general lighting directly above the controlled area, or furniture mounted luminaires that comply with Section 140.6(a)2 and provide general lighting directly above the controlled area; and

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

a. Infrared sensors shall be equipped by the manufacturer, of fitted in the field by the installer, with lenses or shrouds to prevent them from being triggered by movement outside of the controlled area.

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

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

J. To qualify for the PAF for an Institutional Tuning in TABLE 140.6-A, the tuned lighting system shall comply with all of the following requirements:

i. The lighting controls shall limit the maximum output or maximum power draw of the controlled lighting to 85 percent or less of full light output or full power draw; and

ii. The means of setting the limit is accessible only to authorized personnel; and

iii. The setting of the limit is verified by the acceptance test required by Section 130.4(a)7; and

iv. The construction documents specify which lighting systems shall have their maximum light output or maximum power draw set to no greater than 85% of full light output or full power draw.

K. To qualify for the PAF for a Demand Responsive Control in TABLE 140.6-A, a Demand Responsive Control shall meet all of the following requirements:

i. The building shall be 10,000 square feet or smaller; and

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

iii. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in TABLE 130.1-A; and

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

3. **Lighting wattage excluded.** The watts of the following indoor lighting applications may be excluded from actual indoor Lighting Power Density. (Indoor lighting not listed below shall comply with all applicable nonresidential indoor lighting requirements in Part 6.):

A. In theme parks: Lighting for themes and special effects.

B. Studio lighting for film or photography provided that these lighting systems are in addition to and separately switched from a general lighting system.

C. Lighting for dance floors, lighting for theatrical and other live performances, and theatrical lighting used for religious worship, provided that these lighting systems are additions to a general lighting system and are separately controlled by a multiscene or theatrical cross-fade control station accessible only to authorized operators.

Lighting intended for makeup, hair, and costume preparation in performing arts facility dressing rooms, provided that the lighting is separately switched from the general lighting system, switched independently at each dressing station, and is controlled with a Vacancy Sensor.

D. In civic facilities, transportation facilities, convention centers, and hotel function areas: Lighting for temporary exhibits, if the lighting is in addition to a general lighting system and is separately controlled from a panel accessible only to authorized operators.

E. Lighting installed by the manufacturer in walk-in freezers, vending machines, food preparation equipment, and scientific and industrial equipment.

F. In medical and clinical buildings: Examination and surgical lights, low-ambient night-lights, and lighting integral to medical equipment, provided that these lighting systems are additions to and separately switched from a general lighting system.

G. Lighting for plant growth or maintenance, if it is controlled by a multi-level astronomical time-switch control that complies with the applicable provisions of Section 110.9.

H. Lighting equipment that is for sale.

I. Lighting demonstration equipment in lighting education facilities.

J. Lighting that is required for exit signs subject to the CBC. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.

K. Exitway or egress illumination that is normally off and that is subject to the CBC.

L. In hotel/motel buildings: Lighting in guestrooms (lighting in hotel/motel guestrooms shall comply with Section 130.0(b). (Indoor lighting not in guestrooms shall comply with all applicable nonresidential lighting requirements in Part 6.)

M. In high-rise residential buildings: Lighting in dwelling units (Lighting in high-rise residential dwelling units shall comply with Section 130.0(b).) (Indoor lighting not in dwelling units shall comply with all applicable nonresidential lighting requirements in Part 6.)

N. Temporary lighting systems. (As defined in Section 100.1.)

O. Lighting in occupancy group U buildings less than 1,000 square feet.

P. Lighting in unconditioned agricultural buildings less than 2,500 square feet.

Q. 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.

R. Lighting in nonresidential parking garages for seven or less vehicles: Lighting in nonresidential parking garages for seven or less vehicles shall comply with the applicable residential parking garage provisions of Section 150.0(k).

S. Lighting for signs: Lighting for signs shall comply with Section 140.8.

T. Lighting in refrigerated cases less than 3,000 square feet. (Lighting in refrigerated cases less than 3,000 square feet shall comply with the Title 20 Appliance Efficiency Regulations).

U. Lighting in elevators where the lighting meets the requirements in Section 120.6(f).

4. **Luminaire Classification and Power.** Luminaire Classification and Power shall be determined in accordance with Section 130.0(c).

(b) **Calculation of Allowed Indoor Lighting Power: General Rules**

1. 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.

2. 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.

3. The Allowed Indoor Lighting Power allotment for general lighting shall be calculated as follows:

A. The Complete Building Method, as described in Section 140.6(c)1, shall be used only for an entire building, except as permitted by Section 140.6(c)1. As described more fully in Section 140.6(c)1, and subject to the adjustments listed there, the Allowed Indoor Lighting Power allotment for general lighting for the entire building shall be calculated as follows:

i. For a conditioned building, the product of the square feet of conditioned space of the building times the applicable allotment of watts per square foot described in TABLE 140.6-B.

ii. For an unconditioned building, the product of the square foot of unconditioned space of the building times the applicable allotment of watts per square feet described in TABLE 140.6-B.

B. The Area Category Method, as described in Section 140.6(c)2, shall be used either by itself for all areas in the building, or when some areas in the building use the Tailored Method described in Section 140.6(c)3. Under the Area Category Method (either by itself or in conjunction with the Tailored Method), as described more fully in Section 140.6(c)2, and subject to the adjustments listed there, the allowed Indoor Lighting Power allotment for general lighting shall be calculated for each area in the building as follows:

i. For conditioned areas, by multiplying the conditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in TABLE 140.6-C (or TABLE 140.6-D if the Tailored Method is used for that area).

ii. For unconditioned areas, by multiplying the unconditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in TABLE 140.6-C (or TABLE 140.6-D 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.

C. The Tailored Method, as described in Section 140.6(c)3, shall be used either by itself for all areas in the building, or when some areas in the building use the Area Category Method described in Section 140.6(c)2. Under the Tailored Method (either by itself or in conjunction with the Area Category Method) as described more fully in Section 140.6(c)3, 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 TABLE140.6-D (or TABLE140.6-C 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 TABLE140.6-D (or TABLE140.6-C if the Area Category Method is used for that area);

The Allowed Indoor Lighting Power allotment for general lighting for one area for which the Tailored Method was used may be increased up to the amount that the Allowed Indoor Power Lighting for general lighting for another area is decreased, but only if the Tailored Method or Area Category Method was used for the other area, except that such increases and decreases shall not be made between conditioned and unconditioned space.

D. 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. Allowed Indoor Lighting Power allotments for all lighting power allotments other than general lighting shall be restricted as follows:

A. When using the Area Category Method, allowed Indoor Lighting Power allotments for specialized task work; ornamental; precision commercial and industrial work; white board or chalk board; accent, display and feature; decorative; or Videoconferencing Studio; may not be increased as a result of, or otherwise traded off against, decreasing any other allotment; and

B. When using the Tailored Method, allowed Indoor Lighting Power allotments for wall display; floor display and task; ornamental/special effect; or very valuable display case; may not be increased, or otherwise traded between any of the separate allotments.

(c) **Calculation of Allowed Indoor Lighting Power: Specific Methodologies.** The allowed indoor Lighting Power for each building type, or each primary function area shall be calculated using only one of the methods in Subsection 1, 2 or 3 below as applicable.

1. **Complete Building Method.** Requirements for using the Complete Building Method include all of the following:

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

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

i. Entire buildings with one type of use occupancy; or

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

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

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

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

D. Under the Complete Building Method, the allowed indoor Lighting Power allotment is the Lighting Power Density value times the floor area of the entire building.

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

A. The Area Category Method shall be used only for primary function areas, as defined in Section 100.1, that are listed in TABLE 140.6-C.

B. Primary Function Areas in TABLE 140.6-C shall not apply to a complete building. Each primary function area shall be determined as a separate area.

C. For purposes of compliance with Section 140.6(c)2, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in TABLE 146.0-C.

D. Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a Primary Function Area.

E. If at the time of permitting for a newly constructed building, a tenant is not identified for a multi-tenant area, a maximum of 0.6 watts per square foot shall be allowed for the lighting in each area in which a tenant has not been identified. The area shall be classified as Unleased Tenant Area.

F. Under the Area Category Method, the allowed indoor Lighting Power for each primary area is the Lighting Power Density value in TABLE 140.6-C times the square feet of the primary function. The total allowed indoor Lighting Power for the building is the sum of all allowed indoor Lighting Power for all areas in the building.

G. In addition to the allowed indoor Lighting Power calculated according to Sections 140.6(c)2. A through F, the building may add additional lighting power allowances for specialized task work, ornamental, precision, accent, display, decorative, and white boards and chalk boards, in accordance with the footnotes in TABLE 140.6-C under the following conditions:

i. Only primary function areas having a footnote next to the allowed Lighting Power Density allotments in TABLE 140.6-C shall qualify for the added lighting power allowances in accordance with the correlated footnote listed at the bottom of the table; and

ii. The additional lighting power allowances shall be used only if the plans clearly identify all applicable task areas and the lighting equipment designed to illuminate these tasks; and

iii. Tasks that are performed less than two hours per day or poor quality tasks that can be improved are not eligible for the additional lighting power allowances; and

iv. The additional lighting power allowances shall not utilize any type of luminaires that are used for general lighting in the building; and

v. The additional lighting power allowances shall not be used when using the Complete Building Method, or when the Tailored Method is used for any area in the building; and

vi. The additional lighting power allowed is the smaller of lighting power listed in the applicable footnote in TABLE 140.6-C, or the actual design wattage may be added to the allowed lighting power; and

vii. In addition to all other additional lighting power allowed under Sections 140.6(c)2Gi through vi, up to 1.5 watts per square foot of additional lighting power shall be allowed in a videoconferencing studio, as defined in Section 100.1, provided the following conditions are met:

a. A completed and signed Installation Certificate is prepared and submitted in accordance with Section 130.4(b), specifically detailing compliance with the applicable requirements of Section 140.6(c)2Gvii; and

b. The Videoconferencing Studio is a room with permanently installed videoconferencing cameras, audio equipment, and playback equipment for both audio-based and video-based two-way communication between local and remote sites; and

c. General lighting is switched in accordance with TABLE 130.1-A; and

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

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

3. **Tailored Method.** Requirements for using the Tailored Method include all of the following:

A. The Tailored Method shall be used only for primary function areas listed in TABLE 140.6-D, as defined in Section 100.1, and for IES allowances listed in Section 140.6(c)3H.

B. Allowed Indoor Lighting Power allotments for general lighting shall be determined according to Section 140.6(c)3G or H, as applicable. General lighting shall not qualify for a mounting height multiplier.

C. For compliance with this Item, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in TABLE 140.6-D.

D. Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a Primary Function Area.

E. In addition to the allowed indoor Lighting Power allotments for general lighting calculated according to Sections 140.6(c)3G or H, as applicable, the building may add additional lighting power allowances for wall display, floor display and task lighting, ornamental/special effects, and very valuable display cases according to Section 140.6(c)3I through L.

F. The general lighting system shall not use narrow beam direction lamps, wall-washer, valance, direct cove, or perimeter linear slot types of lighting systems.

G. Determine allowed indoor Lighting Power allotments for general lighting for primary function areas listed in TABLE 140.6-D as follows:

i. Use the IES Illuminance values (Lux) listed in Column 2 to determine the Allowed General Lighting Power Density allotments for the area.

ii. Determine the room cavity ratio (RCR) for the area. The RCR shall be calculated according to the applicable equation in TABLE 140.6-F.

iii. Find the allowed Lighting Power Density allotments in TABLE 140.6-G that is applicable to the IES illuminance value (Lux) from Column 2 of Table 140.6-D (as described in Item i.) and the RCR determined in accordance with TABLE 140.6-F (as described in Item ii).

iv. Determine the square feet of the area in accordance with Section 140.6(c)3C and D.

v. Multiply the allowed Lighting Power Density allotment, as determined in accordance with Item iii by the square feet of each primary function area, as determined in accordance with Item iv. The product is the Allowed Indoor Lighting Power allotment for general lighting for the area.

H. Determine allowed indoor Lighting Power allotments for general lighting for only specific primary function areas NOT listed in TABLE 140.6-D as follows:

i. Use this Section only to calculate allowed indoor lighting power for general lighting in the following primary function areas. Do not use Section 140.6(c)3H for any primary function areas NOT listed below:

a. Exercise Center, Gymnasium

b. Medical and Clinical Care

c. Police Stations and Fire Stations

d. Public rest areas along state and federal roadways

e. Other primary function areas that are listed inneither TABLE 140.6-C nor TABLE140.6-D.

ii. When calculating allowed indoor Lighting Power allotments for general lighting using Section 140.6(c)3H, the building shall not add additional lighting power allowances for any other use, including but not limited to wall display, floor display and task, ornamental/special effects, and very valuable display case lighting.

iii. Calculate the allowed indoor Lighting Power for each primary function area in the building as follows:

a. Determine the illuminance values (Lux) according to the Tenth Edition IES Lighting Handbook (IES HB), using the Recommended Horizontal Maintained Illuminance Targets for Observers 25-65 years old for illuminance.

b. Determine the room cavity ratio (RCR) for area. The RCR shall be calculated according to the applicable equation in TABLE 140.6-F.

c. Find the allowed lighting power density in TABLE 140.6-G that is applicable to the illuminance value (Lux) determined in accordance with Item (a) and the RCR determined in accordance with Item (b).

d. Determine the square feet of the area. For compliance with this item, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in Item (i). Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a Primary Function Area.

e. Multiply the square feet determined in accordance with Item (d), by the allowed lighting power density determined in accordance with item (c). The product is the Allowed Indoor Lighting Power allotment for general lighting for the area.

I. Determine additional allowed power for wall display lighting according to column 3 of Table 140.6-D for each primary function area as follows:

i. Additional wall display lighting power shall not be available when using Section 140.6(c)3H for determining the Allowed Indoor Lighting Power allotment for general lighting for the area.

ii. Floor displays shall not qualify for wall display allowances.

iii. Qualifying wall lighting shall:

a. Be mounted within 10 feet of the wall having the wall display. When track lighting is used for wall display, and where portions of that lighting track are more than 10 feet from the wall and other portions are within 10 feet of the wall, portions of track more than 10 feet from the wall shall not be used for the wall display allowance.

b. Be a lighting system type appropriate for wall lighting. Lighting systems appropriate for wall lighting are lighting track adjacent to the wall, wall-washer luminaires, luminaires behind a wall valance or wall cove, or accent light. (Accent luminaires are adjustable or fixed luminaires with PAR, R, MR, AR, or other directional lamp types.)

iv. 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 no more than two feet of the ceiling or are taller than ten feet, and (II) are permanently anchored to the floor, provided, however, that neither commercial industrial stacks nor industrial storage stacks are permanent full height interior partitions.

v. The wall display mounting height multiplier is the applicable factor from TABLE 140.6-E. Mounting height is the distance from the finished floor to the bottom of the luminaire. The wall display mounting height multipliers shall be used to reduce the design watts of the space.

vi. The additional allowed power for wall display lighting shall be the smaller of:

a. The product of wall display power determined in accordance with TABLE 140.6-D, times the wall display lengths determined in accordance with Item iv; or

b. The actual power used for the wall display lighting systems.

J. Determine additional allowed power for floor display lighting and task lighting as follows:

i. Neither additional allowed power for floor display lighting nor additional allowed power for task lighting shall be available when using Section 140.6(c)3H for determining allowed indoor Lighting Power allotment for general lighting.

ii. Displays that are installed against a wall shall not qualify for the floor display lighting power allowances.

iii. Lighting internal to display cases shall be counted as floor display lighting in accordance with Section 140.6(c)3J; or very valuable display case lighting in accordance with Section 140.6(c)3Liii and iv.

iv. Additional allowed power for floor display lighting, and additional allowed power for task lighting, may be used by qualifying floor display lighting systems, qualifying task lighting systems, or a combination of both. For floor areas qualifying for both floor display and task lighting power allowances, the additional allowed power shall be used only once for the same floor area, so that the allowance shall not be additive.

v. Qualifying floor display lighting shall:

a. Be mounted no closer than 2 feet to a wall.

b. Consist of only (I) directional lighting types, such as PAR, R, MR, AR; or (II) lighting employing optics providing directional display light from nondirectional lamps.

c. If track lighting is used, shall be only track heads that are classified as direction lighting types.

vi. Qualifying task lighting shall:

a. Be located immediately adjacent to and capable of illuminating the task for which it is installed.

b. Be of a type different from the general lighting system.

c. Be separately switched from the general lighting system.

vii. If there are illuminated floor displays, floor display lighting power shall be used only if allowed by column 4 of TABLE 140.6-D.

viii. Additional allowed power for a combination of floor display lighting and task lighting shall be available only for (I) floors having floor displays; or (II) floors not having floor displays but having tasks having illuminance recommendations that appear in the Tenth Edition of the IES Lighting Handbook and that are higher than the general lighting level in column 2 of TABLE 140.6-D. The square footage of floor display or the square footage of task areas shall be determined in accordance with Section 140.6(c)3C and D, except that any floor area designed to not have floor displays or tasks, such as floor areas designated as a path of egress, shall not be included for the floor display allowance.

ix. For floor display lighting where the bottom of the luminaire is 12 feet or higher above the finished floor, the wattage allowed in column 4 of TABLE 140.6-D may be increased by multiplying the floor display lighting power allowance by the appropriate factor from TABLE 140.6-E

Luminaire mounting height is the distance from the finished floor to the bottom of the luminaire. The floor display mounting height multipliers shall be used to reduce the design watts of the space.

x. The additional allowed power for floor display lighting for each applicable area shall be the smaller of:

a. The product of allowed floor display and task lighting power determined in accordance with Section 140.6(c)3Jvii times the floor square footage determined in accordance with Section 140.6(c)3Jviii; or

b. The actual power used for the floor display lighting systems.

K. Determine additional allowed power for ornamental/special effects lighting as follows:

i. Additional allowed power for ornamental/special effects lighting shall not be available when using Section 140.6(c)3H for determining general Lighting Power allowances.

ii. Qualifying ornamental lighting includes luminaires such as chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights and light color panels when any of those lights are used in a decorative manner that does not serve as display lighting or general lighting.

iii. Additional lighting power for ornamental/special effects lighting shall be used only if allowed by Column 5 of TABLE 140.6-D.

iv. Additional lighting power for ornamental/special effects lighting shall be used only in areas having ornamental/special effects lighting. The square footage of the floor area shall be determined in accordance with Section 140.6(c)3C and D, and it shall not include floor areas not having ornamental/special effects lighting.

v. The additional allowed power for ornamental/special effects lighting for each applicable area shall be the smaller of:

a. The product of the allowed ornamental/special effects lighting power determined in accordance with Section 140.6(c)3Kiii, times floor square footage determined in accordance with Section 140.6(c)3Kiv; or

b. The actual power of allowed ornamental/special effects lighting.

L. Determine additional allowed power for very valuable display case lighting as follows:

i. Additional allowed power for very valuable display case lighting shall not be available when using Section 140.6(c)3H for determining general Lighting Power allowances.

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

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

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

v. If there is qualifying very valuable display case lighting, in accordance with Section 140.6(c)3Liii, the smallest of the following separate lighting power for display cases presenting very valuable display items is permitted:

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

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

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

(d) **Automatic Daylighting Controls in Secondary Daylit Zones.** All luminaires providing general lighting that is in, or partially in a Secondary Sidelit Daylit Zone as defined in Section 130.1(d)1C, and that is not in a Primary Sidelit Daylit Zone shall:

1. Be controlled independently from all other luminaires by automatic daylighting controls that meet the applicable requirements of Section 110.9; and

2. Be controlled in accordance with the applicable requirements in Section 130.1(d)2; and

3. All Secondary Sidelit Daylit Zones shall be shown on the plans submitted to the enforcing agency.

EXCEPTION 1 to Section 140.6(d): Luminaires in Secondary Sidelit Daylit Zone(s) in areas where the total wattage of general lighting is less than 120 Watts.

EXCEPTION 2 to Section 140.6(d): Luminaires in parking garages complying with Section 130.1(d)3.

TABLE 140.6-A LIGHTING POWER ADJUSTMENT FACTORS (PAF)

<table>
<tr><th>TYPE OF CONTROL</th><th colspan="2">TYPE OF AREA</th><th>FACTOR</th></tr>
<tr><td colspan="4">a. To qualify for any of the Power Adjustment Factors in this table, the installation shall comply with the applicable requirements in Section 140.6(a)2
b. Only one PAF may be used for each qualifying luminaire unless combined below.
c. Lighting controls that are required for compliance with Part 6 shall not be eligible for a PAF</td></tr>
<tr><td>1. Daylight Dimming plus OFF Control</td><td colspan="2">Luminaires in skylit daylit zone or primary sidelit daylit zone</td><td>0.10</td></tr>
<tr><td rowspan="3">2. Occupant Sensing Controls in Large Open Plan Offices</td><td rowspan="3">In open plan offices > 250 square feet: One sensor controlling an area that is:</td><td>No larger than 125 square feet</td><td>0.40</td></tr>
<tr><td>From 126 to 250 square feet</td><td>0.30</td></tr>
<tr><td>From 251 to 500 square feet</td><td>0.20</td></tr>
<tr><td rowspan="2">3. Institutional Tuning</td><td colspan="2">Luminaires in non-daylit areas:
Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.</td><td>0.10</td></tr>
<tr><td colspan="2">Luminaires in daylit areas:
Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.</td><td>0.05</td></tr>
<tr><td>4. Demand Responsive Control</td><td colspan="2">All building types less than 10,000 square feet.
Luminaires that qualify for other PAFs in this table may also qualify for this demand responsive control PAF</td><td>0.05</td></tr>
</table>

TABLE 140.6-B COMPLETE BUILDING METHOD LIGHTING POWER DENSITY VALUES

TYPE OF BUILDING	ALLOWED LIGHTING POWER DENSITY (WATTS PER SQUARE FOOT)
Auditorium Building	1.4
Classroom Building	1.1
Commercial and Industrial Storage Building	0.60
Convention Center Building	1.0
Financial Institution Building	1.0
General Commercial Building/Industrial Work Building	1.00
Grocery Store Building	1.50
Library Building	1.2
Medical Building/Clinic Building	1.0
Office Building	0.80
Parking Garage Building	0.20
Religious Facility Building	1.5
Restaurant Building	1.1
School Building	0.95
Theater Building	1.3
All others buildings	0.50

TABLE 140.6-C AREA CATEGORY METHOD - LIGHTING POWER DENSITY VALUES (WATTS/FT^2)

PRIMARY FUNCTION AREA		ALLOWED LIGHTING POWER DENSITY (W/ft^2)	PRIMARY FUNCTION AREA		ALLOWED LIGHTING POWER DENSITY (W/ft^2)
Auditorium Area		1.40 [3]	Library Area	Reading areas	1.1 [3]
Auto Repair Area		0.90 [2]		Stack areas	1.5 [3]
Beauty Salon Area		1.7	Lobby Area	Hotel lobby	0.95 [3]
Civic Meeting Place Area		1.3 [3]		Main entry lobby	0.95 [3]
Classroom, Lecture, Training, Vocational Areas		1.2 [5]	Locker/Dressing Room		0.70
Commercial and Industrial Storage Areas (conditioned and unconditioned)		0.60	Lounge Area		0.90 [3]
Commercial and Industrial Storage Areas (refrigerated)		0.7	Malls and Atria		0.95 [3]
Convention, Conference, Multipurpose and Meeting Center Areas		1.2 [3]	Medical and Clinical Care Area		1.2
Corridor, Restroom, Stair, and Support Areas		0.60	Office Area	> 250 square feet	0.75
Dining Area		1.0 [3]		≤ 250 square feet	1.0
Electrical, Mechanical, Telephone Rooms		0.55 [2]	Parking Garage Area	Parking Area [10]	0.14
Exercise Center, Gymnasium Areas		1.0		Dedicated Ramps	0.30
Exhibit, Museum Areas		1.8		Daylight Adaptation Zones [9]	0.60
Financial Transaction Area		1.0 [3]	Religious Worship Area		1.5 [3]
General Commercial and Industrial Work Areas	Low bay	0.9 [2]	Retail Merchandise Sales, Wholesale Showroom Areas		1.2 [6 and 7]
	High bay	1.0 [2]			
	Precision	1.2 [4]	Theater Area	Motion picture	0.90 [3]
Grocery Sales Area		1.2 [6 and 7]		Performance	1.4 [3]

CONTINUED: TABLE 140.6-C AREA CATEGORY METHOD - LIGHTING POWER DENSITY VALUES ($WATTS/FT^2$)

Hotel Function Area	1.4[3]	Transportation Function Area	Concourse & Baggage	0.50
			Ticketing	1.0
Kitchen, Food Preparation Areas	1.2	Videoconferencing Studio		1.2[8]
Laboratory Area, Scientific	1.4[1]	Waiting Area		0.80[3]
Laundry Area	0.70	All other areas		0.50
Footnotes for this table are listed below.				

FOOTNOTES FOR TABLE 140.6-C:

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

Footnote number	Type of lighting system allowed	Allowed lighting power density. (W/ft^2 of task area unless otherwise noted)
1	Specialized task work	0.20 W/ft^2
2	Specialized task work	0.50 W/ft^2
3	Ornamental lighting as defined in Section 100.1 and in accordance with Section 140.6.(c)2.	0.50 W/ft^2
4	Precision commercial and industrial work	1.0 W/ft^2
5	Per linear foot of white board or chalk board.	5.5 W per linear foot
6	Accent, display and feature lighting - luminaires shall be adjustable or directional	0.30 W/ft^2
7	Decorative lighting - primary function shall be decorative and shall be in addition to general illumination.	0.20 W/ft^2
8	Additional Videoconferencing Studio lighting complying with all of the requirements in Section 140.6(c)2Gvii.	1.5 W/ft^2
9	Daylight Adaptation Zones shall be no longer than 66 feet from the entrance to the parking garage	
10	Additional allowance for ATM locations in Parking Garages. Allowance per ATM.	200 watts for first ATM location. 50 watt for each additional ATM location in a group.

TABLE 140.6-D TAILORED METHOD LIGHTING POWER ALLOWANCES

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

TABLE 140.6-E ADJUSTMENTS FOR MOUNTING HEIGHT ABOVE FLOOR

Height in feet above finished floor and bottom of luminaire(s)	**Floor Display or Wall Display – Multiply by**
< 12'	1.00
12' to 16'	0.87
> 16’	0.77

TABLE 140.6-F ROOM CAVITY RATIO (RCR) EQUATIONS

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

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

Illuminance Level (Lux)	RCR ≤ 2.0	RCR > 2.0 and ≤ 3.5	RCR > 3.5 and ≤ 7.0	RCR > 7.0
50	0.18	0.22	0.32	0.46
100	0.30	0.38	0.56	0.84
200	0.48	0.64	0.88	1.34
300	0.64	0.82	1.12	1.76
400	0.78	0.98	1.34	2.08
500	0.90	1.10	1.52	2.32
600	1.06	1.26	1.74	2.60
700	1.24	1.46	1.82	2.96
800	1.44	1.70	2.28	3.30
900	1.66	2.00	2.64	3.74
1000	1.84	2.20	2.90	4.06

SECTION 140.7 – REQUIREMENTS FOR OUTDOOR LIGHTING

(a) An outdoor lighting installation complies with this section if it meets the requirements in Subsections (b) and (c), and the actual outdoor lighting power installed is no greater than the allowed outdoor lighting power calculated under Subsection (d). The allowed outdoor lighting shall be calculated according to Outdoor Lighting Zone in Title 24, Part 1, Section 10-114.

EXCEPTIONS to Section 140.7(a): When more than 50 percent of the light from a luminaire falls within one or more of the following applications, the lighting power for that luminaire shall be exempt from Section 140.7:

1. Temporary outdoor lighting.
2. Lighting required and regulated by the Federal Aviation Administration, and the Coast Guard.
3. Lighting for public streets, roadways, highways, and traffic signage lighting, including lighting for driveway entrances occurring in the public right-of-way.
4. Lighting for sports and athletic fields, and children's playgrounds.
5. Lighting for industrial sites, including but not limited to, rail yards, maritime shipyards and docks, piers and marinas, chemical and petroleum processing plants, and aviation facilities.
6. Lighting of public monuments.
7. Lighting of signs complying with the requirements of Sections 130.3 and 140.8.
8. Lighting of stairs, wheelchair elevator lifts for American with Disabilities Act (ADA) compliance, and ramps that are other than parking garage ramps.
9. Landscape lighting.
10. In theme parks: outdoor lighting only for themes and special effects.
11. 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.
12. Outdoor lighting systems for qualified historic buildings, as defined in the California Historic Building Code (Title 24, Part 8), if they consist solely of historic lighting components or replicas of historic lighting components. If lighting systems for qualified historic buildings contain some historic lighting components or replicas of historic components, combined with other lighting components, only those historic or historic replica components are exempt. All other outdoor lighting systems for qualified historic buildings shall comply with Section 140.7.

(b) **Outdoor Lighting Power Trade-offs.** Outdoor lighting power trade-offs shall be determined as follows:

1. Allowed lighting power determined according to Section 140.7(d)1 for general hardscape lighting allowance may be traded to specific applications in Section 140.7(d)2, provided the hardscape area from which the lighting power is traded continues to be illuminated in accordance with Section 140.7(d)1A.
2. Allowed lighting power determined according to Section 140.7(d)2 for additional lighting power allowances for specific applications shall not be traded between specific applications, or to hardscape lighting in Section 140.7(d)1.
3. Trading off lighting power allowances between outdoor and indoor areas shall not be permitted.

(c) **Calculation of Actual Lighting Power.** The wattage of outdoor luminaires shall be determined in accordance with Section 130.0(c).

(d) **Calculation of Allowed Lighting Power.** The allowed lighting power shall be the combined total of the sum of the general hardscape lighting allowance determined in accordance with Section 140.7(d)1, and the sum of the additional lighting power allowance for specific applications determined in accordance with Section 140.7(d)2.

1. **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. In plan view of the site, determine the illuminated hardscape area, which is defined as any hardscape area that is within a square pattern around each luminaire or pole that is ten times the luminaire mounting height with the luminaire in the middle of the pattern, less any areas that are within a building, beyond the hardscape area, beyond property lines, or obstructed by a structure. The illuminated hardscape area shall include portions of planters and landscaped areas that are within the lighting application and are less than or equal to 10 feet wide in the short dimensions and are enclosed by hardscape or other improvement on at least three sides. Multiply the illuminated hardscape area by the Area Wattage Allowance (AWA) from Table 140.7-A for the appropriate Lighting Zone.

B. Determine the perimeter length of the general hardscape area. The total perimeter shall not include portions of hardscape that is not illuminated according to Section 140.7(d)1A. Multiply the hardscape perimeter by the Linear Wattage Allowance (LWA) for hardscape from Table 140.7-A for the appropriate lighting zone. The perimeter length for hardscape around landscaped areas and permanent planters shall be determined as follows:

   i. Landscaped areas completely enclosed within the hardscape area, and which have a width or length less than 10 feet wide, shall not be added to the hardscape perimeter length.

   ii. Landscaped areas completely enclosed within the hardscape area, and which width or length is a minimum of 10 feet wide, the perimeter of the landscaped areas or permanent planter shall be added to the hardscape perimeter length.

   iii. Landscaped edges that are not abutting the hardscape shall not be added to the hardscape perimeter length.

C. Determine the Initial Wattage Allowance (IWA) for general hardscape lighting from Table 140.7-A for the appropriate lighting zone. The hardscape area shall be permitted one IWA per site.

D. The general hardscape lighting allowance shall be the sum of the allowed watts determined from (A), (B) and (C) above.

2. **Additional Lighting Power Allowance for Specific Applications.** Additional lighting power for specific applications shall be the smaller of the additional lighting allowances for specific applications determined in accordance with TABLE 140.7-B for the appropriate lighting zone, or the actual installed lighting power meeting the requirements for the allowance.

TABLE 140.7-A GENERAL HARDSCAPE LIGHTING POWER ALLOWANCE

<table>
<tr><th>Type of Power Allowance</th><th>Lighting Zone 0</th><th>Lighting Zone 1</th><th>Lighting Zone 2[2]</th><th>Lighting Zone 3[2]</th><th>Lighting Zone 4</th></tr>
<tr><td>Area Wattage Allowance (AWA)</td><td rowspan="3">No allowance[1]</td><td>0.020 W/ft²</td><td>0.030 W/ft²</td><td>0.040 W/ft²</td><td>0.050 W/ft²</td></tr>
<tr><td>Linear Wattage Allowance (LWA)</td><td>0.15 W/lf</td><td>0.25 W/lf</td><td>0.35 W/lf</td><td>0.45 W/lf</td></tr>
<tr><td>Initial Wattage Allowance (IWA)</td><td>340 W</td><td>450 W</td><td>520 W</td><td>640 W</td></tr>
<tr><td colspan="6">[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 in Lighting Zone 0 shall meet the maximum zonal lumen limits for Uplight and Glare specified in Table 130.2-A and 130.2-B.

[2]For Lighting Zone 2 and 3, where greater than 50% of the paved surface of a parking lot is finished with concrete, the AWA for that area shall be 0.035 W/ft² for Lighting Zone 2 and 0.040 W/ft² for Lighting Zone 3, and the LWA for both lighting zones shall be 0.70 W/lf. This does not extend beyond the parking lot, and does not include any other General Hardscape areas.</td></tr>
</table>

TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS
All area and distance measurements in plan view unless otherwise noted.

Lighting Application	Lighting Zone 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	15 watts	25 watts	35 watts	45 watts
Primary Entrances to Senior Care Facilities, Police Stations, Hospitals, Fire Stations, and Emergency Vehicle Facilities. Allowance per primary entrance(s) only. Primary entrances shall provide access for the general public and shall not be used exclusively for staff or service personnel. This allowance shall be in addition to the building entrance or exit allowance above. Luminaires qualifying for this allowance shall be within 100 feet of the primary entrance.	Not applicable	45 watts	80 watts	120 watts	130 watts
Drive Up Windows. Allowance per customer service location. Luminaires qualifying for this allowance shall be within 2 mounting heights of the sill of the window.	Not applicable	40 watts	75 watts	125 watts	200 watts
Vehicle Service Station Uncovered Fuel Dispenser. Allowance per fueling dispenser. Luminaires qualifying for this allowance shall be within 2 mounting heights of the dispenser.	Not applicable	120 watts	175 watts	185 watts	330 watts
ATM Machine Lighting. Allowance per ATM machine. Luminaires qualifying for this allowance shall be within 50 feet of the dispenser.	Not applicable	250 watts for first ATM machine, 70 watts for each additional ATM machine.			
WATTAGE ALLOWANCE PER UNIT LENGTH (w/linear ft). May be used for one or two frontage side(s) per site.					
Outdoor Sales Frontage. Allowance for frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. Luminaires qualifying for this allowance shall be located between the principal viewing location and the frontage outdoor sales area.	Not applicable	No Allowance	22.5 W/linear ft	36 W/linear ft	45 W/linear ft
WATTAGE ALLOWANCE PER HARDSCAPE AREA (W/ft²). May be used for any illuminated hardscape area on the site.					
Hardscape Ornamental Lighting. Allowance for the total site illuminated hardscape area. Luminaires qualifying for this allowance shall be rated for 100 watts or less as determined in accordance with Section 130.0(d), and shall be post-top luminaires, lanterns, pendant luminaires, or chandeliers.	Not applicable	No Allowance	0.02 W/ft²	0.04 W/ft²	0.06 W/ft²
WATTAGE ALLOWANCE PER SPECIFIC AREA (W/ft²). Use as appropriate provided that none of the following specific applications shall be used for the same area.					
Building Facades. Only areas of building façade that are illuminated shall qualify for this allowance. Luminaires qualifying for this allowance shall be aimed at the façade and shall be capable of illuminating it without obstruction or interference by permanent building features or other objects.	Not applicable	No Allowance	0.18 W/ft²	0.35 W/ft²	0.50 W/ft²
Outdoor Sales Lots. Allowance for uncovered sales lots used exclusively for the display of vehicles or other merchandise for sale. Driveways, parking lots or other non sales areas shall be considered hardscape areas even if these areas are completely surrounded by sales lot on all sides. Luminaires qualifying for this allowance shall be within 5 mounting heights of the sales lot area.	Not applicable	0.164 W/ft²	0.555 W/ft²	0.758 W/ft²	1.285 W/ft²
Vehicle Service Station Hardscape. Allowance for the total illuminated hardscape area less area of buildings, under canopies, off property, or obstructed by signs or structures. Luminaires qualifying for this allowance shall be illuminating the hardscape area and shall not be within a building, below a canopy, beyond property lines, or obstructed by a sign or other structure.	Not applicable	0.014 W/ft²	0.155 W/ft²	0.308 W/ft²	0.485 W/ft²
Vehicle Service Station Canopies. Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy.	Not applicable	0.514 W/ft²	1.005 W/ft²	1.300 W/ft²	2.200 W/ft²
Sales Canopies. Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy.	Not applicable	No Allowance	0.655 W/ft²	0.908 W/ft²	1.135 W/ft²
Non-sales Canopies and Tunnels. Allowance for the total area within the drip line of the canopy or inside the tunnel. Luminaires qualifying for this allowance shall be located under the canopy or tunnel.	Not applicable	0.084 W/ft²	0.205 W/ft²	0.408 W/ft²	0.585 W/ft²

CONTINUED: TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS

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

Lighting Application	**Lighting Zone 0**	**Lighting Zone 1**	**Lighting Zone 2**	**Lighting Zone 3**	**Lighting Zone 4**
Guard Stations. Allowance up to 1,000 square feet per vehicle lane. Guard stations provide access to secure areas controlled by security personnel who stop and may inspect vehicles and vehicle occupants, including identification, documentation, vehicle license plates, and vehicle contents. Qualifying luminaires shall be within 2 mounting heights of a vehicle lane or the guardhouse.	Not applicable	0.154 W/ft²	0.355 W/ft²	0.708 W/ft²	0.985 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	0.12 W/ft²	0.45 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	0.014 W/ft²	0.135 W/ft²	0.240 W/ft²	0.400 W/ft²
Special Security Lighting for Retail Parking and Pedestrian Hardscape. This additional allowance is for illuminated retail parking and pedestrian hardscape identified as having special security needs. This allowance shall be in addition to the building entrance or exit allowance.	Not applicable	0.007 W/ft²	0.009 W/ft²	0.019 W/ft²	No Allowance

SECTION 140.8 – REQUIREMENTS FOR SIGNS

This section 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.**

1. 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.
2. 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.
3. Lighting for unfiltered light emitting diodes (LEDs) and unfiltered neon shall comply with Section 140.8(b).

(b) **Alternate Lighting Sources.** The sign shall comply if it is equipped only with one or more of the following light sources:

1. High pressure sodium lamps; or
2. 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 measured output wattage to the lamp divided by the measured operating input wattage when tested according to ANSI C82.6-2005.
3. 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.
4. 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.
5. Light emitting diodes (LEDs) with a power supply having an efficiency of 80 percent or greater; or

   EXCEPTION to Section 140.8(b)5: 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).
6. Compact fluorescent lamps that do not contain a medium screw base sockets (E24/E26).

EXCEPTION 1 to Section 140.8: 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 140.8: Exit signs. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.

EXCEPTION 3 to Section 140.8: Traffic Signs. Traffic signs shall meet the requirements of the Appliance Efficiency Regulations.

SECTION 140.9 – PRESCRIPTIVE REQUIREMENTS FOR COVERED PROCESSES

(a) **Prescriptive Requirements for Computer Rooms.** Space conditioning systems serving a computer room with a power density greater than 20 W/ft^2 shall comply with this section by being designed with and having constructed and installed a cooling system that meets the requirements of Subsections 1 through 6.

1. **Economizers.** Each individual cooling system primarily serving computer rooms shall include either:

   A. An integrated air economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 55°F dry-bulb/50°F wet-bulb and below; or

   B. An integrated water economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 40°F dry-bulb/35°F wet-bulb and below.

   EXCEPTION 1 to Section 140.9(a)1: Individual computer rooms under 5 tons in a building that does not have any economizers.

   EXCEPTION 2 to Section 140.9(a)1: New cooling systems serving an existing computer room in an existing building up to a total of 50 tons of new cooling equipment per building.

   EXCEPTION 3 to Section 140.9(a)1: New cooling systems serving a new computer room in an existing building up to a total of 20 tons of new cooling equipment per building.

   EXCEPTION 4 to Section 140.9(a)1: A computer room may be served by a fan system without an economizer if it is also served by a fan system with an economizer that also serves other spaces within the building provided that all of the following are met:

   i. The economizer system is sized to meet the design cooling load of the computer room when the other spaces within the building are at 50 percent of their design load; and

   ii. The economizer system has the ability to serve only the computer room, e.g. shut off flow to other spaces within the building when unoccupied; and

   iii. The noneconomizer system does not operate when the outside air drybulb temperatures is below 60^{o}F and, the cooling load of other spaces within the building served by the economizer system is less than 50 percent of design load.

2. **Reheat.** Each computer room zone shall have controls that prevent reheating, recooling and 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.

3. **Humidification.** Nonadiabatic humidification (e.g. steam, infrared) is prohibited. Only adiabatic humidification (e.g. direct evaporative, ultrasonic) is permitted.

4. **Power Consumption of Fans.** The total fan power at design conditions of each fan system shall not exceed 27 W/kBtu·h of net sensible cooling capacity.

5. **Fan Control.** Each unitaryair conditioner with mechanical cooling capacity exceeding 60,000 Btu/hr and each chilled water fan system shall be designed to vary the airflow rate as a function of actual load and shall have controls and/or devices (such as two-speed or variable speed control) that will result in fan motor demand of no more than 50 percent of design wattage at 66 percent of design fan speed.

6. **Containment.** Computer rooms with air-cooled computers in racks and with a design load exceeding 175 kW/room shall include air barriers such that there is no significant air path for computer discharge air to recirculate back to computer inlets without passing through a cooling system.

   EXCEPTION 1 to Section 140.9(a)6: Expansions of existing computer rooms.

   EXCEPTION 2 to Section 140.9(a)6: Computer racks with a design load less than 1 kW/rack.

EXCEPTION 3 to Section 140.9(a)6: Equivalent energy performance based on computational fluid dynamics or other analysis.

(b) **Prescriptive Requirements for Commercial Kitchens.**

1. **Kitchen exhaust systems.**

   A. Replacement air introduced directly into the hood cavity of kitchen exhaust hoods shall not exceed 10 percent of the hood exhaust airflow rate.

   B. For kitchen/dining facilities having total Type I and Type II kitchen hood exhaust airflow rates greater than 5,000 cfm, each Type I hood shall have an exhaust rate that complies with TABLE 140.9-A. If a single hood or hood section is installed over appliances with different duty ratings, then the maximum allowable flow rate for the hood or hood section shall not exceed the TABLE 140.9-A values for the highest appliance duty rating under the hood or hood section. Refer to ASHRAE Standard 154-2011 for definitions of hood type, appliance duty and next exhaust flow rate.

   EXCEPTION 1 to Section 140.9(b)1B: 75 percent of the total Type I and Type II exhaust replacement air is transfer air that would otherwise be exhausted.

   EXCEPTION 2 to Section 140.9(b)1B: Existing hoods not being replaced as part of an addition or alteration.

TABLE 140.9-A MAXIMUM NET EXHAUST FLOW RATE, CFM PER LINEAR FOOT OF HOOD LENGTH

Type of Hood	Light Duty Equipment	Medium Duty Equipment	Heavy Duty Equipment	Extra Heavy Duty Equipment
Wall-mounted Canopy	140	210	280	385
Single Island	280	350	420	490
Double Island	175	210	280	385
Eyebrow	175	175	Not Allowed	Not Allowed
Backshelf / Passover	210	210	280	Not Allowed

2. **Kitchen ventilation.**

   A. Mechanically cooled or heated makeup air delivered to any space with a kitchen hood shall not exceed the greater of:

      i. The supply flow required to meet the space heating and cooling load; or

      ii. The hood exhaust flow minus the available transfer air from adjacent spaces. Available transfer air is that portion of outdoor ventilation air serving adjacent spaces not required to satisfy other exhaust needs, such as restrooms, not required to maintain pressurization of adjacent spaces, and that would otherwise be relieved from the building.

   EXCEPTION to Section 140.9(b)2A: Existing kitchen makeup air units not being replaced as part of an addition or alteration.

   B. A kitchen/dining facility having a total Type I and Type II kitchen hood exhaust airflow rate greater than 5,000 cfm shall have one of the following:

      i. At least 50 percent of all replacement air is transfer air that would otherwise be exhausted; or

      ii. Demand ventilation system(s) on at least 75 percent of the exhaust air. Such systems shall:

         a. Include controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle; and

         b. Include failsafe controls that result in full flow upon cooking sensor failure; and

         c. Include an adjustable timed override to allow occupants the ability to temporarily override the system to full flow; and

         d. Be capable of reducing exhaust and replacement air system airflow rates to the larger of:

(i) 50 percent of the total design exhaust and replacement air system airflow rates; or

(ii) The ventilation rate required as specified by Section 120.1.

iii. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on at least 50 percent of the total exhaust airflow; or

iv. A minimum of 75 percent of makeup air volume that is:

a. Unheated or heated to no more than 60°F; and

b. Uncooled or cooled without the use of mechanical cooling.

EXCEPTION to Section 140.9(b)2B: Existing hoods not being replaced as part of an addition or alteration.

3. **Kitchen Exhaust System Acceptance.** Before an occupancy permit is granted for a commercial kitchen subject to Section 140.9(b), the following equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.11.

(c) **Prescriptive Requirements for Laboratory exhaust systems.** For buildings with laboratory exhaust systems where the minimum circulation rate to comply with code or accreditation standards is 10 ACH or less, the design exhaust airflow shall be capable of reducing zone exhaust and makeup airflow rates to the regulated minimum circulation rate, or the minimum required to maintain pressurization requirements, whichever is larger. Variable exhaust and makeup airflow shall be coordinated to achieve the required space pressurization at varied levels of demand and fan system capacity.

EXCEPTION 1 to Section 140.9(c): Laboratory exhaust systems serving zones where constant volume is required by the Authority Having Jurisdiction, facility Environmental Health & Safety department or other applicable code.

EXCEPTION 2 to Section 140.9(c): New zones on an existing constant volume exhaust system.

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SUBCHAPTER 6 NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—ADDITIONS, ALTERATIONS, AND REPAIRS

SECTION 141.0 – ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL BUILDINGS, TO EXISTING OUTDOOR LIGHTING, AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

Additions, alterations, and repairs to existing nonresidential, high-rise residential, and hotel/motel buildings, existing outdoor lighting for these occupancies, and internally and externally illuminated signs, shall meet the requirements specified in Sections 100.0 through 110.11, and 120.0 through 130.5 that are applicable to the building project, and either the performance compliance approach (energy budgets) in Section 141.0(a)2 (for additions) or 141.0(b)3 (for alterations), or the prescriptive compliance approach in Section 141.0(a)1 (for additions) or 141.0(b)2 (for alterations), for the Climate Zone in which the building is located. Climate zones are shown in FIGURE 100.1-A.

Covered process requirements for additions, alterations and repairs to existing nonresidential, high-rise residential, and hotel/motel buildings are specified in Section 141.1.

NOTE: For alterations that change the occupancy classification of the building, the requirements specified in Section 141.0(b) apply to the occupancy after the alterations.

(a) **Additions.** Additions shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The envelope and lighting of the addition; any newly installed space-conditioning system, electrical power distribution system, or water-heating system; any addition to an outdoor lighting system; and any new sign installed in conjunction with an indoor or outdoor addition shall meet the applicable requirements of Sections 110.0 through 130.5 and Sections 140.2 through 140.9.

2. **Performance approach.**

   A. The envelope and indoor lighting in the conditioned space of the addition, and any newly installed space-conditioning system, electrical power distribution system, or water-heating system, shall meet the applicable requirements of Sections 110.0 through 130.5; and

   B. Either:

      i. The addition alone shall comply with Section 140.1; or

      ii. Existing plus addition plus alteration. The standard design for existing plus addition, plus alteration 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 141.0(b)2, plus the proposed addition's energy use meeting the requirements of Section 140.1. The proposed design energy use is the combination of the existing building's unaltered components to remain and the altered component's energy features, plus the proposed energy features of the addition.

EXCEPTION 1 to Section 141.0(a): When heating, cooling, or service water heating to an addition are provided by expanding existing systems, the existing systems and equipment need not comply with Sections 110.0 through 120.9, or Sections 140.4 through 140.5.

EXCEPTION 2 to Section 141.0(a): Where an existing system with electric reheat is expanded by adding variable air volume (VAV) boxes to serve an addition, total electric reheat capacity may be expanded so that the total capacity does not exceed 150 percent of the existing installed electric heating capacity in any one permit, and the system need not comply with Section 140.4(g). Additional electric reheat capacity in excess of 150 percent of the existing installed electric heating capacity may be added subject to the requirements of the Section 140.4(g).

EXCEPTION 3 to Section 141.0(a): Duct Sealing. When 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 141.0(b)2D.

EXCEPTION 4 to Section 141.0(a): Additions that increase the area of the roof by 2,000 square feet or less are exempt from the requirements of Section 110.10.

(b) **Alterations.** Alterations to existing nonresidential, high-rise residential, or hotel/motel buildings, relocatable public school buildings or alterations in conjunction with a change in building occupancy to a nonresidential, high-rise residential, or hotel/motel occupancy are not subject to Subsection (a) and shall meet item 1, and either Item 2 or 3 below:

1. **Mandatory Insulation** Requirements for Roofs, Walls, and Floors. Altered components in a nonresidential, high-rise residential, or hotel/motel building shall meet the minimum requirements in this Section.

   A. **Roof/Ceiling Insulation.** The opaque portions of the roof/ceiling that separate conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Section 141.0(b)2Biii.

   B. **Wall Insulation.** For the altered opaque portion of walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 4 below:

      1. **Metal Building.** A minimum of R-13 insulation between framing members, or the weighted average U-factor of the wall assembly shall not exceed U-0.113.

      2. **Metal Framed.** A minimum of R-13 insulation between framing members, or the weighted average U-factor of the wall assembly shall not exceed U-0.217.

      3. **Wood Framed and Others.** A minimum of R-11 insulation between framing members, or the weighted average U-factor of the wall assembly shall not exceed U-0.110.

      4. **Spandrel Panels and Glass Curtain Walls.** A minimum of R-4, or the weighted average U-factor of the wall assembly shall not exceed U-0.280.

      EXCEPTION to Section 141.0(b)1B: Light and heavy mass walls.

   C. **Floor Insulation.** For the altered portion of raised floors that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 3 below:

      1. **Raised Framed Floors.** A minimum of R-11 insulation between framing members, or the weighted average U-factor of the floor assembly shall not exceed the U-factor of U-0.071.

      2. **Raised Mass Floors in High-rise Residential and Hotel/Motel Guest Rooms.** A minimum of R-6 insulation, or the weighted average U-factor of the floor assembly shall not exceed the U-factor of U-0.111.

      3. **Raised Mass Floors in Other Occupancies.** No minimum U-factor requirement.

2. **Prescriptive approach.** The altered components of the envelope, or space conditioning, lighting, electrical power distribution and water heating systems, and any newly installed equipment serving the alteration, shall meet the applicable requirements of Sections 110.0 through 110.9, Sections 120.0 through 120.6, and Sections 120.9 through 130.5

   EXCEPTION to Section 141.0(b)2: The requirements of Section 120.2(i) shall not apply to alterations of space-conditioning systems or components.

   A. Fenestration alterations other than repair and those subject to Section 141.0(b)2 shall meet the requirements below:

i. Vertical fenestration alterations shall meet the requirements in Table 141.0-A

ii. Added vertical fenestration shall meet the requirements of TABLE 140.3-B, C, or D.

iii. All altered or newly installed skylights shall meet the requirements of TABLE 140.3-B, C or D.

EXCEPTION 1 to Section 141.0(b)2Ai: Replacing 150 square feet or less of the entire building's vertical fenestration, RSHGC and VT requirements of TABLE 141.0-A shall not apply.

EXCEPTION 2 to Section 141.0(b)2Aii: In an alteration, where 50 square feet or less of vertical fenestration is added, RSHGC and VT requirements of TABLE 140.3-B, C or D shall not apply.

EXCEPTION 3 to Section 141.0(b)2Aiii: In an alteration, where 50 square feet or less of skylight is added, SHGC and VT requirements of TABLE 140.3-B, C or D shall not apply.

Table 141.0-A ALTERED VERTICAL FENESTRATION MAXIMUM U-FACTOR AND MAXIMUM RSHGC

Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
U-factor	0.47	0.47	0.58	0.47	0.58	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47
RSHGC	0.41	0.31	0.41	0.31	0.41	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.41
VT	See TABLE 140.3-B, C, and D for all Climate Zones															

B. Existing roofs being replaced, recovered or recoated, of a nonresidential, high-rise residential and hotels/motels 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, is being altered the requirements of i through iii below apply:

i. Roofing Products. Nonresidential buildings:

a. Low-sloped roofs in Climate Zones 1 through 16 shall have a minimum aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75, or a minimum SRI of 75.

b. Steep-sloped roofs in Climate Zones 1 through 16 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 to Section 141.0(b)2Bia: An aged solar reflectance less than 0.63 is allowed provided the maximum roof/ceiling U-factor in TABLE 141.0-B is not exceeded.

ii. Roofing Products. High-rise residential buildings and hotels and motels:

a. Low-sloped roofs in Climate Zones 10, 11, 13, 14 and 15 shall have a minimum aged solar reflectance of 0.55 and a minimum thermal emittance of 0.75, or a minimum SRI of 64.

b. Steep-sloped roofs Climate Zones 2 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

EXCEPTION 1 to Section 141.0(b)2Bi 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 SRI.

EXCEPTION 2 to Section 141.0(b)2Bi and ii: Roof constructions that have thermal mass over the roof membrane with a weight of at least 25 lb/ft² are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

Table 141.0-B ROOF/CEILING INSULATION TRADEOFF FOR AGED SOLAR REFLECTANCE

Aged Solar Reflectance	Climate Zone 1, 3-9 U-factor	Climate Zone 2, 10-16 U-factor
0.62- 0.60	0.075	0.052
0.59-0.55	0.066	0.048
0.54-0.50	0.060	0.044
0.49-0.45	0.055	0.041
0.44-0.40	0.051	0.039
0.39-0.35	0.047	0.037
0.34-0.30	0.044	0.035
0.29-0.25	0.042	0.034

iii. For nonresidential buildings, high-rise residential buildings and hotels/motels, when low-sloped roofs are exposed to the roof deck or to the roof recover boards, and meets Section 141.0(b)2Bia or iia, the exposed area shall be insulated to the levels specified in TABLE 141.0-C.

EXCEPTION to Section 141.0(b)2Biii

a. Existing roofs that are insulated with at least R-7 insulation or that has a U-factor lower than 0.089 are not required to meet the R-value requirement of TABLE 141.0-C.

b. If mechanical equipment is located on the roof and will not be disconnected and lifted as part of the roof replacement, insulation added may be limited to the maximum insulation thickness that will allow a height of 8 inches (203 mm) from the roof membrane surface to the top of the base flashing.

c. If adding the required insulation will reduce the base flashing height to less than 8 inches (203 mm) at penthouse or parapet walls, the insulation added may be limited to the maximum insulation thickness that will allow a height of 8 inches (203 mm) from the roof membrane surface to the top of the base flashing, provided that the conditions in Subsections i through iv apply:

i. The penthouse or parapet walls are finished with an exterior cladding material other than the roofing covering membrane material; and

ii. The penthouse or parapet walls have exterior cladding material that must be removed to install the new roof covering membrane to maintain a base flashing height of 8 inches (203 mm); and

iii. For nonresidential buildings, the ratio of the replaced roof area to the linear dimension of affected penthouse or parapet walls shall be less than 25 square feet per linear foot for Climate Zones 2, and 10 through 16, and less than 100 square feet per linear foot for Climate Zones 1, and 3 through 9; and

iv. For high-rise residential buildings, hotels or motels, the ratio of the replaced roof area to the linear dimension of affected penthouse or parapet walls shall be less than 25 square feet per linear foot for all Climate Zones.

v. Tapered insulation may be used which has a thermal resistance less than that prescribed in TABLE 141.0-C at the drains and other low points, provided that the thickness of insulation is increased at the high points of the roof so that the average thermal resistance equals or exceeds the value that is specified in TABLE 141.0-C.

TABLE 141.0-C INSULATION REQUIREMENTS FOR ROOF ALTERATIONS

	Nonresidential		High-Rise Residential and Guest Rooms of Hotel/Motel Buildings	
Climate Zone	Continuous Insulation R-value	U-factor	Continuous Insulation R-value	U-factor
1	R-8	0.082	R-14	0.055
2	R-14	0.055	R-14	0.055
3-9	R-8	0.082	R-14	0.055
10-16	R-14	0.055	R-14	0.055

C. **New or Replacement Space-Conditioning Systems or Components** other than new or replacement space-conditioning system ducts shall meet the requirements of Section 140.4 applicable to the systems or components being altered.

EXCEPTION 1 to Section 141.0(b)2C. Subsection (b)2C does not apply to replacements of equivalent or lower capacity electric resistance space heaters for high rise residential apartment units.

EXCEPTION 2 to Section 141.0(b)2C. Subsection (b)2C does not apply to replacement of electric reheat of equivalent or lower capacity electric resistance space heaters, when natural gas is not available.

EXCEPTION 3 to Section 141.0(b)2C. Section 140.4(n) is not applicable to new or replacement space conditioning systems.

D. **Altered Duct Systems.** When new or replacement space-conditioning system ducts are installed to serve an existing building, the new ducts shall meet the requirements of Section 120.4. If the space conditioning system meets the criteria of Sections 140.4(l)1, 2, and 3, the duct system shall be sealed as confirmed through field verification and diagnostic testing in accordance with the procedures for duct sealing of an existing duct system as specified in Reference Nonresidential Appendix NA2, to meet one of the following requirements:

i. If the new ducts form an entirely new or replacement duct system directly connected to the air handler, the measured duct leakage shall be equal to, or less than 6 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Nonresidential Appendix Section NA2.1.4.2.1.

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.

ii. If the new ducts are an extension of an existing duct system, the combined new and existing duct system shall meet one of the following requirements:

a. The measured duct leakage shall be equal to or less than 15 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Nonresidential Appendix Section NA2.1.4.2.1; or

b. If it is not possible to comply with the duct leakage criterion in Subsection 141.0(b)2Diia, then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test performed by a certified HERS Rater utilizing the methods specified in Reference Nonresidential Appendix NA2.1.4.2.2.

EXCEPTION to Section 141.0(b)2Dii: Duct Sealing. Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos are exempt from the requirements of subsection 141.0(b)2Dii.

E. **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:

i. For all altered units where the existing thermostat does not comply with Reference Joint Appendix JA5, the existing thermostat shall be replaced with a thermostat that complies with Reference Joint Appendix JA5. All newly installed space-conditioning systems requiring a thermostat shall be equipped with a thermostat that complies with Reference Joint Appendix JA5; and

ii. 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 Sections 140.4(l)1, 2 and 3, as confirmed through field verification and diagnostic testing, in accordance with the applicable procedures for duct sealing of altered existing duct systems as specified in Reference Nonresidential Appendix NA2, and conforming to the applicable leakage compliance criteria in Section 141.0(b)2D.

EXCEPTION 1 to Section 141.0(b)2Eii: Duct Sealing. Buildings altered so that the duct system no longer meets the criteria of Sections 144 (l)1, 2, and 3 are exempt from the requirements of Subsection 141.0(b)2Eii.

EXCEPTION 2 to Section 141.0(b)2Eii: Duct Sealing. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in the Reference Nonresidential Appendix NA2 are exempt from the requirements of Subsection 141.0(b)2Eii.

EXCEPTION 3 to Section 141.0(b)2Eii: Duct Sealing. Existing duct systems constructed, insulated or sealed with asbestos are exempt from the requirements of Subsection 141.0(b)2Eii.

F. Spaces with lighting systems installed for the first time shall meet the requirements of Sections 110.9, 130.0, 130.1, 130.2, 130.4, 140.3(c), 140.6, and 140.7.

G. When the requirements of Section 130.1(d) are triggered by the addition of skylights to an existing building and the lighting system is not recircuited, the daylighting control need not meet the multi-level requirements in Section 130.1(d).

H. New internally and externally illuminated signs shall meet the requirements of Sections 110.9, 130.3 and 140.8.

I. **Entire Luminaire Alterations.** Entire luminaire alterations shall meet the following requirements:

i. For each enclosed space, alterations that consist of either (a) removing and reinstalling a total of 10 percent or more of the existing luminaires; or (b) replacing or adding entire luminaires; or (c) adding, removing, or replacing walls or ceilings along with any redesign of the lighting system, shall meet the lighting power allowance in Section 140.6, and the altered luminaires shall meet the applicable requirements in Table 141.0-E; or

ii. For alterations where existing luminaires are replaced with new luminaires, and that do not include adding, removing, or replacing walls or ceilings along with redesign of the lighting system, the replacement luminaires in each office, retail, and hotel occupancy shall have at least 50 percent, and in all other occupancies at least 35 percent, lower rated power at full light output compared to the existing luminaires being replaced, and shall meet the requirements of Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B.

EXCEPTION 1 to Section 141.0(b)2I. Alteration of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded as specified in Section 140.6(a)3.

EXCEPTION 2 to Section 141.0(b)2I. In an enclosed space where two or fewer luminaires are replaced or reinstalled.

EXCEPTION 3 to Section 141.0(b)2I. Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.

EXCEPTION 4 to Section 141.0(b)2I. Acceptance testing requirements of Section 130.4 are not required for alterations where lighting controls are added to control 20 or fewer luminaires.

J. **Luminaire Component Modifications.** Luminaire component modifications in place that include replacing the ballasts or drivers and the associated lamps in the luminaire, permanently changing the light source of the luminaire, or changing the optical system of the luminaire, where 70 or more existing luminaires are modified either on any single floor of a building or, where multiple tenants inhabit the same floor, in any single tenant space, in any single year, shall not prevent or disable the operation of any multi-level, shut-off, or daylighting controls, and shall:

i. Meet the lighting power allowance in Section 140.6 and comply with Table 141.0-E; or

ii. In office, retail, and hotel occupancies have at least 50 percent, and in all other occupancies have at least 35 percent, lower rated power at full light output as compared to the original luminaires prior to being modified, and meet the requirements of Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B.

Lamp replacements alone and ballast replacements alone shall not be considered a modification of the luminaire provided that the replacement lamps or ballasts are installed and powered without modifying the luminaire.

EXCEPTION 1 to Section 141.0(b)2J. Modification of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded by Section 140.6(a)3.

EXCEPTION 2 to Section 141.0(b)2J. In an enclosed space where two or fewer luminaires are modified.

EXCEPTION 3 to Section 141.0(b)2J. Modifications that would directly cause the disturbance of asbestos, unless the modifications are made in conjunction with asbestos abatement.

EXCEPTION 4 to Section 141.0(b)2J. Acceptance testing requirements of Section 130.4 are not required for modifications where lighting controls are added to control 20 or fewer luminaires.

K. **Lighting Wiring Alterations.** For each enclosed space, wiring alterations that add a circuit feeding luminaires; that replace, modify, or relocate wiring between a switch or panelboard and luminaires; or that replace lighting control panels, panelboards, or branch circuit wiring; shall:

i. meet the lighting power allowance in Section 140.6;

ii. meet the requirements in Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)3, and 130.1(c)4;

iii. for each enclosed space, be wired to create a minimum of one step between 30-70 percent of lighting power or meet Section 130.1(b); and

iv. for each enclosed space where wiring alterations include 10 or more luminaires that provide general lighting within the primary sidelit daylit zone or the skylit daylit zone, meet the requirements of 130.1(d).

NOTE: As specified in Section 141.0(b)2I, alterations that include adding, removing, or replacing walls or ceilings resulting in redesign of the lighting system shall meet the requirements of Table 141.0-E.

EXCEPTION 1 to Section 141.0(b)2K. Alterations strictly limited to addition of lighting controls.

EXCEPTION 2 to Section 141.0(b)2K. In an enclosed space where wiring alterations involve two or fewer luminaires.

EXCEPTION 3 to Section 141.0(b)2K. Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.

EXCEPTION 4 to Section 141.0(b)2K. Acceptance testing requirements of Section 130.4 are not required for wiring alterations where lighting controls are added to control 20 or fewer luminaires.

L. Alterations to existing outdoor lighting systems in a lighting application listed in TABLE 140.7-A or 140.7-B shall meet the applicable requirements of Sections 130.0, 130.2(a), 130.2(b), and 130.4, and:

i. In alterations that increase the connected lighting load, the added or altered luminaires shall meet the applicable requirements of Section 130.2(c) and the requirements of Section 140.7 for general hardscape lighting or for the specific lighting applications containing the alterations; and

ii. In alterations that do not increase the connected lighting load, where the greater of 5 luminaires or 10 percent of the existing luminaires are replaced in a general hardscape or a specific lighting application, the alterations shall meet the following requirements:

a. In parking lots and outdoor sales lots where the bottom of the luminaire is mounted 24 feet or less above the ground, the replacement luminaires shall comply with Section 130.2(c)1 AND Section 130.2(c)3;

b. For all other lighting applications and where the bottom of the luminaire is mounted greater than 24 feet above the ground, the replacement luminaires shall comply with Section 130.2(c)1 AND EITHER comply with Section 130.2(c)2 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

iii. In alterations that do not increase the connected lighting load, where the greater of 5 luminaires or 50 percent of the existing luminaires are replaced in general hardscape or a specific application, the replacement luminaires shall meet the requirements of subsection ii above and the requirements of Section 140.7 for general hardscape lighting or specific lighting applications containing the alterations.

EXCEPTION to Section 141.0(b)2Liii. Alterations where the replacement luminaires have at least 40 percent lower power consumption compared to the original luminaires are not required to comply with the lighting power allowances of Section 140.7.

EXCEPTION to Section 141.0(b)2L. Acceptance testing requirements of Section 130.4 are not required for alterations where controls are added to 20 or fewer luminaires.

M. Alterations to existing internally and externally illuminated signs that increase the connected lighting load, replace and rewire more than 50 percent of the ballasts, or relocate the sign to a different location on the same site or on a different site shall meet the requirements of Section 140.8

EXCEPTION to Section 141.0(b)2M. Replacement of parts of an existing sign, including replacing lamps, the sign face or ballasts, that do not require rewiring or that are done at a time other than when the sign is relocated, is not an alteration subject to the requirements of Section 141.0(b)2M.

N. Service water-heating systems shall meet the requirements of Section 140.5, except for the solar water heating requirements.

O. A building shell for which interior walls or ceilings are installed for the first time shall meet the requirements of Section 140.3(c).

P. **Electrical Power Distribution Systems.** Alterations to electrical power distribution systems shall meet the applicable requirements of Section 130.5 as follows:

i. Service Electrical Metering.

New or replacement electrical service equipment shall meet the requirements of Section 130.5(a) applicable to the electrical power distribution system altered.

ii. 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 130.5(b).

iii. 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 130.5(c).

EXCEPTION to Section 141.0(b)2Piii: Voltage drop permitted by California Electrical Code Sections 647.4, 695.6 and 695.7.

iv. 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 130.5(d).

3. Performance approach.

A. The altered envelope, space–conditioning system, lighting and water heating components, and any newly installed equipment serving the alteration, shall meet the applicable requirements of Sections 110.0 through 110.9, Sections 120.0 through 120.6, and Sections 120.9 through 130.5.

EXCEPTION to Section 141.0(b)3A Window Films. Applied window films installed as part of an alteration complies with the U-factor, RSHGC and VT requirements of TABLE 141.0-D.

B. The standard design for an altered component shall be the higher efficiency of existing conditions or the requirements stated in TABLE 141.0-D. For components not being altered, the standard design shall be based on the existing conditions. When the third party verification option is specified, all components proposed for alteration, for which the additional credit is taken, must be verified. The Executive Director shall determine the qualifications required by the third party inspector.

TABLE 141.0-D – THE STANDARD DESIGN FOR AN ALTERED COMPONENT

Altered Component	Standard Design Without Third Party Verification of Existing Conditions Shall be Based On	Standard Design With Third Party Verification of Existing Conditions Shall be Based On
Roof/Ceiling Insulation, Wall Insulation, and Floor/Soffit Insulation	The requirements of Section 141.0(b)1.	
Fenestration The allowed glass area shall be the smaller of the a. or b. below: a. The proposed glass area: or b. The larger of: 1.The existing glass area that remains; or 2.The area allowed in Section 140.3(a)5A.	The U-factor and RSHGC requirements of TABLE 141.0-A.	The existing U-factor and RSHGC levels.
Space-Conditioning System Equipment and Ducts	The requirements of Sections 141.0(b)2C, 141.0(b)2Di or Section 141.0(b)2Dii, and Section 141.0(b)2E.	
Window Film	The U-factor of 0.40 and SHGC value of 0.35.	The existing fenestration in the alteration shall be based on TABLE 110.6-A and Table 110.6-B.
Service Water Heating Systems	The requirements of Section 140.5 without solar water heating requirements.	
Roofing Products	The requirements of Section 141.0(b)2B.	
Lighting System	The requirements of Sections 141.0(b)2F, through 141.0(b)2K.	
All Other Measures	The proposed efficiency levels.	

C. The proposed design shall be based on the actual values of the altered components.

NOTES TO SECTION 141.0(b)3:

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 energy budget and must meet the requirements of Section 141.0(b)3.
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 Nonresidential ACM Reference Manual.

EXCEPTION 1 to Section 141.0(b): 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 120.9 and Section 140.4 or 140.5.

EXCEPTION 2 to Section 141.0(b): 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 120.9 and Section 140.4 or 140.5.

EXCEPTION 3 to Section 141.0(b): 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 with Section 140.4(g). Additional electric reheat capacity in excess of 20 percent may be added subject to the requirements of the Section 140.4(g).

Relocation or moving of a relocatable public school building is not considered an alteration for the purposes of complying with Title 24, Part 6. If an alteration is made to envelope, space–conditioning system, lighting or water heating components of a relocatable public school building, the alteration is subject to Section 141.0(b).

(c) Repairs. Repairs shall not increase the preexisting energy consumption of the repaired component, system, or equipment.

(d) Alternate Method of Compliance. Any addition, alteration, or repair may comply with the requirements of Title 24, Part 6 by meeting the applicable requirements for the entire building.

TABLE 141.0-E CONTROL REQUIREMENTS FOR ENTIRE LUMINAIRE ALTERATIONS

Control requirements that shall be met	**Resulting lighting power, compared to the lighting power allowance specified in Section 140.6(c)2, Area Category Method**	
	Lighting power is ≤ 85% of allowance	**Lighting power is > 85% to 100% of allowance**
Section 130.1(a)1, 2, and 3 Area Controls	Yes	Yes
Section 130.1(b) Multi-Level Lighting Controls – only for alterations to general lighting of enclosed spaces 100 square feet or larger with a connected lighting load that exceeds 0.5 watts per square foot	For each enclosed space, minimum one step between 30-70 percent of lighting power regardless of luminaire type, or meet Section 130.1(b)	Yes
Section 130.1(c) Shut-Off Controls	Yes	Yes
Section 130.1(d) Automatic Daylight Controls	Not Required	Yes
Section 130.1(e) Demand Responsive Controls – only for alterations > 10,000 ft^2 in a single building, where the alteration also changes the area of the space, or changes the occupancy type of the space, or increases the lighting power	Not Required	Yes

SECTION 141.1 – REQUIREMENTS FOR COVERED PROCESSES IN ADDITIONS, ALTERATIONS TO EXISTING NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL BUILDINGS

Covered processes in additions or alterations to existing buildings that will be nonresidential, high-rise residential, and hotel/motel occupancies shall comply with the applicable subsections of section 120.6 and 140.9.

NOTE: For alterations that change the occupancy classification of the building, the requirements of Section 141.1 apply to the occupancy that will exist after the alterations.

SUBCHAPTER 7
LOW-RISE RESIDENTIAL BUILDINGS – MANDATORY FEATURES AND DEVICES

SECTION 150.0 – MANDATORY FEATURES AND DEVICES

Low-rise residential buildings shall comply with the applicable requirements of Sections 150(a) through 150.0(r).

NOTE: The requirements of Sections 150.0(a) through 150.0(r) apply to newly constructed buildings. Sections 150.2(a) and 150.2(b) specify which requirements of Sections 150.0(a) through 150.0(r) also apply to additions or alterations.

(a) **Ceiling and Rafter Roof Insulation.** The opaque portions of ceilings and roofs separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Items 1 through 3 below:

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

   EXCEPTION to Section 150.0(a)1: Ceilings and rafter roofs in an alteration shall be insulated to achieve a weighted average U-factor not exceeding 0.054 or shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-19 or greater.

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

3. Insulation shall be installed in direct contact with a continuous roof or ceiling which is sealed to limit infiltration and exfiltration as specified in Section 110.7, including but not limited to placing insulation either above or below the roof deck or on top of a drywall ceiling..

(b) **Loose-fill Insulation.** 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.

(c) **Wall Insulation.** Opaque portions of above grade walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Items 1, 2, 3 and 4 below:

1. 2x4 inch framing shall have an overall assembly U-factor not exceeding U-0.102, equivalent to an installed R-value of 13 in a wood framed assembly.

   EXCEPTION to Section 150.0(c)1: Existing walls already insulated to a U-factor not exceeding U-0.110 or already insulated between framing members with insulation having an installed thermal resistance of R-11 or greater.

2. 2x6 inch or greater framing shall have an overall assembly U-factor not exceeding U-0.074 or an installed R-value of 19 in a wood framed assembly.

3. Opaque non-framed assemblies shall have an overall assembly U-factor not exceeding U-0.102, equivalent to an installed R-value of 13 in a wood framed assembly.

4. Bay or Bow Window roofs and floors shall be insulated to meet the wall insulation requirements of TABLE 150.1-A.

(d) **Raised-floor Insulation.** Raised floors separating conditioned space from unconditioned space or ambient air shall have an overall assembly U-factor not exceeding U-0.037 or an installed R-value of 19 or greater in a wood framed assembly.

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

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

(e) **Installation of Fireplaces, Decorative Gas Appliances and Gas Logs**

1. If a masonry or factory-built fireplace is installed, it shall have the following:

   A. Closeable metal or glass doors covering the entire opening of the firebox; and

   B. A combustion air intake to draw air from the outside of the building, which is at least 6 square inches in area and is equipped with a readily accessible, operable, and tight-fitting damper or combustion-air control device; and

   EXCEPTION to Section 150.0(e)1B: 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.

   C. A flue damper with a readily accessible control.

   EXCEPTION to Section 150.0(e)1C: 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.

2. Continuous burning pilot lights and the use of indoor air for cooling a firebox jacket, when that indoor air is vented to the outside of the building, are prohibited.

(f) **Slab Edge Insulation.** Material used for slab edge insulation shall meet the following minimum specifications:

1. Water absorption rate for the insulation material alone without facings no greater than 0.3 percent when tested in accordance with Test Method A – 24-Hour-Immersion of ASTM C272.

2. Water vapor permeance no greater than 2.0 perm/inch when tested in accordance with ASTM E96.

3. Concrete slab perimeter insulation shall be protected from physical damage and ultraviolet light deterioration.

4. Insulation for a heated slab floor shall meet the requirements of Section 110.8(g).

(g) **Vapor Retarder**

1. In Climate Zones 1-16, the earth floor of unvented crawl space shall be covered with a Class I or Class II vapor retarder. This requirement shall also apply to controlled ventilation crawl space for buildings complying with the Exception to Section 150.0(d).

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.

(h) **Space-Conditioning Equipment.**

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

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

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

   C. The ACCA Manual J.

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

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

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

3. **Outdoor Condensing Units.**

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

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

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

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

(i) **Thermostats**. All unitary 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).

(j) **Water System Piping and Insulation for Piping, Tanks, and Cooling System Lines.**

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

2. **Water piping and cooling system line insulation thickness and conductivity.** Piping shall be insulated to the thicknesses as follows:

   A. All domestic hot water system piping conditions listed below, whether buried or unburied, must be insulated and the insulation thickness shall be selected based on the conductivity range in TABLE 120.3-A and the insulation level shall be selected from the fluid temperature range based on the thickness requirements in TABLE 120.3-A:

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

      ii. All piping with a nominal diameter of 3/4 inch (19 millimeter) or larger.

      iii. All piping associated with a domestic hot water recirculation system regardless of the pipe diameter.

      iv. Piping from the heating source to storage tank or between tanks.

      v. Piping buried below grade.

      vi. All hot water pipes from the heating source to the kitchen fixtures.

   B. In addition to insulation requirements, all domestic hot water pipes that are buried below grade must be installed in a water proof and non-crushable casing or sleeve.

   C. Pipe for cooling system lines shall be insulated as specified in Subsection A. Distribution piping for steam and hydronic heating systems, shall meet the requirements in TABLE 120.3-A.

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

   EXCEPTION 2 to Section 150.0(j)2: Piping that serves process loads, gas piping, cold domestic water piping, condensate drains, roof drains, vents, or waste piping.

EXCEPTION 3 to Section 150.0(j)2: 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. Insulation shall butt securely against all framing members.

EXCEPTION 4 to Section 150.0(j)2: Piping installed in interior or exterior walls shall not be required to have pipe insulation if all of the requirements are met for compliance with Quality Insulation Installation (QII) as specified in the Reference Residential Appendix RA3.5.

EXCEPTION 5 to Section 150.0(j)2: Piping installed in attics with a minimum of 4 inches (10 cm) of attic insulation on top of the piping shall not be required to have pipe insulation.

NOTE: Where the Executive Director approves a water heater calculation method for particular water heating recirculation systems, piping insulation requirements are those specified in the approved calculation method.

3. **Insulation Protection.** Insulation outside conditioned space shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind. Protection includes but is not limited to the following:

   A. Insulation exposed to weather shall be installed with a cover suitable for outdoor service, including but not limited to aluminum, sheet metal, painted canvas, or plastic cover. The cover shall be water retardant and provides shielding from solar radiation that can cause degradation of the material.

   B. Insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall have a Class I or Class II vapor retarder.

(k) **Residential Lighting.**

1. **Luminaire Requirements**

   A. **Luminaire Efficacy:** All installed luminaires shall be high efficacy in accordance with TABLE 150.0-A.

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

   C. **Recessed Downlight Luminaires in Ceilings.** Luminaires recessed into ceilings shall meet all of the following requirements:

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

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

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

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

      v. Shall not contain screw base sockets; and

      vi. Shall contain light sources that comply with References Joint Appendix JA8, including the elevated temperature requirements, and that are marked “JA8-2016-E” as specified in Reference Joint Appendix JA8.

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

   E. **Night Lights.** Permanently installed night lights and night lights integral to installed luminaires or exhaust fans shall be rated to consume no more than five watts of power per luminaire or exhaust fan as determined in accordance with Section 130.0(c). Night lights shall not be required to be controlled by vacancy sensors.

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

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

G. **Screw based luminaires.** Screw based luminaires shall meet all of the following requirements:

i. The luminaires shall not be recessed downlight luminaires in ceilings; and

ii. The luminaires shall contain lamps that comply with Reference Joint Appendix JA8; and

iii. The installed lamps shall be marked with “JA8-2016” or “JA8-2016-E” as specified in Reference Joint Appendix JA8.

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

H. **Enclosed Luminaires.** Light sources that are not marked “JA8-2016-E” shall not be installed in enclosed luminaires.

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

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

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

EXCEPTION to Section 150.0(k)2B: Lighting integral to an exhaust fan may be on the same switch as the fan provided the lighting can be switched OFF in accordance with the applicable provisions in Section 150.0(k)2 while allowing the fan to continue to operate for an extended period of time.

C. Luminaires shall be switched with readily accessible controls that permit the luminaires to be manually switched ON and OFF.

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

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

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

G. An Energy Management Control System (EMCS) may be used to comply with dimmer requirements in Section 150.0(k) if at a minimum it provides the functionality of a dimmer in accordance with Section 110.9, meets the installation certificate requirements in Section 130.4, the EMCS requirements in Section 130.5(f), and complies with all other applicable requirements in Section 150.0(k)2.

H. An Energy Management Control System (EMCS) may be used to comply with vacancy sensor requirements in Section 150.0(k) if at a minimum it provides the functionality of a vacancy sensor in accordance with Section 110.9, meets the installation certificate requirements in Section 130.4, the EMCS requirements in Section 130.5(f), and complies with all other applicable requirements in Section 150.0(k)2.

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

J. In bathrooms, garages, laundry rooms, and utility rooms, at least one luminaire in each of these spaces shall be controlled by a vacancy sensor.

K. Dimmers or vacancy sensors shall control all luminaires required to have light sources compliant with Reference Joint Appendix JA8.

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

EXCEPTION 2 to Section 150.0(k)2K: Luminaires in hallways.

L. Undercabinet lighting shall be switched separately from other lighting systems.

3. **Residential Outdoor Lighting.** In addition to meeting the requirements of Section 150.0(k)1A, luminaires providing residential outdoor lighting shall meet the following requirements, as applicable:

A. For single-family residential buildings, outdoor lighting permanently mounted to a residential building, or to other buildings on the same lot, 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 switch that does not override to ON the automatic actions of Items ii or iii below; and

ii. Controlled by photocell and motion sensor. Controls that override to ON shall not be allowed unless the override automatically reactivates the motion sensor within 6 hours; or

iii. Controlled by one of the following methods:

a. Photocontrol and automatic time switch control. Controls that override to ON shall not be allowed unless the override shall automatically return the photocontrol and automatic time switch control to its normal operation within 6 hours.; or

b. Astronomical time clock. Controls that override to ON shall not be allowed unless the override shall automatically return the astronomical clock to its normal operation within 6 hours and which is programmed to automatically turn the outdoor lighting OFF during daylight hours; or

c. Energy management control system which meets all of the following requirements:

At a minimum provides the functionality of an astronomical time clock in accordance with Section 110.9; meets the Installation Certification requirements in Section 130.4; does not have an override or bypass switch that allows the luminaire to be always ON; and, is programmed to automatically turn the outdoor lighting OFF during daylight hours.

B. For low-rise multifamily residential buildings, outdoor lighting for private patios, entrances, balconies, and porches; and outdoor lighting for residential parking lots and residential carports with less than eight vehicles per site shall comply with one of the following requirements:

i. Shall comply with Section 150.0(k)3A; or

ii. Shall comply with the applicable requirements in Sections 110.9, 130.0, 130.2, 130.4, 140.7 and 141.0.

C. For low-rise residential buildings with four or more dwelling units, outdoor lighting not regulated by Section 150.0(k)3B or 150.0(k)3D shall comply with the applicable requirements in Sections 110.9, 130.0, 130.2, 130.4, 140.7 and 141.0.

D. Outdoor lighting for residential parking lots and residential carports with a total of eight or more vehicles per site shall comply with the applicable requirements in Sections 110.9, 130.0, 130.2, 130.4, 140.7 and 141.0.

4. **Internally illuminated address signs.** Internally illuminated address signs shall:

A. Comply with Section 140.8; or

B. Shall consume no more than 5 watts of power as determined according to Section 130.0(c).

5. **Residential Garages for Eight or More Vehicles.** Lighting for residential parking garages for eight or more vehicles shall comply with the applicable requirements for nonresidential garages in Sections 110.9, 130.0, 130.1, 130.4, 140.6, and 141.0.

6. **Interior Common Areas of Low-rise Multi-Family Residential Buildings.**

A. In a low-rise multifamily residential building where the total interior common area in a single building equals 20 percent or less of the floor area, permanently installed lighting for the interior common areas in that building shall be high efficacy luminaires and controlled by an occupant sensor.

B. In a low-rise multifamily residential building where the total interior common area in a single building equals more than 20 percent of the floor area, permanently installed lighting in that building shall:

i. Comply with the applicable requirements in Sections 110.9, 130.0, 130.1, 140.6 and 141.0; and

ii. Lighting installed in corridors and stairwells shall be controlled by occupant sensors that reduce the lighting power in each space by at least 50 percent. The occupant sensors shall be capable of turning the light fully on and off from all designed paths of ingress and egress.

(l) RESERVED

(m) **Air-Distribution and Ventilation System Ducts, Plenums, and Fans.**

1. **CMC Compliance.** All air-distribution system ducts and plenums, including, but not limited to, mechanical closets and air-handler boxes, shall be installed, sealed and insulated to 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. Portions of supply-air and return-air ducts and plenums of a space heating or cooling system shall either be insulated to a minimum installed level of R-6.0 (or any higher level required by CMC Section 605.0) or a minimum installed level of R-4.2 when entirely in conditioned space as confirmed through field verification and diagnostic testing in accordance with the requirements of Reference Residential Appendix RA3.1.4.3.8. Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened. 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.

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

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

2. **Factory-Fabricated Duct Systems.**

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

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

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

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

3. **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 be tested in accordance with ASTM C731 and D2202, incorporated herein by reference.

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

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

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

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

E. Drawbands used with flexible duct.

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

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

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

F. Aerosol-sealant closures.

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

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

4. **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.

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

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

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

C. 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.

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

7. **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.

8. **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.

9. **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.

10. **Porous Inner Core Flex Duct.** Flexible ducts having porous inner cores shall not be used.

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

A. For single family dwellings and townhouses with the air-handling unit installed and the ducts connected directly to the air handler, the total leakage of the duct system shall not exceed 5 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1.

B. For single family dwellings and townhouses at the rough-in stage of construction prior to installation of the dwelling's interior finishing:

i. Air-handling unit installed.

If the air-handling unit is installed and the ducts are connected directly to the air handler, the total leakage of the duct system shall not exceed 5 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Sections RA3.1.4.3.2, RA3.1.4.3.2.1 and RA3.1.4.3.3.

ii. Air-handling unit not yet installed.

If the air-handling unit is not yet installed, the total leakage of the duct system shall not exceed 4 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Sections RA3.1.4.3.2, RA3.1.4.3.2.2 and RA3.1.4.3.3.

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

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

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

12. **Air Filtration.** Mechanical systems that supply air to an occupiable space through ductwork exceeding 10 ft (3 m) in length and through a thermal conditioning component, except evaporative coolers, shall be provided with air filter devices in accordance with the following:

A. **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 the system's thermal conditioning components.

ii. The system shall be designed to accommodate the clean-filter pressure drop imposed by the system air filter device(s). The design airflow rate and maximum allowable clean-filter pressure drop at the design airflow rate applicable to each air filter device shall be determined.

iii. All system air filter devices shall be located and installed in such a manner as to allow access and regular service by the system owner.

iv. All system air filter device locations shall be labeled to disclose the applicable design airflow rate and the maximum allowable clean-filter pressure drop as determined according to subsection ii above. The labels shall be permanently affixed to the air filter device readily legible, and visible to a person replacing the air filter media.

B. **Air Filter Media Efficiency**. The system shall be provided with air filter media having a designated efficiency equal to or greater than MERV 6 when tested in accordance with ASHRAE Standard 52.2, or a particle size efficiency rating equal to or greater than 50percent in the 3.0–10 μm range when tested in accordance with AHRI Standard 680.

C. **Air Filter Media Pressure Drop**. The system shall be provided with air filter media that conforms to the maximum allowable clean-filter pressure drop determined according to Section 150.0(m)12Aii, when tested using ASHRAE Standard 52.2, or as rated using AHRI Standard 680, for the applicable design airflow rate(s) for the system air filter device(s). If the alternative to 150.0(m)13B is utilized for compliance, the design clean-filter pressure drop for the system air filter media shall conform to the requirements given in TABLE 150.0-B or 150.0-C.

D. **Air Filter Media Product Labeling**. The system shall be provided with air filter media that has been labeled by the manufacturer to disclose the efficiency and pressure drop ratings that demonstrate conformance with Sections 150.0(m)12B and 150.0(m)12C

13. **Duct System Sizing and Air Filter Grille Sizing.** Space conditioning systems that utilize forced air ducts to supply cooling to an occupiable space shall:

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

    EXCEPTION to 150.0(m)13A: 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.

    B. **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 0.58 W/CFM as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.

    C. **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 0.58 W/CFM as confirmed by field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.3.

    EXCEPTION 1 to Section 150.0(m)13B: Standard ducted systems without zoning dampers may comply by meeting the applicable requirements in TABLE 150.0-B or 150.0-C 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 of Section 150.0(m)12C for the system air filter device(s) shall conform to the requirements given in TABLES 150.0-B and 150.0-C.

    EXCEPTION 2 to Section 150.0(m)13B: Multispeed compressor systems or variable speed compressor systems shall verify air flow (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 150.0(m)13B: The Executive Director may approve alternate airflow and fan efficacy requirements for small duct high velocity systems.

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

(n) **Water Heating System**.

1. Systems using gas or propane water heaters to serve individual dwelling units shall include the following components:

    A. A 120V electrical receptacle that is within 3 feet from the water heater and accessible to the water heater with no obstructions; and

    B. 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

    C. 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

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

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

3. Solar water-heating systems and collectors shall be certified and rated by the Solar Rating and Certification Corporation (SRCC), or by a listing agency that is approved by the Executive Director.
4. Instantaneous water heaters with an input rating greater than 6.8 kBTU/hr (2kW) shall meet the requirements of Section 110.3(c)7.

(o) **Ventilation for Indoor Air Quality.** All dwelling units shall meet the requirements of ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. Window operation is not a permissible method of providing the Whole-Building Ventilation airflow required in Section 4 of ASHRAE Standard 62.2. Continuous operation of central forced air system air handlers used in central fan integrated ventilation systems is not a permissible method of providing the whole-building ventilation airflow required in Section 4 of ASHRAE Standard 62.2. Additionally, all dwelling units shall meet the following requirements:

1. **Field Verification and Diagnostic Testing.**
   A. **Airflow Performance**. The Whole-Building Ventilation airflow required by Section 4 of ASHRAE Standard 62.2 shall be confirmed through field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.7.

(p) **Pool Systems and Equipment Installation.** Any residential pool system or equipment installed shall comply with the applicable requirements of Section 110.4, as well as the requirements listed in this section.

1. **Pump sizing and flow rate.**
   A. All pumps and pump motors installed shall be listed in the Commission's directory of certified equipment and shall comply with the Appliance Efficiency Regulations.
   B. All pump flow rates shall be calculated using the following system equation:

   $$H = C \times F^2$$

   WHERE:

   H is the total system head in feet of water.

   F is the flow rate in gallons per minute (gpm).

   C is a coefficient based on the volume of the pool:

   0.0167 for pools less than or equal to 17,000 gallons.

   0.0082 for pools greater than 17,000 gallons.

   C. Filtration pumps shall be sized, or if programmable, shall be programmed, so that the filtration flow rate is not greater than the rate needed to turn over the pool water volume in 6 hours or 36 gpm, whichever is greater; and
   D. Pump motors used for filtration with a capacity of 1 hp or more shall be multi-speed; and
   E. Each auxiliary pool load shall be served by either separate pumps or the system shall be served by a multi-speed pump; and

   EXCEPTION to Section 150.0(p)1E: Pumps less than 1 hp may be single speed.

   F. Multi-speed pumps shall have controls which default to the filtration flow rate when no auxiliary pool loads are operating; and
   G. For multi-speed pumps, the controls shall default to the filtration flow rate setting within 24 hours and shall have an override capability for servicing.

2. **System piping.**
   A. A length of straight pipe that is greater than or equal to at least 4 pipe diameters shall be installed before the pump; and
   B. Pool piping shall be sized so that the velocity of the water at maximum flow for auxiliary pool loads does not exceed 8 feet per second in the return line and 6 feet per second in the suction line; and

C. All elbows shall be sweep elbows or of an elbow-type that has a pressure drop of less than the pressure drop of straight pipe with a length of 30 pipe diameters.

3. **Filters.** Filters shall be at least the size specified in NSF/ANSI 50 for public pool intended applications.

4. **Valves.** Minimum diameter of backwash valves shall be 2 inches or the diameter of the return pipe, whichever is greater.

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

1. Fenestration, including skylight products, must have a maximum U-factor of 0.58.

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

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

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

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

TABLE 150.0-A CLASSIFICATION OF HIGH EFFICACY LIGHT SOURCES

High Efficacy Light Sources Luminaires installed with only the lighting technologies in this table shall be classified as high efficacy	
Light sources in this column other than those installed in ceiling recessed downlight luminaires are classified as high efficacy and are **not** required to comply with Reference Joint Appendix JA8	Light sources in this column shall be certified to the Commission as High Efficacy Light Sources in accordance with Reference Joint Appendix JA8 and be marked as meeting JA8.
1. Pin-based linear or compact fluorescent light sources using electronic ballasts. 2. Pulse-start metal halide. 3. High pressure sodium. 4. GU-24 sockets containing light sources other than LEDs. [a,b] 5. Luminaires with hardwired high frequency generator and induction lamp. 6. Inseparable SSL luminaires that are installed outdoors. 7. Inseparable SSL luminaires containing colored light sources that are installed to provide decorative lighting.	8. All light sources in ceiling recessed downlight luminaires. Note that ceiling recessed downlight luminaires shall not have screw bases regardless of lamp type as described in Section 150.0(k)1C. 9. GU-24 sockets containing LED light sources. 10. Any light source not otherwise listed in this table and certified to the Commission as complying with Joint Appendix 8.
Notes: a. GU-24 sockets containing light sources such as compact fluorescent lamps and induction lamps. b. California Title 20 Section 1605(k)3 does not allow incandescent sources to have a GU-24 base.	

TABLE 150.0-B: RETURN DUCT SIZING FOR SINGLE RETURN DUCT SYSTEMS

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

Return grille devices shall be labeled in accordance with the requirements in Section 150.0(m)12A to disclose the grille's design airflow rate and a maximum allowable clean-filter pressure drop of 12.5 Pa (0.05 inches water) for the air filter media as rated in accordance with AHRI Standard 680 for the design airflow rate for the return grille.

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

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

TABLE 150.0-C: RETURN DUCT SIZING FOR MULTIPLE RETURN DUCT SYSTEMS

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

Return grille devices shall be labeled in accordance with the requirements in Section 150.0(m)12A to disclose the grille's design airflow rate and a maximum allowable clean-filter pressure drop of 12.5 Pa (0.05 inches water) for the air filter media 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 Diameter (inch)**	**Return Duct 2 Minimum Diameter (inch)**	**Minimum Total Return Filter Grille Gross Area ($inch^2$)**
1.5	12	10	500
2.0	14	12	600
2.5	14	14	800
3.0	16	14	900
3.5	16	16	1000
4 .0	18	18	1200
5 .0	20	20	1500

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

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SUBCHAPTER 8
LOW-RISE RESIDENTIAL BUILDINGS - PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

SECTION 150.1 – PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR LOW-RISE RESIDENTIAL BUILDINGS

(a) **Basic Requirements.** Low-rise residential buildings shall meet all of the following:

1. The applicable requirements of Sections 110.0 through 110.11.
2. The applicable requirements of Section 150.0 (mandatory features).
3. Either the performance standards or the prescriptive standards set forth in this section for the Climate Zone in which the building is located. Climate zones are shown in Reference Joint Appendix JA2 –Weather /Climate Data.

   EXCEPTION to Section 150.1(a)3: If a single contiguous subdivision or tract 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, which is available in Reference Joint Appendix JA2 –Weather/Climate Data.

NOTE: The requirements of Sections 150.0(a) through 150.0(r) apply to newly constructed buildings. Sections 150.2(a) and 150.2(b) specify which requirements of Sections 150.1(a) through 150.1(c) also apply to additions or alterations.

(b) **Performance Standards.** A building complies with the performance standard if the energy budget calculated for the Proposed Design Building under Subsection 2 is no greater than the energy budget calculated for the Standard Design Building under Subsection 1.

1. **Energy Budget for the *Standard Design Building***. The energy budget for a Standard Design Building is determined by applying the mandatory and prescriptive requirements to the Proposed Design Building. The energy budget is the sum of the TDV energy for space conditioning, mechanical ventilation and water heating.
2. **Energy Budget for the *Proposed Design Building***. The energy budget for a Proposed Design Building is determined by calculating the TDV energy for the Proposed Design Building. The energy budget is the sum of the TDV energy for space-conditioning, mechanical ventilation and water heating. The energy budget for the Proposed Design Building is reduced if on-site renewable energy generation is installed, according to methods established by the Commission in the Residential ACM Reference Manual.
3. **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 are documented in the Residential ACM Approval Manual.
4. **Compliance Demonstration Requirements for Performance Standards**.

   A. 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 TDV energy use from depletable energy sources does not exceed the combined water-heating and space-conditioning energy budgets for the applicable Climate Zone.

EXCEPTION to Section 150.1(b)4A: Multiple Orientation: A permit applicant may demonstrate compliance with the energy budget requirements of Section 150.1(a) and (b) for any orientation of the same building model if the documentation demonstrates that the building model with its proposed designs and features would comply in each of the four cardinal orientations.

B. Field verification of installed features, materials, components, manufactured devices and system performance 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, in accordance with the following requirements when applicable:

i. SEER Rating. When performance compliance requires installation of space a conditioning system with a SEER rating that is greater than the minimum SEER rating required by TABLE 150.1-A, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.

ii. EER Rating. When performance compliance requires installation of a space conditioning system that meets or exceeds a specified EER rating, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.

iii. Low Leakage Air Handler. When performance compliance requires installation of a low leakage air-handling unit that meets the qualifications in Reference Joint Appendix JA9, the installed air handling unit shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.1.4.3.9.

(c) **Prescriptive Standards/Component Package.** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE 150.1-A. In TABLE 150.1-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:

1. **Insulation.**

A. Roof and Ceiling insulation shall be installed in a ventilated attic with an R-value equal to or greater than that shown in Table 150.1-A meeting options i through iii below.

i. Option A: A minimum R-value of continuous insulation installed above the roof rafters in contact with the roof deck and an additional layer of ceiling insulation located between the attic and the conditioned space when meeting Section 150.1(c)9A; or

ii. Option B: A minimum R-value of insulation installed between the roof rafters in contact with the roof deck and an additional layer of ceiling insulation located between the attic and the conditioned space when meeting Section 150.1(c)9A; or

iii. Option C: A minimum R-value of ceiling insulation located between the attic and the conditioned space when meeting Section 150.1(c)9B.

NOTE: Low rise residential single family and multi-family buildings with the ducts and air handler located in the conditioned space, as specified by Section 150.1(c)9B, need only comply with insulation requirements of Option C.

B. Walls (including heated basements and crawl spaces) shall be insulated such that the opaque wall has an assembly U-factor equal to or less than shown in Table 150.1-A, or walls shall be insulated between wood framing with anR-value equal to or greater than shown in TABLE 150.1-A. The U-factors shown are maximum U-factors for the opaque wall assembly. Alternatively, for mass walls above grade and for below grade walls with insulation installed on the interior, the R-values shown are the minimum R-values for insulation installed between wood-framing members; and for below grade walls with exterior insulation, the R-values shown are the minimum R-values for continuous insulation.

C. Raised-floors shall be insulated such that the floor assembly has an assembly U-factor equal to or less than shown in Table 150.1-A, or shall be insulated between wood framing with insulation having an R-value equal to or greater than shown in TABLE 150.1-A.

EXCEPTION to Section 150.1(c)1C: Raised-floor insulation may be omitted if the foundation walls are insulated to meet the wall insulation minimums shown in TABLE 150.1-A, and a vapor retarder is placed over the entire floor of the crawl space, and the vents are fitted with automatically operated louvers, and the requirements of Reference Residential Appendix RA4.5.1 are met.

D. Slab floor perimeter insulation shall be installed with a U-factor equal to or less than or R-value equal to or greater than shown in TABLE 150.1-A. The minimum depth of concrete-slab floor perimeter insulation shall be 16 inches or the depth of the footing of the building, whichever is less.

EXCEPTION to Section 150.1(c)1: The insulation requirements of TABLE 150.1-A may also be met by ceiling, roof deck, wall, or floor assemblies that meet the required maximum U-factors using a U-factor calculation method that considers the thermal effects of all elements of the assembly and is approved by the Executive Director.

2. **Radiant Barrier.** A radiant barrier required in TABLE 150.1-A shall meet the requirements specified in Section 110.8(j), and shall meet the installation criteria specified in the Reference Residential Appendix RA4.

3. **Fenestration.**

A. Installed fenestration products shall have an area weighted average U-factor and SHGC no greater than the applicable value in TABLE 150.1-A and shall be determined in accordance with Sections 110.6(a)2 and 110.6(a)3.

EXCEPTION 1 to Section 150.1(c)3A: For each dwelling unit up to 3 square feet of new glazing area installed in doors and up to 3 square feet of new tubular skylights area with dual-pane diffusers shall not be required to meet the U-factor and SHGC requirements of TABLE 150.1-A.

EXCEPTION 2 to Section 150.1(c)3A: 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.

EXCEPTION 3 to Section 150.1(c)3A For fenestration containing chromogenic type glazing:

i. 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;

ii. chromogenic glazing shall be considered separately from other fenestration; and

iii. area-weighted averaging with other fenestration that is not chromatic shall not be permitted and shall be determined in accordance with Section 110.6(a).

EXCEPTION 4 to Section 150.1(c)3A: For dwelling units containing unrated site-built fenestration that meets the maximum area restriction, the U-factor and SHGC can be determined in accordance with the Nonresidential Reference Appendix NA6 or use default values in TABLE 110.6-A and TABLE 110.6-B.

B. The maximum total fenestration area shall not exceed the percentage of conditioned floor area, CFA, as indicated in TABLE 150.1-A. Total fenestration includes skylights and west-facing glazing.

C. The maximum west-facing fenestration area shall not exceed the percentage of conditioned floor area as indicated in TABLE 150.1-A. West-facing fenestration area includes skylights tilted in any direction when the pitch is less than 1:12.

4. **Shading.** Where TABLE 150.1-A requires a Maximum Solar Heat Gain Coefficient (SHGC), the requirements shall be met by one of the following:

A. Complying with the required SHGC pursuant to Section 150.1(c)3A; or

B. An exterior operable shading louver or other exterior shading device that meets the required SHGC; or

C. A combination of Items A and B to achieve the same performance as achieved in Section 150.1(c)3A.

D. For south-facing glazing only, optimal overhangs shall be installed so that the south-facing glazing is fully shaded at solar noon on August 21 and substantially exposed to direct sunlight at solar noon on December 21.

E. Exterior shading devices must be permanently secured with attachments or fasteners that are not intended for removal.

EXCEPTION to Section 150.1(c)4E: Where the California Building Code (CBC) requires emergency egress or where compliance would conflict with Health and Safety regulations.

5. **RESERVED**

6. **Heating System Type.** Heating system types shall be installed as required in TABLE 150.1-A.

EXCEPTION to Section 150.1(c)6: 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.

7. **Space Heating and Space Cooling.** All space heating and space cooling equipment shall comply with minimum Appliance Efficiency Regulations as specified in Sections 110.0 through 110.2 and meet all applicable requirements of Sections 150.0 and 150.1(c)7A.

A. **Refrigerant Charge**. When refrigerant charge verification or fault indicator display is shown as required by TABLE 150.1-A, the system shall comply with either150.1(c)7Ai or 150.1(c)7Aii:

i. air-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted packaged systems, and mini-split systems, shall comply with subsections a, b and c, unless the system is of a type that cannot be verified using the specified procedures:

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

b. System airflow rate greater than or equal to 350 cfm per ton shall be demonstrated by the installer and be verified by the HERS rater as specified by Reference Residential Appendix Section RA3.3 or an approved alternative procedure as specified by RA1; and

c. The installer shall charge the system according to manufacturer's specifications. Refrigerant charge shall be verified according to one of the following options, as applicable:

I. The installer and rater shall perform the standard charge procedure as specified by Reference Residential Appendix Section RA3.2.2 or an approved alternative procedure as specified by RA1; or

II. The system shall be equipped with a fault indicator display (FID) device that meets the specifications of Reference Joint Appendix JA6. The installer shall verify the refrigerant charge and FID device in accordance with the procedures in Reference Residential Appendix Section RA3.4.2. The HERS Rater shall verify FID device in accordance with the procedures in Section RA3.4.2; or

III. The installer shall perform the weigh-in charging procedure as specified by Reference Residential Appendix Section RA3.2.3.1 provided the system is of a type that can be verified using the RA3.2.2 standard charge verification procedure and RA3.3 airflow rate verification procedure or approved alternatives in RA1. The HERS Rater shall verify the charge using RA3.2.2 and RA3.3 or approved alternatives in RA1.

EXCEPTION to Section 150.1(c)7Aia: 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 1 to Section 150.1(c)7Aib: The Executive Director may approve alternate airflow rate requirements for small duct high velocity systems.

EXCEPTION 2 to Section 150.1(c)7Aib: Standard ducted systems without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in TABLE-150.0-B or 150.0-C as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Section RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12C for the system air filter device(s) shall conform to the requirements given in TABLES 150.0-B and 150.0-C.

EXCEPTION 1 to Section 150.1(c)7Aic: 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 Reference Joint Appendix JA5. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.1(c)7Aib.

ii. Air-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted packaged systems, and mini-split systems, which are of a type that cannot comply with the requirements of 150.1(c)7Ai shall comply with subsections a and b, as applicable.

a. The installer shall confirm the refrigerant charge using the weigh-in charging procedure specified in Reference Residential Appendix Section RA3.2.3.1, as verified by a HERS Rater according to the procedures specified in Reference Residential Appendix Section RA3.2.3.2; and

b. Systems that utilize forced air ducts shall comply with the minimum system airflow rate requirement in Section 150.1(c)7Aib provided the system is of a type that can be verified using the procedures in RA3.3 or an approved alternative procedure in RA1.

EXCEPTION to Section 150.1(c)7A: Packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.1(c)7Aib, 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.

8. **Domestic Water-Heating Systems.** Water-heating systems shall meet the requirements of either A, B, or C. For recirculation distribution systems serving individual dwelling unit, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used:

A. For systems serving individual dwelling units, the water heating system shall meet the requirement of either i, ii, or iii:

i. A single gas or propane instantaneous water heater with an input of 200,000 Btu per hour or less and no storage tank, and that meets the requirements of Sections 110.1 and 110.3 shall be installed.

ii. A single gas or propane storage type water heater with an input of 105,000 Btu per hour or less, rated volume less than or equal to 55 gallons and that meets the requirements of Sections 110.1 and 110.3. The dwelling unit shall meet all of the requirements for Quality Insulation Installation (QII) as specified in the Reference Appendix RA3.5, and in addition one of the following shall be installed:

a. A compact hot water distribution system that is field verified as specified in the Reference Appendix RA4.4.16; or

b. All domestic hot water piping shall be insulated and field verified as specified in the Reference Appendix RA4.4.1, RA4.4.3 and RA4.4.14.

iii. A single gas or propane storage type water heater with an input of 105,000 Btu per hour or less, rated volume of more than 55 gallons, and that meets the requirements of Sections 110.1 and 110.3, and in addition one of the following shall be installed:

a. A compact hot water distribution system that is field verified as specified in the Reference Appendix RA4.4.16; or

b. All domestic hot water piping shall be insulated and field verified as specified in the Reference Appendix RA4.4.1, RA4.4.3 and RA4.4.14.

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

i. Gas or propane water heaters, boilers or other water heating equipment that meet the minimum efficiency requirements of Sections 110.1 and 110.3; and

ii. A water heating recirculation loop that meets the requirements of Sections 110.3(c)2 and 110.3(c)5 and is equipped with an automatic control system that controls the recirculation pump operation based on measurement of hot water demand and hot water return temperature and has two recirculation loops each serving half of the building; and

EXCEPTION to Section 150.1(c)8Cii: Buildings with eight or fewer dwelling units are exempt from the requirement for two recirculation loops.

iii. A solar water-heating system meeting the installation criteria specified in Reference Residential Appendix RA4 and with 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. The solar savings fraction shall be determined using a calculation method approved by the Commission.

9. **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 levels meet Option A or B in TABLE 150.1-A. Duct insulation levels shall meet the requirements in TABLE 150.1-A.

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. Duct insulation levels shall meet the requirements in TABLE 150.1-A.

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

10. **Central Fan Integrated Ventilation Systems.** Central forced air system fans used to provide outside air, shall have an air-handling unit fan efficacy less than or equal to 0.58 W/CFM as 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.

11. **Roofing products.** All roofing products shall meet the requirements of Section 110.8 and the applicable requirements of Subsection A or B:

A. Low-rise residential buildings with steep-sloped roofs, in Climate Zones 10 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.

B. Low-rise residential buildings with low-sloped roofs; in Climate Zones 13 and 15 shall have a minimum aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75 or a minimum SRI of 75.

EXCEPTION 1 to Section 150.1(c)11: Building integrated photovoltaic panels and building integrated solar thermal panels are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI.

EXCEPTION 2 to Section 150.1(c)11: Roof constructions that have thermal mass over the roof membrane with a weight of at least 25 lb/ft^2 are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI.

12. **Ventilation Cooling**. Single family homes shall comply with the Whole House Fan (WHF) requirements shown in TABLE 150.1-A. When a WHF is required, comply with Subsections A. through C. below:

    A. Have installed one or more WHFs whose total Air Flow CFM as listed in the CEC Directory is at least 1.5 CFM/ft^2 of conditioned floor area; and

    B. Have at least 1 square foot of attic vent free area for each 750 CFM of rated whole house fan Air Flow CFM, or if the manufacturer has specified a greater free vent area, the manufacturers' free vent area specifications; and

    C. Provide homeowners who have WHFs with a one page "How to operate your whole house fan" informational sheet.

13. **HVAC System Bypass Ducts.** Bypass ducts that deliver conditioned supply air directly to the space conditioning system return duct airflow shall not be used.

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN

						Climate Zone															
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation	Roofs/Ceilings	Option A (meets §150.1(c)9A)	Continuous Insulation Above Roof Rafter	Roofing Type	No Air Space[1]	NR	NR	NR	R 8	NR	NR	NR	R 8	R 8	R 8	R 8	R 8	R 8	R 8	R 8	R 8
					With Air Space[2]	NR	NR	NR	R 6	NR	NR	NR	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6
			Ceiling Insulation			R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38
			Radiant Barrier			NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
		Option B (meets §150.1(c)9A)	Below Roof Deck Insulation[3]	Roofing Type	No Air Space	NR	NR	NR	R 18	NR	NR	NR	R 18	R 18	R 18	R 18	R 18	R 18	R 18	R 18	R 18
					With Air Space	NR	NR	NR	R 13	NR	NR	NR	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13
			Ceiling Insulation			R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38
			Radiant Barrier			NR	REQ	REQ	NR	REQ	REQ	REQ	NR	NR	NR	NR	NR	NR	NR	NR	NR
		Option C (meets §150.1(c)9B)	Ceiling Insulation			R 38	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38
			Radiant Barrier			NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN (CONTINUED)

				Climate Zone 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation	Walls	Above Grade	Framed[4]	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.065	U 0.065	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051
			Mass Wall Interior[5]	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.059 R 17
			Mass Wall Exterior[6]	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.070 R 13
		Below Grade	Below Grade Interior[7]	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.066 R 15
			Below Grade Exterior[8]	U=0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.100 R 10	U 0.100 R 10	U 0.053 R 19
	Floors	Slab Perimeter		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R 7.0
		Raised		U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19
		Concrete Raised		U 0.092 R 8.0	U 0.092 R 8.0	U 0.269 R 0	U 0.269 R 0	U0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0
Building Envelope	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	0.63	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR
		Steep Sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0. 75	0.75	0.75	0.75	0.75	0.75	NR
Building Envelope	Fenestration	Maximum U-facto		0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
		Maximum SHGC		NR	0.25	NR	0.25	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
		Maximum Total Area		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
		Maximum West Facing Area		NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%

CONTINUED: TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN (CONTINUED)

				Climate Zone															
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
HVAC SYSTEM	**Space Heating**[11]	**Electric-Resistance Allowed**		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
		If gas, AFUE		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
		If Heat Pump, HSPF[9]		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
	Space cooling	**SEER**		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
		Refrigerant Charge Verification or Fault Indicator Display		NR	REQ	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
		Whole House Fan[10]		NR	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR	NR
	Central System Air Handlers	**Central Fan Integrated Ventilation System Fan Efficacy**		REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
	Ducts[12]	**Roof/Ceiling Options A & B**	Duct Insulation	R-8	R-8	R-6	R-8	R-6	R-6	R-6	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8
			§150.1(c)9A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Roof/Ceiling Option C	Duct Insulation	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6
			§150.1(c)9B	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
Water Heating	**All Buildings**			System Shall meet Section 150.1(c)8															

Footnote requirements to TABLE 150.1-A:

1. Install the specified R-value with no air space present between the roofing and the roof deck.
2. 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.
3. R-values shown for below roof deck insulation are for wood-frame construction with insulation installed between the framing members.
4. Assembly U-factors 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 meet the required maximum U-factor.
5. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft^2. "Interior" denotes insulation installed on the inside surface of the wall.
6. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft^2. "Exterior" denotes insulation installed on the exterior surface of the wall.
7. Below grade "interior" denotes insulation installed on the inside surface of the wall.
8. Below grade "exterior" denotes insulation installed on the outside surface of the wall.
9. HSPF means "heating seasonal performance factor."
10. When whole house fans are required (REQ), only those whole house fans that are listed in the Appliance Efficiency Directory may be installed. Compliance requires installation of one or more WHFs whose total airflow CFM is capable of meeting or exceeding a minimum 1.5 cfm/square foot of conditioned floor area as specified by Section 150.1(c)12.
11. 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.
12. For duct and air handler location: REQ denotes location in conditioned space. When the table indicates ducts and air handlers are in conditioned space, a HERS verification is required as specified by Reference Residential Appendix RA3.1.4.3.8.

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SUBCHAPTER 9
LOW-RISE RESIDENTIAL BUILDINGS - ADDITIONS AND ALTERATIONS TO EXISTING LOW-RISE RESIDENTIAL BUILDINGS

SECTION 150.2 – ENERGY EFFICIENCY STANDARDS FOR ADDITIONS AND ALTERATIONS TO EXISTING LOW-RISE RESIDENTIAL BUILDINGS

(a) **Additions.** Additions to existing low-rise residential buildings shall meet the requirements of Sections 110.0 through 110.9, Sections 150.0(a) through (q), and either Section 150.2(a)1 or 2.

EXCEPTION 1 to Section 150.2(a): Additions 1,000 square feet or less are exempt from the ASHRAE Standard 62.2 Section 4 requirements to provide whole-building ventilation airflow as referenced by Section 150.0(o), however all other applicable requirements of ASHRAE Standard 62.2 as referenced by Section 150.0(o) shall be met by the addition.

EXCEPTION 2 to Section 150.2(a): Additions of 300 square feet or less are exempt from the roofing requirements of Section 150.1(c)11.

EXCEPTION 3 to Section 150.2(a): Existing inaccessible piping shall not require insulation as defined under Section 150.0(j)2Aiii.

EXCEPTION 4 to Section 150.2(a): 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 5 to Section 150.2(a): Space-Conditioning System Ducts. When 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 150.2(b)1D.

EXCEPTION 6 to Section 150.2(a): Additions 1,000 square feet or less are exempt from the Ventilation Cooling requirements of Section 150.1(c)12.

NOTE: For alterations that change the occupancy classification of the building, the requirements specified in Section 150.2(b) apply to the occupancy after the alterations.

1. **Prescriptive approach.** Additions to existing buildings shall meet the following additional requirements:

   A. Additions that are greater than 700 square feet shall meet the prescriptive requirements of Section 150.1(c), except:

      i. 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-19 in a 2x6 framing.

      ii. The maximum allowed fenestration area shall be the greater of 175 square feet or 20 percent of the addition floor area, and the maximum allowed west-facing fenestration area shall be the greater of 70 square feet or the requirements of Section 150.1(c).

   B. Additions that are 700 square feet or less shall meet all the requirements of Section 150.1(c) except:

      i. Roof and Ceiling insulation shall meet the requirement of Section 150.0; and

      ii. 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-19 in a 2x6 framing; and

iii. In Climate Zones 2, 4 and 6-16; the maximum allowed west-facing fenestration area shall not be greater than 60 square feet; and shall also comply with either a or b below:

a. For additions that are 700 square feet or less but greater than 400 square feet, the maximum allowed fenestration area limit is the greater of 120 square feet or 25 percent of the conditioned floor area of the addition; or

b. For additions that are 400 square feet or less, the maximum allowed fenestration area is the greater of 75 square feet or 30 percent of the conditioned floor area of the addition.

C. Additions larger than 1,000 square feet shall meet the ASHRAE Standard 62.2 Section 4 requirement to provide whole-building ventilation airflow. The whole-building ventilation airflow rate shall be based on the conditioned floor area of the entire dwelling unit comprised of the existing dwelling conditioned floor area plus the addition conditioned floor area.

D. **Water Heater**. When a second water heater is installed as part of the addition, one of the following types of water heaters shall be installed and assumed to comply:

i. A natural gas or propane water-heating system that meets the requirements of Section150.1(c)8; or

ii. If no natural gas is connected to the building, an electric water heater that has an energy factor equal to or greater than required under the Appliance Efficiency Regulations. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used; or

iii. A water-heating system determined by the Executive Director to use no more energy than the one specified in Item 1 above; or if no natural gas is connected to the building, a water-heating system determined by the Executive Director to use no more energy than the one specified in Item 2 above; or

iv. Using the existing building plus addition compliance or addition alone compliance as defined in Section 150.2(a)2 demonstrate that the proposed water heating system uses no more energy than the system defined in Item 1 above regardless of the type or number of water heaters installed.

2. **Performance approach.** Performance calculations shall meet the requirements of Section 150.1(a) through (c), pursuant to the applicable requirements in Items A, B, and C below.

A. For additions alone. The addition complies if the addition alone meets the energy budgets as specified in Section 150.1(b).

B. Existing plus alteration plus addition. The standard design for existing plus alteration plus addition energy use is the combination of the existing building's unaltered components to remain; existing building altered components that are the more efficient, in TDV energy, of either the existing conditions or the requirements of Section 150.2(b)2; plus the proposed addition's energy use meeting the requirements of Section 150.2(a)1. The proposed design energy use is the combination of the existing building's unaltered components to remain and the altered components' energy features, plus the proposed energy features of the addition.

EXCEPTION to Section 150.2(a)2B: Existing structures with a minimum R-11 insulation in framed walls showing compliance with Section150.2(a)2 are exempt from showing compliance with Section 150.0(c).

C. Additions larger than 1,000 square feet shall meet the ASHRAE Standard 62.2 Section 4 requirement to provide whole-building ventilation airflow. The whole-building ventilation airflow rate shall be based on the conditioned floor area of the entire dwelling unit comprised of the existing dwelling conditioned floor area plus the addition conditioned floor area.

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Section 150.0(a) through (m), Section 150.0(o) through (q); and

A. **Fenestration**. Alterations that add vertical fenestration and skylight area shall meet the total fenestration area and west facing fenestration area, U-factor, and Solar Heat Gain Coefficient requirements of Section 150.1(c) and TABLE 150.1-A.

EXCEPTION 1 to Section 150.2(b)1A: Alterations that add fenestration area of up to 75 square feet shall not be required to meet the total fenestration area and west-facing fenestration area requirements of Sections 150.1(c)3B and C.

EXCEPTION 2 to Section 150.2(b)1A: Alterations that add up to 16 square feet of new skylight area with a maximum U-factor of 0.55 and a maximum SHGC of 0.30 area shall not be required to meet the total fenestration area and west-facing fenestration area requirements of Sections 150.1(c)3B and C.

B. **Replacement Fenestration.** Replacement of fenestration, where existing fenestration area in an existing wall or roof is replaced with a new manufactured fenestration product and up to the total fenestration area removed in the existing wall or roof, the replaced fenestration shall meet the U-factor and Solar Heat Gain Coefficient requirements of Sections 150.1(c)3A, and 150.1(c)4.

EXCEPTION 1 to Section 150.2(b)1B: Replacement of vertical fenestration no greater than 75 square feet with a U-factor no greater than 0.40 in Climate Zones 1-16, and a SHGC value no greater than 0.35 in Climate Zones 2, 4, and 6-16.

EXCEPTION 2 to Section 150.2(b)1B: Replaced skylights must meet a U-factor no greater than 0.55, and a SHGC value no greater than 0.30.

NOTE: Glass replaced in an existing sash and frame or replacement of sashes in an existing frame are considered repairs.

C. Entirely **New or Complete Replacement Space-Conditioning Systems** installed as part of an alteration, shall include all the system heating or cooling equipment, including but not limited to . condensing unit and cooling or heating coil for split systems; or complete replacement of a package unit; plus entirely new or replacement duct system (Section 150.2(b)1Diia); plus a new or replacement air handler.

Entirely New or complete replacement space-conditioning systems shall:

i. Meet the requirements of Sections 150.0(h), 150.0(i), 150.0(j)2, 150.0(j)3, 150.0(m)1 through 150.0(m)13, 150.1(c)6, 150.1(c)7, 150.1(c)10 and Table 150.2-A; and

ii. Be limited to natural gas, liquefied petroleum gas, or the existing fuel type unless it can be demonstrated that the TDV energy use of the new system is more efficient than the existing system.

D. **Altered Duct Systems - Duct Sealing**: In all Climate Zones, when more than 40 feet of new or replacement space-conditioning system ducts are installed, the ducts shall comply with the applicable requirements of subsections i and ii below:

i. New ducts located in unconditioned space shall meet the applicable requirements of Sections 150.0(m)1 through 150.0(m)11, and the duct insulation requirements of TABLE 150.2-A, and

TABLE 150.2-A DUCT INSULATION R-VALUE

Climate Zone	1 through 10, 12&13	11, 14 through 16
Duct R-Value	R-6	R-8

ii. The altered duct system, regardless of location, shall be sealed as confirmed through field verification and diagnostic testing in accordance with all applicable procedures for duct sealing of altered existing duct systems as specified in the Reference Residential Appendix RA3.1, utilizing the leakage compliance criteria specified in Reference Residential Appendix TABLE RA3.1-2, and conforming to either Subsection a or b below:

a. **Entirely New or Complete Replacement Duct System.** If the new ducts form an entirely new or replacement duct system directly connected to the air handler, the measured duct leakage shall be equal to or less than 5 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1.

Entirely new or complete replacement duct systems installed as part of an alteration shall be constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the dwelling unit's existing duct system, including but not limited to registers, grilles, boots, air handler, coil, plenums, duct material; if the reused parts are accessible and can be sealed to prevent leakage.

Entirely new or complete replacement duct systems shall also conform to the requirements of Section 150.0(m)12 and 150.0(m)13.

b. **Extension of an Existing Duct System**. If the new ducts are an extension of an existing duct system, the combined new and existing duct system shall meet one of the following requirements:

1. The measured duct leakage shall be equal to or less than 15 percent of nominal system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

2. The measured duct leakage to outside shall be equal to or less than 10 percent of nominal system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or

3. If it is not possible to meet the duct sealing requirements of either Section150.2(b)1Diib1, or 150.2(b)1Diib2, then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

EXCEPTION to Section 150.2(b)1Diib: Duct Sealing. Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos.

E. **Altered Space-Conditioning System - Duct Sealing:** In all Climate Zones, 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; 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 Reference Residential Appendix Table RA3.1-2, conforming to one of the following requirements:

i. The measured duct leakage shall be equal to or less than 15 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

ii. The measured duct leakage to outside shall be equal to or less than 10 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or

iii. If it is not possible to meet the duct sealing requirements of either Section 150.2(b)1Ei or Section 150.2(b)1Eii, then, all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

EXCEPTION 1 to Section 150.2(b)1E: Duct Sealing. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in the Reference Residential Appendix RA3.1.

EXCEPTION 2 to Section 150.2(b)1E: Duct Sealing. Duct systems with less than 40 linear feet as determined by visual inspection.

EXCEPTION 3 to Section 150.2(b)1E: Duct Sealing. Existing duct systems constructed, insulated or sealed with asbestos.

F. **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:

i. All thermostats associated with the system shall be replaced with setback thermostats meeting the requirements of Section 110.2(c).

ii. 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, and minisplit systems, shall comply with subsections a and b, unless the system is of a type that cannot be verified using the specified procedures. Systems that cannot comply with the requirements of 150.2(b)1Fii shall comply with 150.2(b)1Fiii.

a. Minimum system airflow rate greater than or equal to 300 cfm per ton shall be demonstrated by the installer and be verified by the HERS Rater according to the procedures specified in Reference Residential Appendix Section RA3.3 or an approved alternative procedure as specified in Section RA1; and

b. 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.

1. 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

2. 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

3. The installer shall perform the weigh-in charging procedure as specified by Reference Residential Appendix Section RA3.2.3.1 provided the system is of a type that can be verified using the RA3.2.2 standard charge verification procedure and RA3.3 airflow rate verification procedure or approved alternatives in RA1. The HERS Rater shall verify the charge using RA3.2.2 and RA3.3 or approved alternatives in RA1.

EXCEPTION 1 to Section 150.2(b)1Fiia: Systems unable to comply with the minimum 300 cfm per ton 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 Reference Joint Appendix JA5.

EXCEPTION 2 to Section 150.2(b)1Fiia: The Executive Director may approve alternate airflow and fan efficacy requirements for small duct high velocity systems.

EXCEPTION 3 to Section 150.2(b)Fiia: Entirely new or complete replacement space conditioning systems, as specified by section 150.2(b)1C, without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in TABLE-150.0-B or 150.0-C as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Section RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12C for the system air filter device(s) shall conform to the requirements given in TABLES 150.0-B and 150.0-C.

EXCEPTION 1 to Section 150.2(b)1Fiib: 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 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 Reference Joint Appendix JA5. Ducted systems shall comply with the minimum system airflow rate requirements in Section 150.2(b)1Fiia.

EXCEPTION to Section 150.2(b)1Fii: Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.2(b)1Fiia, 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.

iii. In climate Zones 2, 8, 9, 10, 11, 12, 13, 14, and 15, air-cooled air conditioners or air-source heat pumps, including but not limited to ducted split systems, ducted package systems, and minisplit systems, which are of a type that cannot comply with the requirements of 150.2(b)1Fiib shall comply with subsections a and b, as applicable.

a. The installer shall confirm the refrigerant charge using the weigh-in charging procedure specified in Reference Residential Appendix Section RA3.2.3.1, as verified by a HERS Rater according to the procedures specified in Reference Residential Appendix RA3.2.3.2; and

b. Systems that utilize forced air ducts shall comply with the minimum system airflow rate requirement in Section 150.2(b)1Fiia provided the system is of a type that can be verified using the procedures in RA3.3 or an approved alternative procedure in RA1.

EXCEPTION to Section 150.2(b)1Fiii: Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.2(b)1Fiiib, 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.

G. **Water-Heating System**. Replacement service water-heating systems or components shall:

i. **Pipe Insulation.** For newly installed piping, the insulation requirements of Section 150.0(j)2 shall be met. For existing accessible piping the applicable requirements of Section 150.0(j)2Ai, iii, and iv shall be met.

ii. **Water heating system.** The replacement water heating system shall meet one of the following requirements:

a. A natural gas or propane water-heating system that meets the requirements of Section 110.1 and 110.3. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used; or

b. If no natural gas is connected to the building, an electric water heater that meets the requirements of Section 110.1 and 110.3. For electric resistance storage type water heaters, the capacity shall not exceed 60 gallons. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used; or

c. A water-heating system determined by the executive director to use no more energy than the one specified in Item 1 above; or if no natural gas is connected to the building, a water-heating system determined by the executive director to use no more energy than the one specified in Item 2 above; or

d. Using the existing building plus addition compliance approach as defined in Section 150.2(b)2 demonstrate that the proposed water heating system uses no more energy than the system defined in Item 1 above regardless of the type or number of water heaters installed.

H. **Roofs.** Replacements of the exterior surface of existing roofs shall meet the requirements of Section 110.8 and the applicable requirements of Subsections i and ii where more than 50 percent of the roof is being replaced:

i Low-rise residential buildings with steep-sloped roofs, in Climate Zones 10 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 TO 150.2(b)1Hi: The following shall be considered equivalent to Subsection i:

a. Air-space of 1.0 inch (25 mm) is provided between the top of the roof deck to the bottom of the roofing product; or

b. The installed roofing product has a profile ratio of rise to width of 1 to 5 for 50 percent or greater of the width of the roofing product; or

c. Existing ducts in the attic are insulated and sealed according to Section 150.1(c)9; or

d. Buildings with at least R-38 ceiling insulation; or

e. Buildings with a radiant barrier in the attic meeting the requirements of Section 150.1(c)2; or

f. Buildings that have no ducts in the attic; or

g. In Climate Zones 10-15, R- 2or greater insulation above the roof deck.

ii. Low-sloped roofs in Climate Zones 13 and 15 shall have a 3-year aged solar reflectance equal or greater than 0.63 and a thermal emittance equal or greater than 0.75, or a minimum SRI of 75.

EXCEPTION 1 to Section 150.2(b)1Hii: Buildings with no ducts in the attic.

EXCEPTION 2 to Section 150.2(b)1Hii: The aged solar reflectance can be met by using insulation at the roof deck specified in TABLE 150.2-B.

I. **Lighting**. The altered lighting system shall meet the lighting requirements of Section 150.0(k). The altered luminaires shall meet the luminaire efficacy requirements of Section 150.0(k) and TABLE 150.0-A.

2. **Performance approach.** This performance approach shall only be used for projects that include tradeoffs between two or more altered components that are listed in TABLE 150.2-C.

NOTE: The altered components may be components of the same type, such as a tradeoff between two windows, or components of differing types, such as a tradeoff between a window and an amount of attic insulation.

A. The altered components shall meet the applicable requirements of Sections 110.0 through 110.9 and Section 150.0(a) through (q); and

B. The standard design for an altered component shall be the higher efficiency of existing conditions or the requirements stated in TABLE 150.2-C. For components not being altered, the standard design shall be based on the existing conditions. When the third party verification option is specified as a requirement, all components proposed for alteration for which the additional credit is taken, must be verified.

TABLE 150.2-B AGED SOLAR REFLECTANCE INSULATION TRADE OFF TABLE

Aged Solar Reflectance	Roof Deck Insulation R-value	Aged Solar Reflectance	Roof Deck Insulation R-value
0.62-0.60	2	0.44-0.40	12
0.59-0.55	4	0.39-0.35	16
0.54-0.50	6	0.34-0.30	20
0.49-0.45	8	0.29-0.25	24

TABLE 150.2-C STANDARD DESIGN FOR AN ALTERED COMPONENT

Altered Component	Standard Design Without Third Party Verification of Existing Conditions Shall be Based On	Standard Design With Third Party Verification of Existing Conditions Shall be Based On
Ceiling Insulation, Wall Insulation, and Raised-floor Insulation	The requirements of Sections 150.0(a), (c), and (d)	The existing insulation R-value
Fenestration	The U-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.	If the proposed U-factor is ≤ 0.40 and SHGC value is ≤ 0.35, the standard design shall be based on the existing U-factor and SHGC values as verified. Otherwise, the standard design shall be based on the U-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.
Window Film	The U-factor of 0.40 and SHGC value of 0.35.	The existing fenestration in the alteration shall be based on Table 110.6-A and Table 110.6-B.
Space-Heating and Space-Cooling Equipment	The requirements of TABLE 150.1-A.	The existing efficiency levels.
Air Distribution System – Duct Sealing	The requirements of Section 150.2(b)1D.	
Air Distribution System – Duct Insulation	The proposed efficiency levels.	The existing efficiency levels.
Water Heating Systems	The requirements of Section 150.1(b)1 without the solar water heating requirements.	The existing efficiency energy factor.
Roofing Products	The requirements of Section 150.2(b)1H.	
All Other Measures	The proposed efficiency levels.	The existing efficiency levels.

C. The proposed design shall be based on the actual values of the altered components.

NOTES TO SECTION 150.2(b)2:

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 150.2(b)2B.
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 Residential ACM Approval Manual

EXCEPTION 1 to Section 150.2(b): Any dual-glazed greenhouse or garden window installed as part of an alteration complies with the U-factor requirements in Section 150.1(c)3.

EXCEPTION 2 to Section 150.2(b): 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.

EXCEPTION 3 to Section 150.2(b): Space-Conditioning System Ducts. The requirements of Section150.0(m)12, 150.0(m)13, 150.0(m)14 and 150.0(m)15 are not applicable to Section 150.2(b).

(c) **Whole Building.** Any addition or alteration may comply with the requirements of Title 24, Part 6 by meeting the requirements for the entire building.

CALIFORNIA MECHANICAL CODE, CALIFORNIA CODE OF REGULATIONS, TITLE 24, PART 4 CHAPTER 6, DUCT SYSTEMS

TABLE P4-A ADOPTION TABLE

CODE SECTION	**CEC**
Entire CMC as noted in this table [1]	
601.0	X
602.0	X
604.0	X
605.0	X

[1] Adopted by reference for Occupancies A, B, E, F, H, M, R and S; see Sections 110.8(d)3, 120.4 and 150.0(m).

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APPENDIX 1-A
STANDARDS AND DOCUMENTS REFERENCED IN THE ENERGY EFFICIENCY REGULATIONS

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE

AHRI 210/240-2008	Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment (2008 with Addendum 1)
ANSI/AHRI/CSA 310/380-2004	Standard for Packaged Terminal Air-Conditioners and Heat Pumps (2004)
AHRI 320-98	Water-Source Heat Pumps
AHRI 325-98	Ground Water-Source Heat Pumps (1998)
ANSI/AHRI 340/360-2007	Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment (2007 with Addenda 1 and 2)
ANSI/AHRI 365-2009	Commercial and Industrial Unitary Air-Conditioning Condensing Units (2009) Performance
ANSI/AHRI 460-2005	Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers (2005)
AHRI 550/590-2011	Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle (2011 with Addendum 3)
ANSI/AHRI 560-2000	Absorption Water Chilling and Water Heating Packages (2000)
AHRI 680	Performance Rating of Residential Air Filter Equipment (2009)
Available from:	Air-Conditioning and Refrigeration Institute 4301 North Fairfax Drive, Suite 425 Arlington, Virginia 22203 (703) 524-8800

AIR CONDITIONING CONTRACTORS OF AMERICA

Manual J – Residential Load Calculation, Eighth Edition (2003)

Available from:	Air Conditioning Contractors of America, Inc. 2800 Shirlington Road, Suite 300 Arlington, VA 22206 www.acca.org (703) 575-4477

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION
CANADIAN STANDARDS ASSOCIATION
WINDOW AND DOOR MANUFACTURERS ASSOCIATION

AAMA/WDMA/CSA 101/ I.S.2/A440-11	NAFS 2011 – North American Fenestration Standard/Specification for windows, doors, and skylights
Available from:	AAMA 1827 Walden Office Square, Suite 550 Schaumburg, IL 60173-4268 (847)303-5664 www.aamanet.org
	CSA 5060 Spectrum Way, Suite 100 Mississauga, ON, Canada L4W 5N6 (800)463-6727 www.csagroup.org
	WDMA 2025 M Street, NW, Suite 800 Washington, DC 20036-3309 (202)367-1157 www.wdma.com

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI Z21.10.3-2001	Gas Water Heaters, Volume 1, Storage Water Heaters with Input Ratings above 75,000 Btu/h (2001)
ANSI Z21.13-2000	Gas-Fired Low Pressure Steam and Hot Water Boilers (2000)
ANSI Z21.40.4-1996	Performance Testing and Rating of Gas-Fired, Air-Conditioning and Heat Pump Appliances (1996)
ANSI Z21.47-2001	Gas-Fired Central Furnaces (2001)
ANSI Z83.8-2002	Gas Unit Heaters and Gas-Fired Duct Furnaces (2002)
Available from:	American National Standards Institute
	25 West 43rd Street, 4th Floor
	New York, NY 10036
	(212) 642-4900
ANSI/NSPI-5 2003	Residential Inground Swimming Pools (2003)ANSI C82.6-2005
	Ballasts for High-Intensity Discharge Lamps - Methods of Measurement
Available from:	Association of Pool & Spas Professionals
	2111 Eisenhower Ave.
	Alexandria, VA 22314
	(703) 838-0083

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS (NATIONAL PUBLICATIONS)

ASHRAE Standard 52.2 -2012	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size,
ASHRAE Standard 55-2010	Thermal Environment Conditions for Human Occupancy
ASHRAE Standard 62.2-2010	Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
ASHRAE Handbook	
Applications Volume,	Heating, Ventilating and Air-Conditioning Applications (2011)
Equipment Volume,	Heating, Ventilating and Air-Conditioning Systems and Equipment (2008)
Fundamentals Volume,	Fundamentals (2009)
Available from:	ASHRAE 1791 Tullie Circle N.E. Atlanta, Georgia 30329-2305 www.ashrae.org

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS (REGIONAL PUBLICATION)

ASHRAE Climatic Data for Region X Arizona, California, Hawaii, Nevada, Publication SPCDX, 1982, ISBN #20002196 and Supplement, 1994, ISBN #20002596

Available from:	Order Desk Building News 10801 National Boulevard Los Angeles, CA 90064 (800) 873-6397 or (310) 474-7771 http://www.bnibooks.com/

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ASME A112.18.1-2011/CSA B125.1-11	Plumbing Supply Fittings
Available from:	ASME Three Park Avenue New York, NY 10016-5990 (800) 843-2763 http://www.asme.org/

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM C55-14	Standard Specification for Concrete Brick (2014)
ASTM C177-13	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus (2013)
ASTM C272-12	Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions (2012)
ASTM C335-10	Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation (2010)
ASTM C518-10	Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus (2010)
ASTM C731-10	Standard Test Method for Extrudability, After Package Aging, of Latex Sealants (2010)
ASTM C732-12	Standard Test Method for Aging Effects of Artificial Weathering on Latex Sealants (2012)

ASTM C836-12	Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course (2012)
ASTM C1167-11	Standard Specification for Clay Roof Tiles(2011)
ASTM C1371-10	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers (2010)
ASTM C1492-09	Standard Specification for Concrete Roof Tile (2009)
ASTM C1549-14	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer (2014)
ASTM C1583-13	Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method) (2013)
ASTM D448-12	Standard Classification for Sizes of Aggrerate for Road and Bridge Construction (2012)
ASTM D522-13	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings (2013)
ASTM D822-13	Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings (2013)
ASTM D1003-13	Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics (2013)
ASTM D1653-13	Standard Test Methods for Water Vapor Transmission of Organic Coating Films (2013)
ASTM D1863-11	Standard Specification for Mineral Aggregate Used on Built-Up Roofs (2011)
ASTM D2370-10	Standard Test Method for Tensile Properties of Organic Coatings (2010)
ASTM D2824-13	Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Nonfibered, Asbestos Fibered, and Fibered without Asbestos (2013)
ASTM D3468-13	Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing (2013)
ASTM D3805-09	Standard Guide for Application of Aluminum-Pigmented Asphalt Roof Coatings (2009)
ASTM D4798-11	Standard Test Method Accelerated Weathering Test Conditions and Procedures for Bituminours Materials (Xenon-Arc Method) (2011)
ASTM D5870-11	Standard Practice for Calculating Property Retention Index of Plastics (2011)
ASTM D6694-13	Standard Specification for Liquid-Applied Silicone Coating Used in Spray Polyurethane Foam Roofing (2013)
ASTM E96-14	Standard Test Methods for Water Vapor Transmission of Materials (2014)
ASTM E283-12	Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen (2012)
ASTM E408-13	Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques (2013)
ASTM E972-13	Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight (2013)
ASTM E1918-15	Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field (2015)
ASTM E1980-11	Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces (2011)
ASTM E2178-13	Standard Test Method for Air Permeance of Building Materials (2013)
ASTM E2357-11	Standard Test Method for Determining Air Leakage of Air Barrier Assemblies (2011)
ASTM E779-10	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization (2010)
ASTM E1677-11	Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls (2011)
Available From:	American Society for Testing and Materials 100 Bar Harbor Dive West Conshohocken, Pennsylvania 19428-2959 (800) 262-1373 or (610) 832-9585

CALIFORNIA BUILDING STANDARDS COMMISSION

2013 California Electrical Code

2013 California Plumbing Code

2013 California Mechanical Code

2013 California Building Code

Available from: California Building Standards Commission
2525 Natomas Park Drive, Suite 130
Sacramento, CA 95833-2936
(916) 263-0916
www.bsc.ca.gov

CALIFORNIA ENERGY COMMISSION

Appliance Efficiency Regulations

Building Energy Efficiency Standards for Residential and Nonresidential Buildings

Reference Appendices for the Building Energy Efficiency Standards for Residential and Nonresidential Buildings

Nonresidential Alternative Calculation Method (ACM) Approval Manual

Nonresidential Alternative Calculation Method (ACM) Reference Manual

Nonresidential Compliance Manual

Residential Alternative Calculation Method (ACM) Approval Manual

Residential Alternative Calculation Method (ACM) Reference Manual

Residential Compliance Manual

New Solar Homes Partnership Guidebook, currently adopted by the Energy Commission.

Available from: California Energy Commission/Publications
1516 Ninth Street
Sacramento, CA 95814
(916) 654-5200
www.energy.ca.gov/title24.

CALIFORNIA DEPARTMENT OF CONSUMER AFFAIRS

Standards for Insulating Material

Available from: California Department of Consumer Affairs
Bureau of Electronic and Appliance ,Home Furnishings and Thermal Insulation
4244 South Market Court, Suite D
Sacramento, California 95834-1243
(916) 999-2041

COOLING TECHNOLOGY INSTITUTE

CTI ATC-105-00	Acceptance Test Code for Water Cooling Towers (2000)
CTI STD-201-04	Standard for the Certification of Water-Cooling Tower Thermal Performance (2004)
Available from:	Cooling Technology Institute 2611 FM 1960 West, Suite A-101 Houston, Texas 77068-3730 PO Box 73383 Houston, Texas 77273-3383 (281) 583-4087

COOL ROOF RATING COUNCIL

CRRC-1	Product Rating Program Manual (2014)
Available from:	Cool Roof Rating Council 449 15th Street, Suite 400 Oakland, CA 94612 (866) 465-2523 www.coolroofs.org

HYDRONICS INSTITUTE

HI Heating Boiler Standard 86, 6th Edition, (1989)

Available from:	Hydronics Institute 35 Russo Place, P.O. Box 218 Berkeley Heights, New Jersey 07922 (908) 464-8200

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA

The IESNA Lighting Handbook, Ninth Edition (2000)

Available from:	IESNA 120 Wall Street, 17th Floor New York, New York 10005-4001 (212) 248-5000 Email: iesna@iesna.org

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS

2007 California Mechanical Code

Available from: International Association of Plumbing and Mechanical Officials
2001 E. Walnut Drive South
Walnut, California 91789-2825
800 85-IAPMO (854-2766)
www.iapmo.org

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS

2007 California Building Code

Available from: International Conference of Building Officials
International Code Council Los Angeles District Office
5360 South Workman Mill Road
Whittier, California 90601-2298
(800) 284-4406
www.icbo.org

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO-13256-1 Water-Source Heat Pumps - Testing and Rating for Performance - Part 1: Water-to-Air and Brine-to-Air Heat Pumps (1998)

Available from: ISO
1, rue de Varembe
Case postale 56
CH-1211
Geneve 20, Switzerland

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

NEMA SSL 7A-2013 "Phase Cut Dimming for Solid State Lighting: Basic Compatibility"

Available from: 1300 North 17th Street, Suite 1752
Rosslyn, VA 22209
703-841-3200
www.nema.org

NATIONAL FENESTRATION RATING COUNCIL

NFRC 100	Procedures for Determining Fenestration Product U-factors (2014)
NFRC 200	Procedures for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence (2014)
NFRC 202	Procedure for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence (2014)
	Note: This Technical document has yet not been fully approved by NFRC. If this document is not approved before the Building Energy Standards effective date it will be removed.
NFRC 203	Procedure for Determining Visible Transmittance of Tubular Daylighting Devices (2014)
	Note: This Technical document has yet not been fully approved by NFRC. If this document is not approved before the Building Energy Standards effective date it will be removed.
NFRC 400	Procedures for Determining Fenestration Product Air Leakage (2014)
Available from:	National Fenestration Rating Council
	6035 Ivy Lane, Suite 140
	Greenbelt, MD 20770.
	(301) 589-1776
	WWW.NFRC.org and Email: info@nfrc.org

NSF INTERNATIONAL (FORMERLY NATIONAL SANITATION FOUNDATION)

NSF/ANSI 50 2005	Circulation System Components and Related Materials for Swimming Pools, Spas/Hot Tubs (2005)
Available from:	NSF International
	PO Box 130140
	Ann Arbor, MI 48113
	(734) 769-8010

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION

Residential Comfort System Installation Standards Manual (1998)

Available from:	Sheet Metal And Air Conditioning Contractors National Association (SMACNA)
	4201 Lafayette Center Drive
	Chantilly, VA 20151-1209
	(703) 803-2980
	www.smacna.org

UNDERWRITERS LABORATORIES

UL 181	Standard for Safety for Factory-made Air Ducts and Connectors (1996)
UL 181A	Standard for Safety for Closure Systems for Use with Rigid Air Ducts and Air Connectors (1994)
UL 181B	Standard for Safety for Closure Systems for Use with Flexible Air Ducts and Air Connectors (1995)
UL 723	Standard for Test for Surface Burning Characteristics of Building Materials (1996)
UL 727	Standard for Oil-Fired Central Furnaces (1994)
UL 731	Standard for Oil-Fired Unit Heaters (1995)
UL 1574	Track Lighting Systems (2000)
UL 1598	Standard for Luminaires (2000)
UL 2108	Low Voltage Lighting Systems (2008)
Available from:	Underwriters Laboratories
	333 Pfingsten Road
	Northbrook, Illinois 60062-2096
	(847) 272-8800

Table of Contents

4 Mechanical Systems

4.1 Overview

The objective of the Building Energy Efficiency Standards (Energy Standards) requirements for mechanical systems is to reduce energy consumption while maintaining occupant comfort. These goals are achieved by:

1. Maximizing equipment efficiency, both at design conditions and during part load operation
2. Minimizing distribution losses of heating and cooling energy
3. Optimizing system control to minimize unnecessary operation and simultaneous use of heating and cooling energy

The Energy Standards also recognize the importance of indoor air quality for occupant comfort and health. To this end, the Energy Standards incorporate requirements for outdoor air ventilation that must be met during all operating conditions.

This chapter summarizes the requirements for space conditioning, ventilating, and service water heating systems for non-process loads in nonresidential buildings. Chapter 10 covers process loads in nonresidential buildings and spaces.

This chapter is organized as follows:

Section 4.1 provides an overview of the chapter and the scope of the mechanical systems requirement in the Energy Standards.

Section 4.2 addresses the requirements for Heating, Ventilation, and Air Conditioning (HVAC) and service water heating equipment efficiency and equipment mounted controls.

Section 4.3 includes mechanical ventilation, natural ventilation, and demand controlled ventilation.

Section 4.4 covers construction and insulation of ducts and pipes and duct sealing to reduce leakage.

Section 4.5 covers control requirements for HVAC systems including zone controls and controls to limit reheating and recooling.

Section 4.6 covers the remaining requirements for HVAC systems, including sizing and equipment selection, load calculations, economizers, electric resistance heating limitation, limitation on air-cooled chillers, fan power consumption, and fan and pump flow controls.

Section 4.7 covers the remaining requirements for service water heating.

Section 4.8 covers the performance method of compliance.

Section 4.9 covers compliance requirements for additions and alterations.

Section 4.10 covers the glossary, reference, and definitions.

Section 4.11 describes the mechanical plan check documents, which includes information that must be included in the building plans and specifications to show compliance with the Energy Standards, including the mechanical compliance documents.

Acceptance requirements apply at all times to the systems covered regardless of whether the prescriptive or performance compliance approach is used.

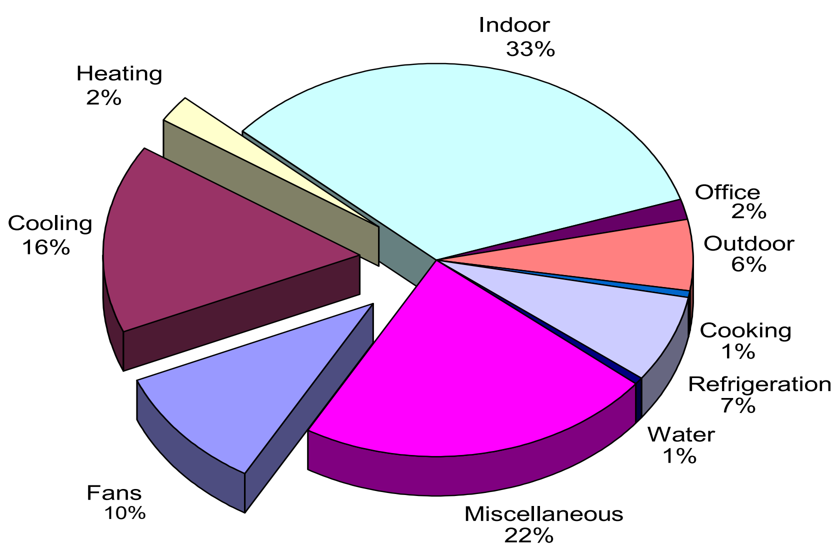
Chapter 12 describes mandated acceptance test requirements, which are summarized at the end of each section.

The full acceptance requirements are in §120.5 of the Energy Standards and in the 2016 Reference Appendix NA7.

4.1.1 HVAC Energy Use

Mechanical and lighting systems are the largest consumers of energy in nonresidential buildings. The amount of energy consumed by various mechanical components varies according to system design and climate. For most buildings in lower elevation California climates, fans and cooling equipment are the largest components of energy consumed for HVAC purposes. Energy consumed for heating is usually less than fans and cooling, followed by service water heating.

Figure 4-1: Typical Nonresidential Building Electricity Use



Heating, cooling and ventilation account for about 28% of commercial building electricity use in California. Source IEQ RFP, December 2002, California Energy Commission No. 500-02-501.

4.1.2 Mandatory Measures

Mandatory measures, covered in §110.0-110.5 and §120.0-120.9, apply to all nonresidential buildings, whether the designer chooses the prescriptive or performance approach for compliance and include:

1. Equipment certification and equipment efficiency - §110.1 and §110.2.
2. Service water heating systems and equipment - §110.3.
3. Spa and pool heating systems and equipment - §110.4.
4. Restrictions on pilot lights for natural gas appliances and equipment - §110.5.
5. Ventilation requirements - §120.1.
6. Control requirements - §120.2.

7. Pipe insulation - §120.3.
8. Duct construction and insulation - §120.4.
9. Acceptance tests in §120.5 and the 2016 Reference Appendices NA7.
10. Commissioning - §120.8.
11. Commercial Boilers - §120.9.

4.1.3 Prescriptive and Performance Compliance Approaches

The Energy Standards allow mechanical system compliance to be demonstrated by meeting the mandatory requirements and the requirements of either the prescriptive or performance compliance approaches.

4.1.3.1 Prescriptive Compliance Approach

The measures in the prescriptive compliance approach, §140.4, cover specific requirements for individual components and systems that directly comply with the Energy Standards, including:

1. Load calculations, sizing, system type and equipment selection - §140.4(a) and (b).
2. Fan power consumption - §140.4(c).
3. Controls to reduce reheating, recooling and mixing of conditioned air streams - §140.4(d).
4. Economizers - §140.4(e).
5. Supply temperature reset - §140.4(f).
6. Restrictions on electric-resistance heating - §140.4(g).
7. Fan speed controls for heat rejection equipment - §140.4(h).
8. Limitation on centrifugal fan cooling towers - §140.4(h).
9. Minimum chiller efficiency - §140.4(i).
10. Limitation on air-cooled chillers - §140.4(j).
11. Hydronic system design - §140.4(k).
12. Duct sealing - §140.4(l).
13. Supply fan control - §140.4(m).
14. Mechanical System Shut-off control - §140.4(n).

4.1.3.2 Performance Compliance Approach

The performance compliance approach, §140.1, allows the designer to trade off energy use in different building systems. This approach provides greater design flexibility, but requires extra effort and a computer simulation of the building. The design must still meet all of the mandatory requirements.

Performance approach trade-offs can be applied to the following disciplines: mechanical, lighting, envelope, and covered processes. The performance approach requires creating two models using Energy Commission-certified compliance software:

1. Base-case building energy model which meets all of the mandatory and prescriptive requirements.
2. Proposed building energy model that reflects the proposed building design.

The proposed model complies if it has a lower TDV value than the base-case model.

The performance approach may only be used to model the performance of mechanical systems that are covered under the building permit application (see Section 4.8 and Chapter 11 for more detail).

4.2 Equipment Requirements

With the exception of chillers, all of the equipment efficiency requirements are mandatory measures.

The mandatory requirements for mechanical equipment must be included in the system design, whether compliance is shown by the prescriptive or the performance approach. These features have been shown to be cost effective over a wide range of building types and mechanical systems.

It is worth noting that most mandatory features for equipment efficiency are requirements for the manufacturer. It is the responsibility of the designer, however, to specify products in the building design that meet these requirements. Manufacturers of central air conditioners and heat pumps, room A/C, package terminal A/C, package terminal heat pumps, spot air conditioners, computer room air conditioners, central fan-type furnaces, gas space heaters, boilers, pool heaters and water heaters are regulated through the Title 20 Appliance Efficiency Regulations. Manufacturers must certify to the Energy Commission that their equipment meets or exceeds minimum standards. The Energy Commission maintains a database which lists the certified equipment and can be found at: www.energy.ca.gov/appliances/database

Additionally, manufacturers of low leakage air-handling units must certify to the Energy Commission that the air-handler unit meets the specifications in Reference Joint Appendix JA9.

4.2.1 Mandatory Requirements

Mechanical equipment must be certified by the manufacturer as complying with the mandatory requirements in the following Sections:

- §110.1 - Mandatory Requirements for Appliances.
- §110.2 - Mandatory Requirements for Space Conditioning Equipment
  - Efficiency
  - Gas- and Oil-Fired Furnace Standby Loss Controls
  - Low Leakage Air-Handling Units
- §110.3 - Mandatory Requirements for Service Water Heating Systems and Equipment
  - Certification by Manufactures
  - Efficiency
- §110.4 - Mandatory Requirements for Pool and Spa Systems and Equipment
  - Certification by Manufactures

- §110.5 - Natural Gas Central Furnaces, Cooking Equipment, and Pool and Spa Heaters: Pilot Lights Prohibited

Mechanical equipment must be specified and installed in accordance with Sections:

- §110.2 - Mandatory Requirements for Space Conditioning Equipment
  - Controls for Heat Pumps with Supplementary Electric Resistance Heaters
  - Thermostats
  - Open and Closed Circuit Cooling Towers (blowdown control)
- §110.3 - Mandatory Requirements for Service Water Heating Systems and Equipment
- §120.1 - Requirements for Ventilation
- §120.2 - Required Controls for Space Conditioning Systems including
  - Occupant Controlled Smart Thermostats (OCST)
  - Direct Digital Controls (DDC)
  - Optimum start/stop controls
- §120.3 - Requirements for Pipe Insulation
- §120.4 - Requirements for Air Distribution Ducts and Plenums
- §120.5 - Required Nonresidential Mechanical System Acceptance

4.2.2 Equipment Efficiency

§110.2(a)

All space conditioning equipment installed in a nonresidential building subject to these regulations must be certified as meeting certain minimum efficiency and control requirements. These requirements are contained in §110.2. Minimum efficiencies vary based on the type and capacity of the equipment. The following tables, which are duplicates of Tables 110.2A-110.2K of the Energy Standards, list the minimum equipment efficiency requirements.

Table 4-1: Unitary Air Conditioners and Condensing Units

Equipment Type	Size Category	Efficiency [a,b]		Test Procedure[c]
		Before 1/1/2016	After 1/1/2016	
Air conditioners, air cooled both split and single packaged	≥65,000 Btu/h and < 135,000 Btu/h	11.2 EER 11.4 IEER	11.2 EER 12.9 IEER	ANSI/AHRI 340/360
	≥135,000 Btu/h and < 240,000 Btu/h	11.0 EER 11.2 IEER	11.0 EER 12.4 IEER	
	≥240,000 Btu/h and < 760,000 Btu/h	10.0 EER 10.1 IEER	10.0 EER 11.6 IEER	
	≥760,000 Btu/h	9.7 EER 9.8 IEER	9.7 EER 11.2 IEER	
Air conditioners, water cooled	≥65,000 Btu/h and < 135,000 Btu/h	12.1 EER 12.3 IEER	12.1 EER 13.9 IEER	ANSI/AHRI 340/360
	≥135,000 Btu/h and < 240,000 Btu/h	12.5 EER 12.5 IEER	12.5 EER 13.9 IEER	ANSI/AHRI 340/360
	≥240,000 Btu/h and < 760,000 Btu/h	12.4 EER 12.6 IEER	12.4 EER 13.6 IEER	ANSI/AHRI 340/360
	≥760,000 Btu/h	12.2 EER 12.4 IEER	12.2 EER 13.5 IEER	ANSI/AHRI 340/360
Air conditioners, evaporatively cooled	≥65,000 Btu/h and < 135,000 Btu/h	12.1 EER[b] 12.3 IEER[b]		ANSI/AHRI 340/360
	≥135,000 Btu/h and < 240,000 Btu/h	12.0 EER[b] 12.2 IEER[b]		ANSI/AHRI 340/360
	≥240,000 Btu/h and < 760,000 Btu/h	11.9 EER[b] 12.1 IEER[b]		ANSI/AHRI 340/360
	≥760,000 Btu/h	11.7 EER[b] 11.9 IEER[b]		ANSI/AHRI 340/360
Condensing units, air cooled	≥ 135,000 Btu/h	10.5 EER 11.8 IEER		ASNI/AHRI 365
Condensing units, water cooled	≥ 135,000 Btu/h	13.5 EER 14.0 IEER		ASNI/AHRI 365
Condensing units, evaporatively cooled	≥ 135,000 Btu/h	13.5 EER 14.0 IEER		

[a] IEERs are only applicable to equipment with capacity control as specified by ANSI/AHRI 340/360 test procedures
[b] Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat
[c] Applicable test procedure and reference year are provided under the definitions

Energy Standards Table 110.2-A

Table 4-2: Unitary and Applied Heat Pumps

Equipment Type	Size Category	Efficiency[a,b]		Test Procedure[c]
		Before 1/1/2016	**After 1/1/2016**	
Air Cooled (cooling mode), both split system and single package	≥65,000 Btu/h and < 135,000 Btu/h	11.0 EER 11.2 IEER	11.0 EER 12.2 IEER	ANSI/AHRI 340/360
	≥135,000 Btu/h and < 240,000 Btu/h	10.6 EER 10.7 IEER	10.6 EER 11.6 IEER	
	≥240,000 Btu/h	9.5 EER 9.6 IEER	9.5 EER 10.6 IEER	
Water source (cooling mode)	≥65,000 Btu/h and < 135,000 Btu/h	86^0F entering water	13.0 EER	ISO-13256-1
Groundwater source (cooling mode)	< 135,000 Btu/h	59^0F entering water	18.0 EER	ISO-13256-1
Ground source (cooling mode)	< 135,000 Btu/h	77^0F entering water	14.1 EER	ISO-13256-1
Water source water-to-water (cooling)	< 135,000 Btu/h	86^0F entering water	10.6 EER	ISO-13256-2
Groundwater source water-to-water	< 135,000 Btu/h	59^0F entering water	16.3 EER	ISO-13256-1
Ground source brint-to-water (cooling mode)	< 135,000 Btu/h	77^0F entering water	12.1 EER	ISO-13256-2
Air Cooled (Heating Mode) Split system and single package	≥65,000 Btu/h and < 135,000 Btu/h (cooling capacity)	47^0F db/43^0F wb outdoor air	3.3 COP	ANSI/AHRI 340/360
		17^0F db/15^0F wb outdoor air	2.25 COP	
	≥135,000 Btu/h (cooling capacity)	47^0F db/43^0F wb outdoor air	3.2 COP	
		17^0F db/15^0F wb outdoor air	2.05 COP	

(Cont.) Table 4-2: Unitary and Applied Heat Pumps

Equipment Type	Size Category	Subcategory or Rating Condition	Efficiency[a]	Test Procedure[c]
Water source (heating mode)	< 135,000 Btu/h (cooling capacity)	68⁰F entering water	4.3 COP	ISO-13256-1
	≥135,000 Btu/h and < 240,000 Btu/h (cooling capacity)	68⁰F entering water	2.9 COP	
Groundwater source (heating mode)	< 135,000 Btu/h (cooling capacity)	50⁰F entering water	3.7 COP	ISO-13256-1
Ground source (heating mode)	< 135,000 Btu/h (cooling capacity)	32⁰F entering water	3.2 COP	ISO-13256-1
Water source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	68⁰F entering water	3.7 COP	ISO-13256-2
Groundwater source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	50⁰F entering water	3.1 COP	ISO-13256-2
Ground source brine-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	32⁰F entering water	2.5 COP	ISO-13256-2

[a] IEERs are applicable to equipment with capacity control as specified by ANSI/AHRI 340/360 test procedures.
[b] Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat
[c] Applicable test procedure and reference year are provided under the definitions

Energy Standards Table 110.2-B

Table 4-3: Air Cooled Gas Engine Heat Pumps

Equipment Type	Size Category	Subcategory or Rating Condition	Efficiency	Test Procedure[a]
Air-cooled gas-engine heat pump (cooling mode)	All Capacities	95⁰F db Outdoor air	0.60 COP	ANSI Z21.40.4A
Air-cooled gas-engine heat pump (heating mode)	All Capacities	47⁰F db/43°F wb Outdoor air	0.72 COP	ANSI Z21.40.4A

[a] Applicable test procedure and reference year are provided under the definitions

Energy Standards Table 110.2-C

Table 4-4: Water Chilling Packages Minimum Efficiency

Equipment Type	Size Category	Path A Efficiency [a,b]	Path B Efficiency [a,b]	Test Procedure
Air Cooled, With Condenser Electrically Operated	< 150 tons	≥ 10.1 EER ≥ 13.7 IPLV	≥ 9.7 EER ≥ 15.8 IPLV	AHRI 550/590
	≥ 150 tons	≥ 10.1 EER ≥ 14.0 IPLV	≥ 9.7 EER ≥ 16.1 IPLV	
Air Cooled, without condenser Electrically Operated	All Capacities	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements.		
Water Cooled, Electrically Operated, (Reciprocating)	All Capacities	Reciprocating units must comply with the water-cooled positive displacement efficiency requirements.		AHRI 550/590
Water Cooled, Electrically Operated Positive Displacement	< 75 tons	≤ 0.750 kW/ton ≤ 0.600 IPLV	≤ 0.780 kW/ton ≤ 0.500 IPLV	AHRI 550/590
	≥ 75 tons and < 150 tons	≤ 0.720-kW/ton ≤ 0.560 IPLV	≤ 0.750 kW/ton ≤ 0.490 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.660 kW/ton ≤ 0.540 IPLV	≤ 0.680 kW/ton ≤ 0.440 IPLV	
	≥ 300 tons and < 600 tons	≤ 0.610 kW/ton ≤ 0.520 IPLV	≤ 0.625 kW/ton ≤ 0.410 IPLV	
	> 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 tons	≤ 0.610 kW/ton ≤ 0.550 IPLV	≤ 0.695 kW/ton ≤ 0.440 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.610 kW/ton ≤ 0.550 IPLV	≤ 0.635 kW/ton ≤ 0.400 IPLV	
	≥ 300 tons and < 400 tons	≤ 0.560 kW/ton ≤ 0.520 IPLV	≤ 0.595 kW/ton ≤ 0.390 IPLV	
	≥ 400 tons and < 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	
	≥ 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	

(Cont.) Table 4-4: Water Chilling Packages Minimum Efficiency

Equipment Type	Size Category	Path A Efficiency [a,b]	Path B Efficiency [a,b]	Test Procedure[c]
Air Cooled Absorption, Single Effect	All Capacities	≥ 0.600 COP	NA[d]	ANSI/AHRI 560
Water Cooled Absorption, Single Effect	All Capacities	≥ 0.700 COP	NA[d]	
Absorption Double Effect, Indirect-Fired	All Capacities	≥ 1.000 COP ≥ 1.050 IPLV	NA[d]	
Absorption Double Effect, Direct-Fired	All Capacities	≥ 1.000 COP ≥ 1.000 IPLV	NA[d]	
Water Cooled Gas Engine Driven Chiller	All Capacities	≥ 1.2 COP ≥ 2.0 IPLV	NA[d]	ANSI Z21.40.4A

[a] No requirements for:

- Centrifugal chillers with design leaving evaporator temperature < 36^0F; or
- Positive displacement chillers with designed leaving fluid temperatures ≤ 32^0F; or
- Absorption chillers with design leaving fluid temperature < 40^0F

[b] Must meet the minimum requirements of Path A or Path B. However, both the full load (COP) and IPLV must be met to fulfill the requirements of the applicable Path.

[c] See §100.1 for definitions

[d] NA means not applicable

Energy Standards Table 110.2-D

Table 4-5: Packaged Terminal Air Conditioners and Heat Pumps

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Efficiency	Test Procedure[c]
PTAC (cooling mode) newly constructed or newly conditioned or additions	All Capacities	95^{0}F db Outdoor air	14.0-(0.300 x Cap/1000) [a] EER	ANSI/AHRI/CSA 310/380
PTAC (cooling mode) Replacements[b]	All Capacities	95^{0}F db Outdoor air	10.9-(0.213 x Cap/1000) [a] EER	
PTHP (cooling mode) Newly constructed or newly conditioned or additions	All Capacities	95^{0}F db Outdoor air	14.0-(0.300 x Cap/1000) [a] EER	
PTHP (Cooling mode) Replacements[b]	All Capacities	95^{0}F db Outdoor air	10.8-(0.213 x Cap/1000) [a] EER	
PTHP (Heating mode) Newly constructed or newly conditioned or additions	All Capacities		3.7-(0.052 x Cap/1000) [a] COP	
PTHP (Heating mode) Replacements[b]	All Capacities		2.9-(0.026 x Cap/1000) [a] COP	
SPVAC (Cooling mode)	< 65,000 Btu/h	95^{0}F db/75^{0}F wb Outdoor air	10.0 EER	ANSI/AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h	95^{0}F db/75^{0}F wb Outdoor air	10.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95^{0}F db/75^{0}F wb Outdoor air	10.0 EER	
SPVAC (Cooling Mode) nonweatherized space constrained	≤ 30,000 Btu/h	95^{0}F db/75^{0}F wb Outdoor air	9.20 EER	
	> 30,000 Btu/h and ≤36,000 Btu/h	95^{0}F db/75^{0}F wb Outdoor air	9.00 EER	
SPVHP (Cooling mode)	< 65,000 Btu/h	95^{0}F db/75^{0}F wb Outdoor air	10.0 EER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	95^{0}F db/75^{0}F wb Outdoor air	10.0EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95^{0}F db/75^{0}F wb Outdoor air	10.0 EER	
SPVHP (Cooling mode) nonweatherized space constrained	≤ 30,000 Btu/h	95^{0}F db/75^{0}F wb Outdoor air	9.20 EER	
	> 30,000 Btu/h and ≤36,000 Btu/h	95^{0}F db/75^{0}F wb Outdoor air	9.00 EER	
SPVHP (Heating mode)	< 65,000 Btu/h	47^{0}F db/43^{0}F wb Outdoor air	3.0 COP	
	≥ 65,000 Btu/h and < 135,000 Btu/h	47^{0}F db/43^{0}F wb Outdoor air	3.0 COP	
	≥ 135,000 Btu/h and < 240,000 Btu/h	47^{0}F db/43^{0}F wb Outdoor air	3.0 COP	

SPVHP (Heating mode)	≤ 30,000 Btu/h	47^0F db/43^0F wb Outdoor air	3.00 COP	
nonweatherized space constrained	> 30,000 Btu/h and ≤36,000 Btu/h	47^0F db/43^0F wb Outdoor air	3.00 COP	

[a] cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.
[b] Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEWLY CONSTRUCTED BUILDINGS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches high or less than 42 inch wide and having a cross-sectional area less than 670 square inches.
[c] Applicable test procedure and reference year are provided under the definitions

Energy Standards Table 110.2-E

Table 4-6: Heat Transfer Equipment

Equipment Type	Subcategory	Minimum Efficiency [a]	Test Procedure [b]
Liquid-to-liquid heat exchangers	Plate type	NR	ANSI/AHRI 400

[a] NR = no requirement
[b] Applicable test procedure and reference year are provided under the definitions

Energy Standards Table 110.2-F

Table 4-7: Performance Requirements for Heat Rejection Equipment

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Subcategory or Rating Condition	Performance Required, [a, b, c, d]	Test Procedure[e]
Propeller or axial fan open-circuit cooling towers	All	95^0F entering water 85^0F leaving water 75^0F entering air wb	≥ 42.1 gpm/hp	CTI ATC-105 and CTI STD-201
Centrifugal fan open-circuit cooling towers	All	95^0F entering water 85^0F leaving water 75^0F entering air wb	≥ 20.0 gpm/hp	
Propeller or axial fan closed-circuit cooling towers	All	102^0F entering water 90^0F leaving water 75^0F entering air wb	≥ 14.0 gpm/hp	
Centrifugal fan closed-circuit cooling towers	All	102^0F entering water 90^0F leaving water 75^0F entering air wb	≥ 7.0 gpm/hp	

(Cont.) Table 4-7: Performance Requirements for Heat Rejection Equipment

Propeller or axial fan evaporative condensers	All	R-507A test fluid 165^{0}F entering gas temp 105^{0}F condensing temp 75^{0}F entering air wb	≥ 157,000 Btu/h x hp	CTI ATC-106
	All	Ammonia test fluid 140^{0}F entering gas temp 96.3^{0}F condensing temp 75^{0}F entering air wb	≥ 134,000 Btu/h x hp	
Centrifugal fan evaporative condensers	All	R-507A test fluid 165^{0}F entering gas temp 105^{0}F condensing temp 75^{0}F entering air wb	≥ 135,000 Btu/h x hp	
	All	Ammonia test fluid 140^{0}F entering gas temp 96.3^{0}F condensing temp 75^{0}F entering air wb	≥ 110,000 Btu/h x hp	
Air cooled condensers	All	125^{0}F condensing temperature R22 test fluid 190^{0}F entering gas temperature 15^{0}F subcooling 95^{0}F entering db	≥ 176,000 Btu/h x hp	ANSI/AHRI 460

a Open-circuit cooling tower performance is defined as the water flow rating of the tower at the given rated conditions divided by the fan motor nameplate power.

b Closed-circuit cooling tower performance is defined as the process water flow rating of the tower at the given rated conditions divided by the sum of the fan motor nameplate rated power and the integral spray pump motor nameplate power.

c Air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan motor nameplate power.

d Open cooling towers shall be tested using the test procedures in CTI ATC-105. Performance of factory assembled open cooling towers shall be either certified as base models as specified in CTI STD-201 or verified by testing in the field by a CTI approved testing agency. Open factory assembled cooling towers with custom options added to a CTI certified base model for the purpose of safe maintenance or to reduce environmental or noise impact shall be rated at 90 percent of the CTI certified performance of the associated base model or at the manufacturer's stated performance, whichever is less. Base models of open factory assembled cooling towers are open cooling towers configured in exact accordance with the Data of Record submitted to CTI as specified by CTI STD-201. There are no certification requirements for field erected cooling towers.

e Applicable test procedure and reference year are provided under the definitions.

For refrigerated warehouses or commercial refrigeration applications, condensers shall comply with requirements specified by §120.6(a) or §120.6(b)

Energy Standards Table 110.2-G

Table 4-8: Electrically Operated Variable Refrigerant Flow Air Conditioners

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure[a]
Variable Refrigerant Flow (VRF) Air Conditioners, Air Cooled	< 65,000 Btu/h	All	VRF Multi-Split System	13.0 SEER	ANSI/AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	11.2 EER 13.1 IEER[b]	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	11.0 EER 12.9 IEER[b]	
	≥ 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-Split System	10.0 EER 11.6 IEER[b]	

a Applicable test procedure and reference year are provided under the definitions.
b IEERs are only applicable to equipment with capacity control as specified by ASNI/AHRI 1230 test procedures.

Energy Standards Table 110.2-H

Table 4-9: Electrically Operated VRF Air to Air and Applied Heat Pumps

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure[b]
VRF Air Cooled, (cooling mode)	< 65,000 Btu/h	All	VRF multi-split System[a]	13 SEER	AHRI 1230
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or none)	VRF multi-split System[a]	11.0 EER 12.9 IEER[c]	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or none)	VRF multi-split System[a]	10.6 EER 12.3 IEER[c]	
	≥ 240,000 Btu/h	Electric Resistance (or none)	VRF multi-split System[a]	9.5 EER 11.0 IEER[c]	
VRF Water source (cooling mode)	< 65,000 Btu/h	All	VRF multi-split System[a] 86^{0}F entering water	12.0 EER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	VRF multi-split System[a] 86^{0}F entering water	12.0 EER	
	≥ 135,000 Btu/h	All	VRF multi-split system[a] 86^{0}F entering water	10.0 EER	
VRF Groundwater source (cooling mode)	< 135,000 Btu/h	All	VRF multi-split system[a] 59^{0}F entering water	16.2 EER	

(Cont.) Table 4-9: Electrically Operated VRF Air to Air and Applied Heat Pumps

VRF Groundwater source (cooling mode)	≥ 135,000 Btu/h	All	VRF multi-split system[a] 59^{0}F entering water	13.8 EER	AHRI 1230
VRF Ground source (cooling mode)	< 135,000 Btu/h	All	VRF multi-split system[a] 77^{0}F entering water	13.4 EER	
	≥ 135,000 Btu/h	All	VRF multi-split system[a] 77^{0}F entering water	11.0 EER	
VRF Air cooled (heating mode)	< 65,000 Btu/h (cooling capacity)		VRF multi-split system	7.7 HSPF	
	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)		VRF multi-split system 47^{0}F db/ 43^{0}F wb outdoor air	3.3 COP	
			VRF multi-split system 17^{0}F db/ 15^{0}F wb outdoor air	2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)		VRF multi-split system 47^{0}F db/ 43^{0}F wb outdoor air	3.2 COP	
			VRF multi-split system 17^{0}F db/ 15^{0}F wb outdoor air	2.05 COP	
VRF Water source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF multi-split system 68^{0}F entering water	4.2 COP	
	≥ 135,000 Btu/h (cooling capacity)		VRF multi-split system 68^{0}F entering water	3.9 COP	
VRF Groundwater source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF multi-split system 50^{0}F entering water	3.6 COP	
	≥ 135,000 Btu/h (cooling capacity)		VRF multi-split system 50^{0}F entering water	3.3 COP	
VRF Ground source (heating mode)	< 135,000 Btu/h (cooling capacity)		VRF multi-split system 32^{0}F entering water	3.1 COP	
	≥ 135,000 Btu/h (cooling capacity)		VRF multi-split system 32^{0}F entering water	2.8 COP	

[a] Deduct 0.2 from the required EERs and IEERs for VRF multi-split system units with a heating recovery section.
[b] Applicable test procedure and reference year are provided under the definitions.
[c] IEERs are only applicable to equipment with capacity control as specified by ANSI/AHRI 1230 test procedures.

Energy Standards Table 110.2-I

Table 4-10: Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters

Equipment Type	Size Category (Input)	Subcategory or Rating Condition[b]	Minimum Efficiency	Test Procedure[a]
Warm-Air Furnace, Gas-Fired	< 225,000 Btu/h	Maximum Capacity[b]	78% AFUE or 80% E_t	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, ANSI Z21.47
	≥ 225,00 Btu/h	Maximum Capacity[b]	80% E_t	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-Air Furnace, Oil-Fired	< 225,000 Btu/h	Maximum Capacity[b]	78% AFUE or 80% E_t	DOE 10 CFR Part 430 or Section 42, Combustion, UL 727
	≥ 225,000 Btu/h	Maximum Capacity[b]	81% E_t	Section 42, Combustion, UL 727
Warm-Air Duct Furnaces, Gas-Fired	All Capacities	Maximum Capacity[b]	80% E_c	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heaters, Gas-Fired	All Capacities	Maximum Capacity[b]	80% E_c	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heaters, Oil-Fired	All Capacities	Maximum Capacity[b]	81% E_c	Section 40, Combustion, UL 731

[a] Applicable test procedure and reference year are provided under the definitions.
[b] Compliance of multiple firing rate units shall be at maximum firing rate.
E_t = thermal efficiency, units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.
E_c = combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.
Combustion units not covered by NAECA (3-phase power or cooling capacity greater than or equal to 19 kW) may comply with either rating.

Energy Standards Table 110.2-J

Table 4-11: Gas and Oil Fired Boilers

Equipment Type	Sub Category	Size Category (Input)	Minimum Efficiency[b,c]		Test Procedure[a]
			Before 3/2/2020	**After 3/2/2020**	
Boiler, hot water	Gas Fired	< 300,000 Btu/h	82% AFUE	82% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	80% E_t	80% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	82% E_c	82% E_c	
	Oil Fired	< 300,000 Btu/h	84% AFUE	84% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	82% E_t	82% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	84% E_c	84% E_c	
Boiler, steam	Gas Fired	< 300,000 Btu/h	80% AFUE	80% AFUE	DOE 10 CFR Part 430
	Gas Fired – all, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	79% E_t	79% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	79% E_t	79% E_t	DOE 10 CFR Part 431
	Gas Fired, natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	77% E_t	79% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	77% E_t	79% E_t	DOE 10 CFR Part 431
	Oil-Fired	< 300,000 Btu/h	82% AFUE	82% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	81% E_t	81% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	81% E_t	81% E_t	DOE 10 CFR Part 431

[a] Applicable test procedure and reference year are provided under the definitions.
[b] E_c = combustion efficiency (100% less flue losses). See reference document for detail information
[c] E_t = thermal efficiency. See test procedure for detailed information.
[d] Maximum capacity – minimum and maximum ratings as provided for and allowed by the unit's controls.
[e] Included oil-fired (residual).

Energy Standards Table 110.2-K

In the above tables, where more than one efficiency standard or test method is listed, the requirements of both shall apply. For example, unitary air-cooled air conditioners have an EER requirement for full-load operation and an IEER for part-load operation. The air conditioner must have both a rated EER and IEER equal to or higher than that specified in the Energy Standards at the specified Air-Conditioning, Heating, and Refrigeration Institute (AHRI) standard rating conditions. Similarly, where equipment serves more than one function, it must comply with the efficiency standards applicable to each function.

When a requirement is for equipment rated at its "maximum rated capacity" or "minimum rated capacity," the capacity shall be as provided for and allowed by the controls during steady state operation. For example, a boiler with high/low firing must meet the efficiency requirements when operating at both its maximum capacity and minimum capacity.

Exceptions exist to the listed minimum efficiency for specific equipment. The first exception applies to water-cooled centrifugal water-chilling packages, which are not designed for operation at ANSI/AHRI Standard 550/590 test conditions, which are:

1. 44°F leaving chilled water temperature.
2. 85°F entering condenser water temperature.
3. 3 gallons per minute per ton condenser water flow.

Packages not designed to operate at these conditions must have maximum adjusted Full Load and NPLV ratings. These ratings can be calculated, in kW/ton, using Equation 4-1 and Equation 4-2.

Equation 4-1

$$Full\ Load\ Rating_{max,\ adj} = \frac{(Full\ Load\ Rating)}{K_{adj}}$$

Equation 4-2

$$NPLV\ Rating_{max,\ adj} = \frac{(IPLV\ Rating)}{K_{adj}}$$

The values for the Full Load and IPLV Ratings are found in Table 4-4. K_{adj} is the product of A and B, as in Equation 4-3. A is calculated by entering the value for $LIFT$ determined using Equation 4-5 into the fourth level polynomial in Equation 4-4. B is found using Equation 4-6.

Equation 4-3

$$K_{adj} = A \times B$$

Equation 4-4

$$A = (1.4592 \times 10^{-7})(LIFT^4) - (3.46496 \times 10^{-5})(LIFT^3) + (3.14196 \times 10^{-3})(LIFT^2) - (0.147199)(LIFT) + 3.9302$$

Equation 4-5

$$LIFT = LvgCond - LvgEvap$$

Where:

LvgCond = Full-load leaving condenser fluid temperature (°F)

LvgEvap = Full-load leaving evaporator fluid temperature (°F)

Equation 4-6

$$B = (0.0015)(LvgEvap) + 0.934$$

Where:

LvgEvap = Full-load leaving evaporator fluid temperature (°F)

The adjusted maximum adjusted Full Load and NPLV rating values are only applicable for centrifugal chillers meeting all of the following full-load design ranges:

1. Minimum Leaving Evaporator Fluid Temperature: 36°F
2. Maximum Leaving Condenser Fluid Temperature: 115°F
3. LIFT ≥ 20°F and ≤ 80°F

Centrifugal chillers designed to operate outside of these ranges are not covered by this exception and therefore have no minimum efficiency requirements.

Exception 2 is for positive displacement (air- and water-cooled) chillers, with a leaving evaporator fluid temperature higher than 32°F, which shall show compliance with Table 4-4 when tested or certified with water at standard rating conditions, per the referenced test procedure.

Exception 3 is for equipment primarily serving refrigerated warehouses or commercial refrigeration systems. These systems must comply with the efficiency requirements of Energy Standards §120.6(a) or (b). For more information see Chapter 10.

4.2.3 Equipment Not Covered by the Appliance Efficiency Regulations

§110.2 and §110.3.

To comply, equipment specified in the plans and specifications must meet the minimum standards mandated in that section. Manufacturers of equipment not regulated by the Appliance Efficiency Regulations are not required to certify their equipment to the Energy Commission; it is the responsibility of the designer and contractor to specify and install equipment that complies.

To verify certification, use one of the following options:

1. The Energy Commission's website includes listings of energy efficient appliances for several appliance types. The website address is http://www.energy.ca.gov/appliances/. The Energy Commission's Hotline staff can provide further assistance, at 1-800-772-3300 or (916) 654-5106, if appliance information is not found on the website.
2. The complete appliance database can be downloaded. This requires spreadsheet programs compatible with Microsoft Excel. To use the data, a user must download the database file (or files), download a brand file and a manufacturer file, and then decompress the files. Next, the user will need to download a description file that provides details on what is contained in each of the data fields. With these files, and using database software, the data can be sorted and manipulated.
3. The Air Conditioning, Heating and Refrigeration Institute (AHRI) Directory of Certified Products can be used to verify certification of air-conditioning equipment. This information is available on their website at www.ahrinet.org.

4.2.4 Controls for Heat Pumps with Supplementary Electric Resistance Heaters

§110.2(b)

The Energy Standards discourage use of electric resistance heating when an alternative method of heating is available. In the case of a heat pump, these systems may contain electric resistance heat strips which act as a supplemental heating source. If this system is used, then controls must be put in place that prevents use of the electric resistance supplementary heating when the heating load can be satisfied with the heat pump alone.

This includes the requirement that the thermostat must be able to provide step up controls that will incrementally adjust the indoor temperature setting so that the heat pump can gradually raise the temperature until the final desired indoor temperature is reached. Also, the controls must set a “cut-on” temperature for compressor heating which is higher than the “cut-on” temperature for electric resistance heating, and the “cut-off temperature for compression heating is higher than the “cut-off” temperature for electric resistance heating.

Exceptions exist for this requirement:

1. If the electric resistance heating is for defrost, and during transient periods such as start-ups and following room thermostat set points (or another control mechanism designed to preclude the unnecessary operation).
2. If the heat pump is a room air-conditioner heat pump.

4.2.5 Thermostats

§110.2(c) and §120.2(b)4

When a central energy management control system (EMCS) is not included in the design of the HVAC system, then a thermostat with setback capabilities must be installed. The requirement is for all unitary heating or cooling systems to have a thermostat that is capable of at least 4 set points in a 24 hour period. In the case of a heat pump, the control requirements of Section 4.2.4 must also be met. In addition, per §120.2(b)4, the thermostats on all unitary single zone, air conditioners, heat pumps must comply with the requirements of Reference Joint Appendix JA5, also known as the Occupant Controlled Smart Thermostats, which are capable of receiving demand response signals in the event of grid congestion and shortages during high electrical demand periods.

There are two exceptions to §120.2(b)4 Occupant Controlled Smart Thermostats:

1. Systems serving zones that must have constant temperatures to protect a process or product (e.g. a laser laboratory or a museum).
2. The following HVAC systems do not need to comply with the setback or Occupant Controlled Smart Thermostat requirement:
   a. Gravity gas wall heaters
   b. Gravity floor heaters
   c. Gravity room heaters
   d. Non-central electric heaters
   e. Fireplaces or decorative gas appliance
   f. Wood stoves
   g. Room air conditioners
   h. Room heat pumps
   i. Packaged terminal air conditioners
   j. Packaged terminal heat pumps

4.2.6 Furnace Standby Loss Controls

§110.2(d)

Forced air gas- and oil-fired furnaces with input ratings ≥ 225,000 Btu/h are required to have controls and designs that limit their standby losses:

1. They must have either an intermittent ignition or interrupted device (IID). Standing pilot lights are not allowed.
2. They must have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for furnaces where combustion air is drawn from the conditioned space.

Any furnace with an input rating ≥225,000 Btu/h that is not located within the conditioned space must have jacket losses not exceeding 0.75 percent of the input rating. This includes electric furnaces as well as fuel-fired units.

4.2.7 Open and Closed Circuit Cooling Towers

§110.2 (e)

All open and closed circuit cooling towers with rated capacity of 150 tons or greater must have a control system that maximizes the cycles of concentration based on the water quality conditions based on either conductivity or flow. If the controls system is conductivity based, then the system must automate bleed and chemical feed based on conductivity. The installation criteria for the conductivity controllers must be in accordance with the manufacturer's specifications in order to maximize accuracy. If the control system is flow based, then the system must be automated in proportion to metered makeup volume, metered bleed volume, recirculating pump run time or bleed time.

The makeup water line must be equipped with an analog flow meter that is either wired or wireless and an overflow alarm to prevent overflow of the sump in the event of water valve failure. The alarm system may send an audible signal or an alert through an EMCS.

Drift eliminators are of a louvered or comb like design that is installed at the top of the cooling tower to capture water particles that become entrained in the air stream. These drift eliminators are now required to achieve drift reduction to 0.002 percent of the circulated water volume for counter-flow towers and 0.005 percent for cross-flow towers.

Additionally, maximum achievable cycles of concentration must be documented based on local water supply (which is reported annually by the local utility) and Langelier Saturation Index (LSI) of 2.5 or less. A calculator that is approved by the Energy Commission must be used in this process and the compliance document must be reviewed and approved by the Professional Engineer (P.E.) of record. The Energy Commission's website includes an approved LSI calculator in the form of an excel file. The website address is http://www.energy.ca.gov/title24/2013standards/documents/maximum_cycles_calculator.xls

4.2.8 Pilot Lights

§110.5

Pilot lights are prohibited in:

1. Fan type central furnaces. This includes all space-conditioning equipment that distributes gas-heated air through duct work §110.5(a). This prohibition does not apply to radiant heaters, unit heaters, boilers or other equipment that does not use a fan to distribute heated air.

2. Household cooking appliances unless the appliance does not have an electrical connection, and the pilot consumes less than 150 Btu/h §110.5(b).
3. Pool and spa heaters §110.5(c) and §110.5(d) respectively.

Example 4-1

Question

If a 15 ton (180kBtuh) air-cooled packaged AC unit with a gas furnace rated at 260,000 Btu/h maximum heating capacity has an EER of 10.9, an IEER of 11.2, and a heating thermal efficiency of 78 percent, does it comply?

Answer

No. The cooling side complies because both the EER and IEER exceed the requirements of Table 4-1(11.0-0.2=10.8 EER and 11.2-0.2=11.0 IEER for a 15 ton unit). The EER and IEER in this table are for units with electric heat. Footnote b reduces the required EER and IEER by 0.2 for units with heating sections other than electric resistance heat. With gas heat, an EER of 10.9 (>10.8) and an IEER of 11.2 (>11.0), this unit complies. Note that the 0.2 deduction provided in Table 4-1and Table 4-2compensate for the higher fan power required to move air over the heat exchangers for fuel-fired heaters.

From Table 4-10, the heating efficiency must be at least 80 percent thermal efficiency. This unit has a 78percent thermal efficiency (<80%); therefore the unit does not comply.

Example 4-2

Question

A 500,000 Btu/h gas-fired boiler with high/low firing has a full load combustion efficiency of 82 percent, 78 percent thermal efficiency and a low-fire combustion efficiency of 80 percent. Does the unit comply?

Answer

No. Per Table 4-11, the thermal efficiency must be greater than 80 percent. This boiler's thermal efficiency is 78percent (<80%) so it doesn't comply.

Example 4-3

Question

A 300 ton centrifugal chiller is designed to operate at 44°F chilled water supply, 90°F condenser water return and 3 gpm/ton condenser water flow. What is the maximum allowable full load kW/ton and NPLV?

Answer

As the chiller is centrifugal and is designed to operate at a condition different from AHRI Standard 550/590 standard rating conditions, the appropriate efficiencies can be calculated using the Kadj equations.

From Table 4-4 (Equipment Type: Water Cooled, Electrically Operated, Centrifugal; Size Category: ≥ 300 tons and < 600 tons), this chiller at AHRI rating conditions has a maximum full load efficiency of 0.576 kW/ton and a maximum IPLV of 0.549 kW/ton for Path A and a maximum full load efficiency of 0.600 kW/ton and a maximum IPLV of 0.400 kW/ton for Path B.

The Kadj is calculated as follows:

LIFT = LvgCond – LvgEvap = 90F-44F = 46F

$A = (0.00000014592 \times (46)^4) – (0.0000346496 \times (46)^3)+ (0.00314196 \times (46)^2) – (0.147199 \times *(46)) + 3.9302=1.08813$

$B = (0.0015 \times 44) + 0.934 = 1.000$

$Kadj=A \times B=1.08813$

For compliance with Path A, the maximum Full load kW/ton = 0.576 / 1.08813 = 0.529 kW/ton and the maximum NPLV= 0.549 / 1.08813 = 0.505 kW/ton

For compliance with Path B the maximum Full load kW/ton = 0.600 / 1.08813 = 0.551 kW/ton and the maximum NPLV= 0.400 / 1.08813 = 0.388 kW/ton

To meet the mandatory measures of 4.2.2 (Energy Standards §110.2) the chiller can comply with either the Path A or Path B requirement (footnote b in Table 4-4). To meet the prescriptive requirement of 4.6.2.8 (Energy Standards §140.4(i)) the chiller would have to meet or exceed the Path B requirement.

Example 4-4

Question

A 300 ton water cooled chiller with a screw compressor that serves a thermal energy storage system is designed to operate at 34°F chilled water supply, 82°F condenser water supply and 94°F condenser water return, does it have a minimum efficiency requirement and if so, what is the maximum full load kW/ton and NPLV?

Answer

As the chiller is positive displacement (screw and scroll compressors are positive displacement) and is designed to operate at a chilled water temperature above 32°F it does have a minimum efficiency requirement per 4.2.2 (Exception 2 to §110.2(a)). From Table 4-4(Equipment Type: Water Cooled, Electrically Operated, Positive Displacement; Size Category: ≥ 300 tons) this chiller at AHRI rating conditions has a maximum full load efficiency of 0.620 kW/ton and a maximum IPLV of 0.540 kW/ton for Path A and a maximum full load efficiency of 0.639 kW/ton and a maximum IPLV of 0.490 kW/ton for Path B.

The Kadj is calculated as follows:

LIFT = LvgCond – LvgEvap = 94F-34F = 60F
A = (0.00000014592 x (60)4) – (0.0000346496 x (60)3)+ (0.00314196 x (60)2) – (0.147199 x *(60)) + 3.9302=0.81613
B = (0.0015 x 34) + 0.934 = 0.98500
Kadj=A x B=0.80388

For compliance with Path A, the maximum Full load kW/ton = 0.620 / 0.80388 = 0.771 kW/ton and the maximum NPLV= 0.540 / 0.80388 = 0.672 kW/ton. For compliance with Path B the maximum Full load kW/ton = 0.639 / 0.80388 = 0.795 kW/ton and the maximum NPLV= 0.490 / 0.80388 = 0.610 kW/ton. To meet the mandatory measures of 4.2.2 (Energy Standards §110.2) the chiller can comply with either the Path A or Path B requirement (footnote b in Table 4-4). To meet the prescriptive requirement of 4.6.2.8 (Energy Standards §140.4(i)) the chiller would have to meet or exceed the Path B requirement.

Example 4-5

Question

Are all cooling towers required to be certified by CTI?

Answer

No. Per footnote d in Table 4-7, field-erected cooling towers are not required to be certified. Factory-assembled towers must either be CTI-certified or have their performance verified in a field test (using ATC 105) by a CTI-approved testing agency. Furthermore only base models need to be tested; options in the air-stream, like access platforms or sound traps, will derate the tower capacity by 90 percent of the capacity of the base model or the manufacturer’s stated performance, whichever is less.

Example 4-6

Question

Are there any mandatory requirements for a water-to-water plate-and-frame heat exchanger?

Answer

Yes, Table 4-6 requires that it be rated per ANSI/AHRI 400. This standard ensures the accuracy of the ratings provided by the manufacturer.

4.2.9 Commercial Boilers

§120.9

A commercial boiler is a type of boiler with a capacity (rated maximum input) of 300,000 Btu per hour (Btu/h) or more and serving a space heating or water heating load in a commercial building.

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

1. 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 non-positive vent static pressure. This is sometimes referred to as natural draft or atmospheric boilers. Forced draft boilers, which rely on a fan to provide the appropriate amount of air into the combustion chamber, are exempt from this requirement.
2. 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). This requirement applies to natural draft and forced draft boilers.

Combustion air positive shut-off is a means of restricting air flow through a boiler combustion chamber during standby periods, used to reduce standby heat loss. A flue damper and a vent damper are two examples of combustion air positive shut-off devices.

Installed dampers can be interlocked with the gas valve so that the damper closes and inhibits air flow through the heat transfer surfaces when the burner has cycled off, thus reducing standby losses. Natural draft boilers receive the most benefit from draft dampers because they have less resistance to airflow than forced draft boilers. Forced draft boilers rely on the driving force of the fan to push the combustion gases through an air path that has relatively higher resistance to flow than in a natural draft boiler. Positive shut-off on a forced draft boiler is most important on systems with a tall stack height or multiple boiler systems sharing a common stack.

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

1. The fan motor shall be driven by a variable speed drive, or
2. 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.

Electricity savings result from run time at part-load conditions. As the boiler firing rate decreases, the combustion air fan speed can be decreased.

C. Newly installed boilers with an input capacity of 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 measured flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

Boilers with steady state full-load thermal efficiency 85 percent or higher are exempt from this requirement.

One way to meet this requirement is with parallel position control. Boilers mix air with fuel (usually natural gas although sometimes diesel or oil) to supply oxygen during combustion. Stoichiometric combustion is the ideal air/fuel ratio where the mixing proportion is correct, the fuel is completely burned, and the oxygen is entirely consumed. Boilers operate most efficiently when the combustion air flow rate is slightly higher than the stoichiometric air-fuel ratio. However, common practice almost always relies on excess air to ensure complete combustion, avoid unburned fuel and potential explosion, and prevent soot and smoke in the exhaust. Excess air has a penalty, which is increased stack heat loss and reduced combustion efficiency.

Parallel positioning controls optimize the combustion excess air to improve the combustion efficiency of the boiler. It includes individual servo motors allowing the fuel supply valve and the combustion air damper to operate independently of each other. This system relies on preset fuel mapping (i.e., a pre-programmed combustion curve) to establish proper air damper positions (as a function of the fuel valve position) throughout the full range of burner fire rate. Developing the combustion curve is a manual process, performed in the field with a flue-gas analyzer in the exhaust stack, determining the air damper positions as a function of the firing rate/fuel valve position. Depending on type of burner, a more consistent level of excess oxygen can be achieved with parallel position compared to single-point positioning control, since the combustion curve is developed at multiple points (firing rates), typically 10 to 25 points. Parallel positioning controls allow excess air to remain relatively low throughout a burner's firing range. Maintaining low excess air levels at all firing rates provides significant fuel and cost savings while still maintaining a safe margin of excess air to insure complete combustion.

4.3 Ventilation Requirements

§120.1

All of the ventilation requirements are mandatory measures. Some measures require acceptance testing, which is addressed in Section 4.3.11.

Within a building, all enclosed spaces that are normally used by humans must be continuously ventilated during occupied hours with outdoor air, using either natural or mechanical ventilation An exception is provided for refrigerated warehouses or other buildings or spaces that are not normally used for human occupancy or work.

The Energy Standards allow for ventilation to use transfer air as long as it doesn't have any "unusual sources of indoor air contaminants" and "the outdoor air that is supplied to all spaces combined, is sufficient to meet the requirements for each space individually. Good practice dictates that sources of contaminants be isolated and controlled with local exhaust. The designation and treatment of such spaces is subject to the designer's discretion. Spaces needing special consideration include:

- Commercial and coin-operated dry cleaners.
- Bars and cocktail lounges.
- Smoking lounges and other designated smoking areas.
- Beauty and barbershops.

- Auto repair workshops.
- Print shops, graphic arts studios and other spaces where solvents are used in a process.
- Copy rooms, laser printer rooms or other rooms where it is expected that equipment may generate heavy concentrations of ozone or other contaminants.
- Blueprint machines.

"Spaces normally used by humans" refers to spaces where people can be reasonably expected to remain for an extended period of time. Spaces where occupancy will be brief and intermittent, and that do not have any unusual sources of air contaminants, do not need to be directly ventilated. For example:

- A closet does not need to be ventilated, provided it is not normally occupied.
- A storeroom that is only infrequently or briefly occupied does not require ventilation. However, a storeroom that can be expected to be occupied for extended periods for clean-up or inventory must be ventilated, preferably with systems controlled by a local switch so that the ventilation system operates only when the space is occupied.

"Continuously ventilated during occupied hours" implies that the design ventilation must be provided throughout the entire occupied period. This means that VAV systems must provide the code-required ventilation over their full range of operating supply airflow. Some means of dynamically controlling the minimum ventilation air must be provided.

4.3.1 Natural Ventilation

§120.1(b)1

Natural outdoor ventilation may be provided for spaces where all normally occupied areas of the space are within a specific distance from an operable wall or roof opening through which outdoor air can flow. This distance is 20 ft. for most spaces and 25 ft. for hotel/motel guestrooms and high-rise residential spaces. The sum of the operable open areas must total at least 5 percent of the floor area of each space that is naturally ventilated. The openings must also be readily accessible to the occupants of the space at all times.

Airflow through the openings must come directly from the outdoors; air may not flow through any intermediate spaces such as other occupied spaces, unconditioned spaces, corridors, or atriums. Also, high windows, operable skylights, and other operable openings need to have a control mechanism accessible from the floor.

Example 4-7

Question

What is the window area required to ventilate a 30 ft. x 32 ft. classroom?

Answer

In order for all points to be within 20 ft. of an opening, windows must be distributed and run at least along two of the opposite walls. The area of the openings must be:

(32 ft. x 30 ft.) x 5 percent = 48 ft²

The actual window area must be at least 96 ft² if only half the window can be open at a time.

Calculations must be based on free area, taking into account framing and bug screens; the actual window area is approximately 100 ft² without bug screens and 110 ft² with bug screens.

Example 4-8

Question

Naturally ventilated classrooms are located on either side of a doubly-loaded corridor and transoms are provided between the classrooms and corridor. Can the corridor be naturally ventilated through the classrooms?

Answer

No. The corridor cannot be naturally ventilated through the classrooms and transom openings. The Energy Standards require that naturally ventilated spaces have direct access to properly-sized openings to the outdoors. The corridor would require mechanical ventilation using either supply or exhaust fans.

4.3.2 Mechanical Ventilation

§120.1(b)2 and (d)

Mechanical outdoor ventilation must be provided for all spaces normally occupied that are not naturally ventilated. The Energy Standards require that a space conditioning system provide outdoor air equal to or exceeding the ventilation rates required for each of the spaces that it serves. At the space, the required ventilation can be provided either directly through supply air or indirectly through transfer of air from the plenum or an adjacent space. The required minimum ventilation airflow at the space can be provided by an equal quantity of supply or transfer air. At the air-handling unit, the minimum outside air must be the sum of the ventilation requirements of each of the spaces that it serves. The designer may specify higher outside air ventilation rates based on the owner’s preference or specific ventilation needs associated with the space. However, specifying more ventilation air than the minimum allowable ventilation rates increases energy consumption and electrical peak demand and increases the costs of operating the HVAC equipment. Thus the designer should have a compelling reason to specify higher design minimum outside air rates than the calculated minimum outside air requirements in the Energy Standards.

The minimum OSA provided is required to be within 10 percent of the calculated minimum for both VAV and constant volume units.

In summary:

1. Ventilation compliance at the space is satisfied by providing supply and/or transfer air.
2. Ventilation compliance at the unit is satisfied by providing, at minimum, the outdoor air that represents the sum of the ventilation requirements at each space that it serves.

For each space requiring mechanical ventilation the ventilation rates must be the greater of either:

1. The conditioned floor area of the space, multiplied by the applicable minimum ventilation rate from Table 4-12. This provides dilution for the building-borne contaminants like off-gassing of paints and carpets, or
2. 15 cfm per person, multiplied by the expected number of occupants. For spaces with fixed seating (such as a theater or auditorium), the expected number of occupants is the number of fixed seats. For spaces without fixed seating, the expected number of occupants is assumed to be no less than one-half that determined for egress purposes in the California Building Code (CBC). The Energy Standards specify the minimum outdoor ventilation rate to which the system must be designed. If desired, the designer may, with documentation, elect to provide more ventilation air. For example, the design outdoor ventilation rate may be determined using the procedures described in

ASHRAE 62, provided the resulting outdoor air quantities are no less than required by the Energy Standards.

Table 4-12: Minimum Ventilation Rates

Type of Use	CFM per ft² of Conditioned Floor Area
Auto repair workshop	1.50
Barber shop	0.40
Bars, cocktail lounges, and casinos	0.20
Beauty shop	0.40
Coin-operated dry cleaning	0.30
Commercial dry cleaning	0.45
High-rise residential	Ventilation Rates Specified by the CBC and CMC
Hotel guest room (less than 500 ft²)	30 cfm/guest room
Hotel guest room (500 ft² or greater)	0.15
Retail store	0.20
All Others	0.15

Energy Standards Table 120.1-A

Table 4-13 shows the typical maximum occupant loads for various building uses (upon which minimum ventilation calculations are based). This provides dilution for the occupant-borne contaminants (or bioeffluents) like body odor and germs.

Table 4-14 summarizes the combination of these two rates for typical spaces.

As previously stated, each space-conditioning system must provide outdoor ventilation air as follows.

1. For a space-conditioning system serving a single space, the required system outdoor airflow is equal to the design outdoor ventilation rate of the space.
2. For a space-conditioning system serving multiple spaces, the required outdoor air quantity delivered by the space-conditioning system must not be less than the sum of the required outdoor ventilation rate to each space. The Energy Standards do not require that each space actually receive its calculated outdoor air quantity. Instead, the actual supply to any given space may be any combination of recirculated air, outdoor air, or air transferred directly from other spaces, provided:
    a. The total amount of outdoor air delivered by the space-conditioning system(s) to all spaces is at least as large as the sum of the space design quantities.
    b. Each space always receives supply airflow, including recirculated air and/or transfer air, no less than the calculated outdoor ventilation rate.
    c. When using transfer air, none of the spaces from which air is transferred has any unusual sources of contaminants.

Table 4-13: CBC Maximum Floor Area Allowances Per Occupant

Function of Space	Occupant Load Factor
Accessory storage areas, mechanical equipment room	300 gross
Agricultural building	300 gross
Aircraft hangers	500 gross
Airport terminal	
Baggage claim	20 gross
Baggage handling	300 gross
Concourse	100 gross
Waiting areas	15 gross
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Exhibit Gallery and Museum	30 net
Assembly with fixed seats	See Section 1004.4
Assembly without fixed seats	
Concentrated (chairs only – not fixed)	7 net
Standing space	5 net
Non-concentrated (tables and chairs)	15 net
Bowling centers and all other spaces	7 net
Bowling lanes (including 15 feet of approach)	5 person per lane
Business areas	100 gross
Courtrooms – other than fixed seating areas	40 net
Day care	35 net
Dormitories	50 gross
Educational	
Classroom area	20 net
Shops and other vocational room areas	50 net
Exercise rooms	50 gross
H-5 Fabrication and manufacturing areas	200 gross
Industrial areas	100 gross
Institutional areas	
Inpatient treatment areas	240 gross
Outpatient areas	100 gross
Sleeping areas	120 gross
Kitchens, commercial	200 gross
Library	
Reading rooms	50 net
Stack area	100 gross
Locker Rooms	50 gross
Mercantile	
Area on other floors	60 gross
Basement and grade floor areas	30 gross
Storage, stock, shipping areas	300 gross
Parking garages	200 gross
Residential	200 gross
Skating rinks, swimming pools	
Rink and pool	50 gross
Decks	15 gross
Stages and platforms	15 net
Warehouses	500 gross

Source: Table 1004.1.2 of the California Building Code

Where:

Floor Area, Gross - The floor area within the inside perimeter of the exterior walls of the building under consideration, exclusive of vent shafts and courts, without deduction for corridors, stairways, closets, the thickness of interior walls, columns or other features. The floor area of a building, or portion thereof, not provided with surrounding exterior walls shall be the usable area under the horizontal projection of the roof or floor above. The gross floor area shall not include shafts with no openings or interior courts.

Floor Area, Net - The actual occupied area not including unoccupied accessory areas such as corridors, stairways, toilet rooms, mechanical rooms and closets.

Table 4-14: Required Minimum Ventilation Rate per Occupancy

	Occupancy	Use	CBC Occupancy Load (ft^2/occ)	CBC Occupancy Load (occ/1000 ft^2)[A]	CBC Based Ventilation (cfm/ft^2)[B]	Ventilation from Table 120.1-A (cfm/ft^2)	Required Ventilation (larger of CBC or Table 120.1-A) (cfm/ft^2)
1)	Aircraft Hangars		500	2	0.02	0.15	0.15
2)	Auction Rooms		See Section 1004.4			0.15	n.a.
3)	Assembly Areas (Concentrated Use)						
		Auditoriums	See Section 1004.4			0.15	n.a.
		Bowling Lane	5 persons per lane			0.15	n.a.
		Bowling Center[5] (all other spaces)	7	142.86	1.07	0.15	1.07
		Churches & Chapels (Religious Worship)	7	142.86	1.07	0.15	1.07
		Dance Floors	5	200	1.50	0.15	1.50
		Lobbies	15	66.67	0.50	0.15	0.50
		Lodge Rooms	7	142.86	1.07	0.15	1.07
		Reviewing Stands	15	66.67	0.50	0.15	0.50
		Stadiums	See Section 1004.4			0.15	n.a.
		Theaters - All	See Section 1004.4			0.15	n.a.
		Waiting Areas	15	66.67	0.50	0.15	0.50
4)	Assembly Areas (Non-concentrated Use)						
		Conference & Meeting Rooms[1]	15	66.67	0.50	0.15	0.50
		Dining Rooms/Areas	15	66.67	0.50	0.15	0.50
		Drinking Establishments[2]	15	66.67	0.50	0.20	0.50
		Exhibit/Display Areas	15	66.67	0.50	0.15	0.50
		Gymnasiums/Sports Arenas	15	66.67	0.50	0.15	0.50
		Lounges	15	66.67	0.50	0.20	0.50
		Stages and Platform	15	66.67	0.50	0.15	0.50
		Gaming, Keno, Slot Machine and Live Games Areas	11	90.91	0.68	0.20	0.68
5)	Auto Repair Workshops		100	10	0.08	1.50	1.50
6)	Barber & Beauty Shops		100	10	0.08	0.40	0.40
7)	Children's Homes & Homes for Aged		120	8.33	0.06	0.15	0.15
8)	Classrooms		20	50	0.38	0.15	0.38
9)	Courtrooms		40	25	0.19	0.15	0.19
10)	Dormitories		50	20	0.15	0.15	0.15
11)	Dry Cleaning (Coin-Operated)		100	10	0.08	0.30	0.30
12)	Dry Cleaning (Commercial)		100	10	0.08	0.45	0.45
13)	Exercise Rooms		50	20	0.15	0.15	0.15
14)	Garage, Parking		200	5	0.04	0.15	0.15
15)	Healthcare Facilities:	Sleeping Rooms	120	8.33	0.06	0.15	0.15
		Treatment Rooms	240	4.17	0.03	0.15	0.15

(Cont) Table 4-14: Required Minimum Ventilation Rate per Occupancy

	Occupancy	Use	CBC Occupancy Load (ft^2/occ)	CBC Occupancy Load (occ/1000 ft^2)[A]	CBC Based Ventilation (cfm/ft^2)[B]	Ventilation from Table 120.1-A (cfm/ft^2)	Required Ventilation (larger of CBC or Table 120.1-A) (cfm/ft^2)
16)	Hotels and Apartments						
		Hotel Function Area	7	142.86	1.07	0.15	1.07
		Hotel Lobby	100	10	0.08	0.15	0.15
		Hotel Guest Room (<500 ft^2)[3]	200	5	0.04	n.a.[3]	n.a.[3]
		Hotel Guest Room (≥500 ft^2)	200	5	0.04	0.15	0.15
		High-rise Residential[4]	200	5	0.04	n.a.[4]	n.a.[4]
17)	Kitchen (Commercial)		200	5	0.04	0.15	0.15
18)	Library:	Reading Rooms	50	20	0.15	0.15	0.15
		Stack Areas	100	10	0.08	0.15	0.15
19)	Locker Rooms		50	20	0.15	0.15	0.15
20)	Manufacturing		200	5	0.04	0.15	0.15
21)	Mechanical Equipment Room		300	3.33	0.03	0.15	0.15
22)	Nurseries for Children - Day Care		35	28.57	0.21	0.15	0.21
23)	Offices:	Office	100	10	0.08	0.15	0.15
		Bank/Financial Institution	100	10	0.08	0.15	0.15
		Medical & Clinical Care	100	10	0.08	0.15	0.15
24)	Retail:	Sales, Wholesale Showrooms	30	33.33	0.25	0.20	0.25
		Basement and Ground Floor	30	33.33	0.25	0.20	0.25
		Upper Floors	60	16.67	0.13	0.20	0.20
		Grocery	30	33.33	0.25	0.20	0.25
		Malls, Arcades, & Atria	30	33.33	0.25	0.20	0.25
25)	School Shops & Vocational Rooms		50	20	0.15	0.15	0.15
26)	Skating Rinks:	Skate Area	50	20	0.15	0.15	0.15
		On Deck	15	66.67	0.50	0.15	0.50
27)	Swimming Pools:	Pool Area	50	20	0.15	0.15	0.15
		On Deck	15	66.67	0.50	0.15	0.50
28)	Transportation Function Area		30	33.33	0.25	0.15	0.25
29)	Warehouses, Industrial & Commercial Storage/Stockrooms		500	2	0.02	0.15	0.15
30)	All Others -- Including Unknown, Corridors, Restrooms, & Support Areas Commercial & Industrial Work		100	10	0.08	0.15	0.15

Footnotes:

1. Includes Convention & Civic Meeting Areas.
2. Bars, Cocktail & Smoking Lounges, Casinos.
3. Guestrooms less than 500 ft^2 use 30 cfm/guestroom.
4. High-rise Residential - for habitable areas not ventilated with Natural Ventilation, cfm=(0.06 cfm/ft^2 + 5 cfm/occ). Default occupancy for dwelling units shall be two persons for studio and one-bedroom units, with one additional person for each additional bedroom.
5. Bowling centers, allow 5 persons for each lane including 15 feet of approach.

Equations:

A. CBC Occupancy Load Equation:

$$Number\ of\ occupants/1000ft^2 = \frac{1000}{ft^2/occupant}$$

B. CBC Based Ventilation Equation:

$$cfm/ft^2 = 15\ cfm \times \frac{\left(\frac{Occupants/1000\ ft^2}{2}\right)}{1000}$$

Example 4-9

Question

Ventilation for a two-room building:

Consider a building with two spaces, each having an area of 1,000 ft². One space is used for general administrative functions, and the other is used for classroom training. It is estimated that the office will contain 7 people, and the classroom will contain 50 (fixed seating). What are the required outdoor ventilation rates?

Answer

1. For the office area, the design outdoor ventilation air is the larger of:

   7 people x 15 cfm/person = 105 cfm; or

   1,000 ft² x 0.15 cfm/ft² = 150 cfm

   For this space, the design ventilation rate is 150 cfm.

2. For the classroom, the design outdoor ventilation air is the larger of:

   50 people x 15 cfm/person = 750 cfm; or

   1,000 ft² x 0.15 cfm/ft² = 150 cfm

   For this space the design ventilation rate is 750 cfm.

Assume the total supply air necessary to satisfy cooling loads is 1,000 cfm for the office and 1,500 cfm for the classroom. If each space is served by a separate system, then the required outdoor ventilation rate of each system is 150 cfm and 750 cfm, respectively. This corresponds to a 15 percent outside air (OA) fraction in the office HVAC unit, and 50 percent in the classroom unit.

If both spaces are served by a central system, then the total supply will be (1,000 + 1,500) cfm = 2500 cfm. The required outdoor ventilation rate is (150 + 750) = 900 cfm total. The actual outdoor air ventilation rate for each space is:

Office OA = 900 cfm x (1,000 cfm / 2,500 cfm) = 360 cfm

Classroom OA = 900 cfm x (1,500 cfm / 2,500 cfm) = 540 cfm

While this simplistic analysis suggests that the actual OA cfm to the classroom is less than design (540 cfm vs. 750 cfm), the analysis does not take credit for the dilution effect of the air recirculated from the office. The office is over-ventilated (360 cfm vs. 150 cfm) so the concentration of pollutants in the office return air is low enough that it can be used, along with the 540 cfm of outdoor air, to dilute pollutants in the classroom. The Energy Standards allow this design provided that the system always delivers at least 750 cfm to the classroom (including transfer or recirculated air), and that any transfer air is free of unusual contaminants.

4.3.3 Direct Air Transfer

The Energy Standards allow air to be directly transferred from other spaces in order to meet a part of the ventilation supply to a space, provided the total outdoor quantity required by all spaces served by the building's ventilation system is supplied by the mechanical systems. This method can be used for any space, but is particularly applicable to conference rooms, toilet rooms, and other rooms that have high ventilation requirements. Transfer air must be free from any unusual contaminants, and should not be taken directly from rooms where such sources of contaminants are anticipated. It is typically taken from the return plenum or directly from an adjacent space.

Air may be transferred using any method that ensures a positive airflow. Examples include: dedicated transfer fans, exhaust fans, and fan-powered VAV boxes. A system having a ducted return may be balanced so that air naturally transfers into the space. Exhaust fans serving the space may discharge directly outdoors, or into a return plenum. Transfer systems should be designed to minimize recirculation of transfer air back into the space; duct work should be arranged to separate the transfer air intake and return points.

When each space in a two-space building is served by a separate constant volume system, the calculation and application of ventilation rate is straightforward, and each space will always receive its design outdoor air quantity. However, a central system serving both spaces does not deliver the design outdoor air quantity to each space. Instead, one space receives more than its allotted share, and the other less. This is because the training room has a higher design outdoor ventilation rate and/or a lower cooling load relative to the other space.

4.3.4 Distribution of Outdoor Air to Zonal Units

§120.1(d)

When a return plenum is used to distribute outside air to a zonal heating or cooling unit, the outside air supply must be connected either:

1. Within 5 ft. of the unit; or
2. Within 15 ft. of the unit, with the air directed substantially toward the unit, and with a discharge velocity of at least 500 ft. per minute.

Water source heat pumps and fan coils are the most common application of this configuration. The unit fans should be controlled to run continuously during occupancy in order for the ventilation air to be circulated to the occupied space.

A central space-conditioning system(s) augmented by a few zonal units for spot conditioning may use transfer air from spaces served by the central system. A direct source of outdoor air is not required for each zonal unit. Similarly, transfer air may be used in buildings having central interior space-conditioning systems with outdoor air, and zonal units on the perimeter (without outdoor air).

While not required, the Energy Standards recommend that sources of unusual contaminants be controlled through the use of containment systems that capture the contaminants and discharge them directly outdoors. Such systems may include exhaust hoods, fume hoods, small space exhausts and differential pressure control between spaces. The designer is advised to consult ASHRAE standards or other publications for guidance in this subject.

4.3.5 Ventilation System Operation and Controls

§120.1(c)

4.3.5.1 Outdoor Ventilation Air and VAV Systems

Except for systems employing Energy Commission-certified demand controlled ventilation (DCV) devices or space occupancy sensors, the Energy Standards require that the minimum rate of outdoor air calculated per §120.1(b)2 be provided to each space *at all times* when the space is normally occupied §120.1(c)1. For spaces served by variable air volume (VAV) systems, this means that the minimum supply setting of each VAV box should be no less than the design outdoor ventilation rate calculated for the space, unless transfer air is used. If transfer air is used, the minimum box position, plus the transfer air, must meet the minimum ventilation rate. If transfer air is not used, the box must be controlled so that the minimum required airflow is maintained at all times (unless demand controlled ventilation or occupant sensor are employed).

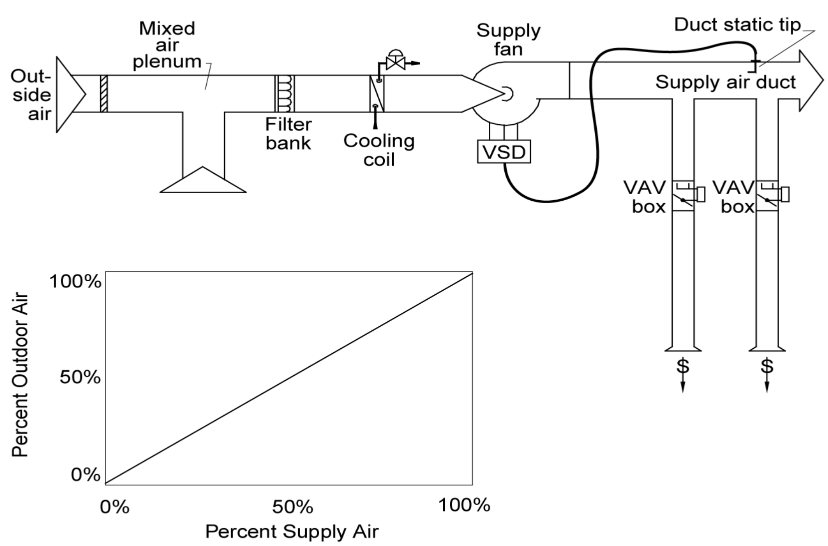
The design outdoor ventilation rate at the system level must always be maintained when the space is occupied, even when the fan has modulated to its minimum capacity §120.1(c)1. Section 4.3.11 describes mandated acceptance test requirements for outside air ventilation in VAV air handling systems. In these tests, the minimum outside air in VAV systems will be measured both at full flow and with all boxes at minimum position.

Figure 4-2 shows a typical VAV system. In standard practice, the testing and balancing (TAB) contractor sets the minimum position setting for the outdoor air damper during construction. It is set under the conditions of design airflow for the system, and remains in the same position throughout the full range of system operation. Does this meet code? The answer is no. As the system airflow drops, so will the pressure in the mixed air plenum. A fixed position on the minimum outdoor air damper will produce a varying outdoor airflow. As depicted in Figure 4-2, this effect will be approximately linear (in other words, outdoor air airflow will drop directly in proportion to the supply airflow).

The following paragraphs present several methods used to dynamically control the minimum outdoor air in VAV systems, which are described in detail below.

Regardless of how the minimum ventilation is controlled, care should be taken to reduce the amount of outdoor air provided when the system is operating during the weekend or after hours with only a fraction of the zones active. §120.2(g) requires provision of “isolation zones” of 25,000 ft² or less. This can be provided by having the VAV boxes return to fully closed when their associated zone is in unoccupied mode. When a space or group of spaces is returned to occupied mode (e.g. through off-hour scheduling or a janitor’s override), only the boxes serving those zones need to be active. During this partial occupancy, the ventilation air can be reduced to the requirements of those zones that are active. If all zones are of the same occupancy type (e.g. private offices), simply assign a floor area to each isolation zone and prorate the minimum ventilation area by the ratio of the sum of the floor areas presently active divided by the sum of all the floor areas served by the HVAC system.

Figure 4-2: VAV Reheat System with a Fixed Minimum Outdoor Air Damper Setpoint



A. Fixed Minimum Damper Setpoint

This method does not comply with the Energy Standards; the airflow at a fixed minimum damper position will vary with the pressure in the mixed air plenum. It is explicitly prohibited in §120.1(e)2.

B. Dual Minimum Setpoint Design

This method complies with the Energy Standards. An inexpensive enhancement to the fixed damper setpoint design is the dual minimum setpoint design, commonly used on some packaged AC units. The minimum damper position is set proportionally based on fan speed or airflow between a setpoint determined when the fan is at full speed (or airflow) and minimum speed (or airflow). This method complies with the letter of the Energy Standards but is not accurate over the entire range of airflow rates and when there are wind or stack effect pressure fluctuations. But with DDC, this design has very low costs.

C. Energy Balance Method

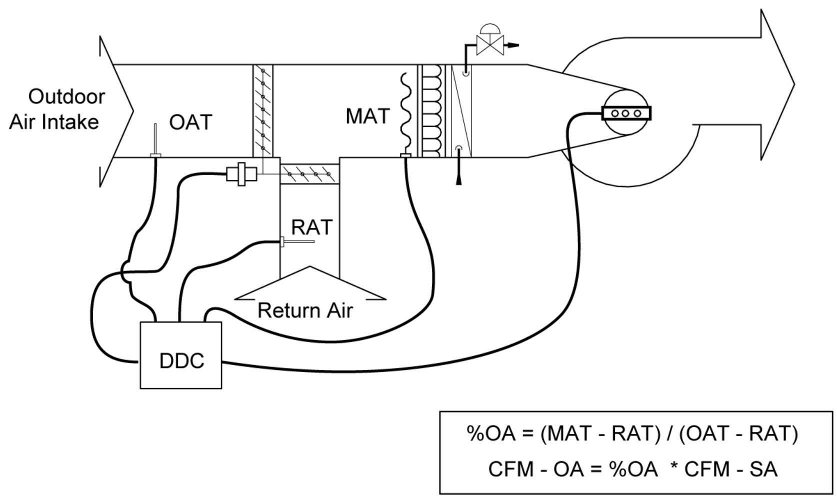
The energy balance method uses temperature sensors in the outside, as well as return and mixed air plenums to determine the percentage of outdoor air in the supply air stream. The outdoor airflow is then calculated using the equations shown in Figure 4-3. This method requires an airflow monitoring station on the supply fan.

While technically feasible, it may be difficult to meet the outside air acceptance requirements with this approach because:

1. It is difficult to accurately measure the mixed air temperature, which is critical to the success of this strategy. Even with an averaging type bulb, most mixing plenums have some stratification or horizontal separation between the outside and mixed airstreams.[1]
2. Even with the best installation, high accuracy sensors, and field calibration of the sensors, the equation for percent outdoor air will become inaccurate as the return air temperature approaches the outdoor air temperature. When they are equal, this equation predicts an infinite percentage outdoor air.
3. The accuracy of the airflow monitoring station is likely to be low at low supply airflows.
4. The denominator of the calculation amplifies sensor inaccuracy as the return air temperature approaches the outdoor air temperature.

[1] This was the subject of ASHRAE Research Project 1045-RP, "Verifying Mixed Air Damper Temperature and Air Mixing Characteristics." Unless the return is over the outdoor air there are significant problems with stratification or airstream separation in mixing plenums.

Figure 4-3: Energy Balance Method of Controlling Minimum Outdoor Air



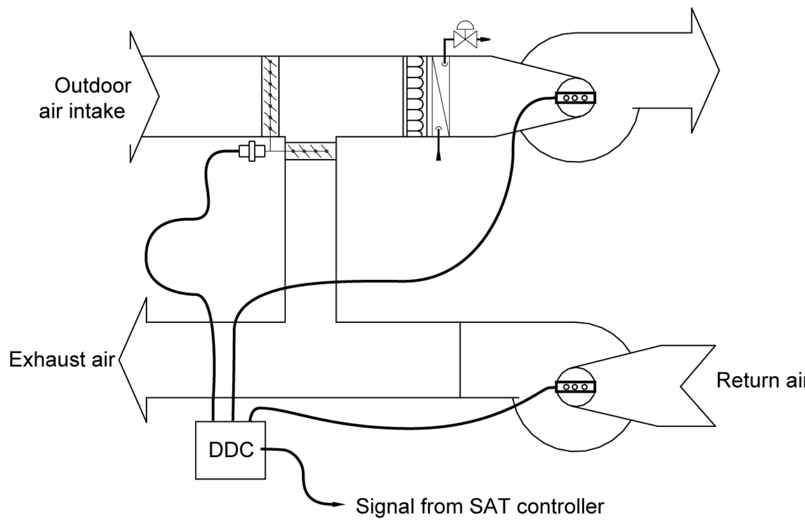
D. Return Fan Tracking

This method is also technically feasible, but will likely not meet the acceptance requirements because the cumulative error of the two airflow measurements can be large, particularly at low supply/return airflow rates. It only works theoretically when the minimum outdoor air rate equals the rate of air required to maintain building pressurization (the difference between supply air and return air rates). Return fan tracking (Figure 4-4) uses airflow monitoring stations on both the supply and return fans. The theory behind this is that the difference between the supply and return fans has to be made up by outdoor air, and controlling the flow of return air forces more ventilation into the building. Several problems occur with this method:

1. The relative accuracy of airflow monitoring stations is poor, particularly at low airflows;
2. The cost of airflow monitoring stations;
3. It will cause building pressurization problems unless the ventilation air is equal to the desired building exfiltration plus the building exhaust.

ASHRAE research has also demonstrated that in some cases this arrangement can cause outdoor air to be drawn into the system through the exhaust dampers due to negative pressures at the return fan discharge.

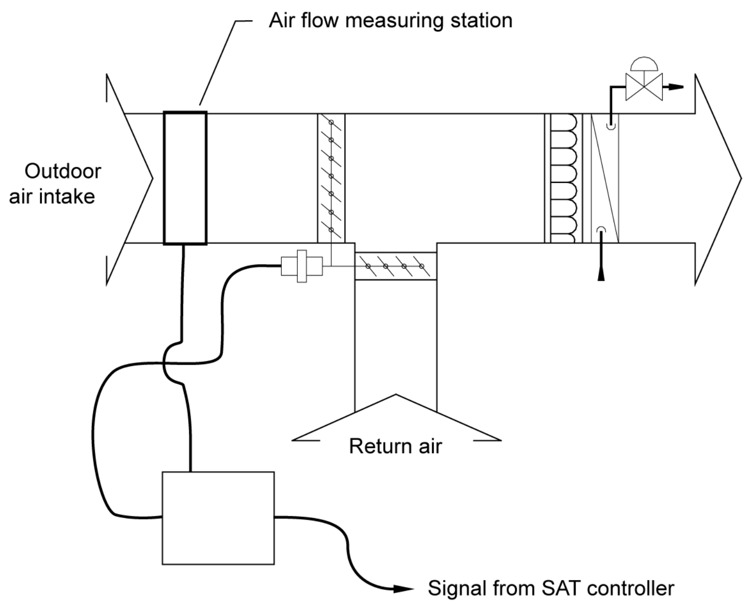
Figure 4-4: Return Fan Tracking



E. Airflow Measurement of the Entire Outdoor Air Inlet

This method is technically feasible but will likely not meet the acceptance requirements depending on the airflow measurement technology. Most airflow sensors will not be accurate to a 5-15 percent turndown (the normal commercial ventilation range). Controlling the outdoor air damper by direct measurement with an airflow monitoring station (Figure 4-5) can be an unreliable method. Its success relies on the turndown accuracy of the airflow monitoring station. Depending on the loads in a building, the ventilation airflow can be between 5 and 15 percent of the design airflow. If the outdoor airflow sensor is sized for the design flow for the airside economizer, this method has to have an airflow monitoring station that can turn down to the minimum ventilation flow (between 5 and 15 percent). Of the different types available, only a hot-wire anemometer array is likely to have this low-flow accuracy while traditional pilot arrays will not. One advantage of this approach is that it provides outdoor airflow readings under all operating conditions, not just when on minimum outdoor air. For highest accuracy, provide a damper and outdoor air sensor for the minimum ventilation air that is separate from the economizer outdoor air intake.

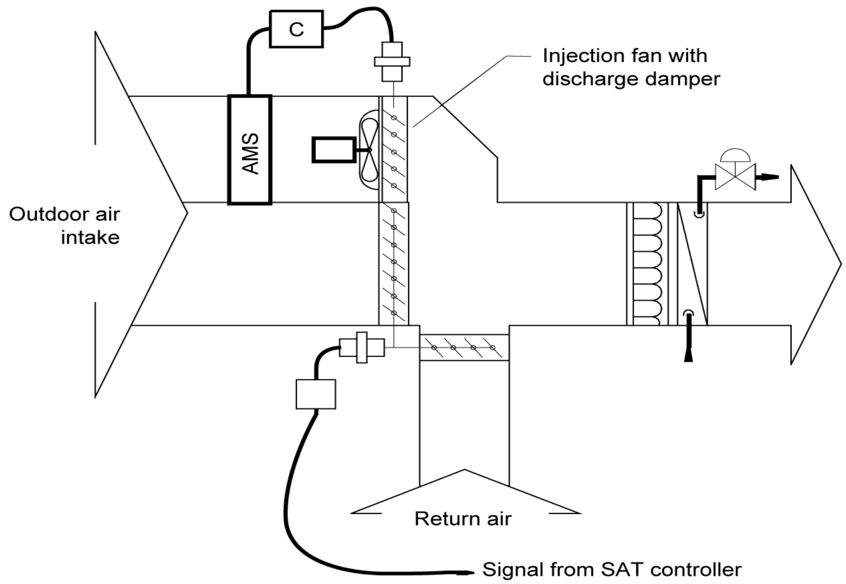
Figure 4-5: Airflow Measurement of 100% Outdoor Air



F. Injection Fan Method

This method complies with the Energy Standards, but it is expensive and may require additional space. Note that an airflow sensor and damper are required since fan airflow rate will vary as mixed air plenum pressure varies. The injection fan method (Figure 4-6) uses a separate outdoor air inlet and fan sized for the minimum ventilation airflow. This inlet contains an airflow monitoring station, and a fan with capacity control (e.g., discharge damper; VFD), which is modulated as required to achieve the desired ventilation rate. The discharge damper is recommended since a damper must be provided anyway to shut off the intake when the AHU is off, and also to prevent excess outdoor air intake when the mixed air plenum is very negative under peak conditions. (The fan is operating against a negative differential pressure and thus cannot stop flow just by slowing or stopping the fan.) This method works, but the cost is high and often requires additional space for the injection fan assembly.

Figure 4-6: Injection Fan with Dedicated Minimum Outdoor Air Damper



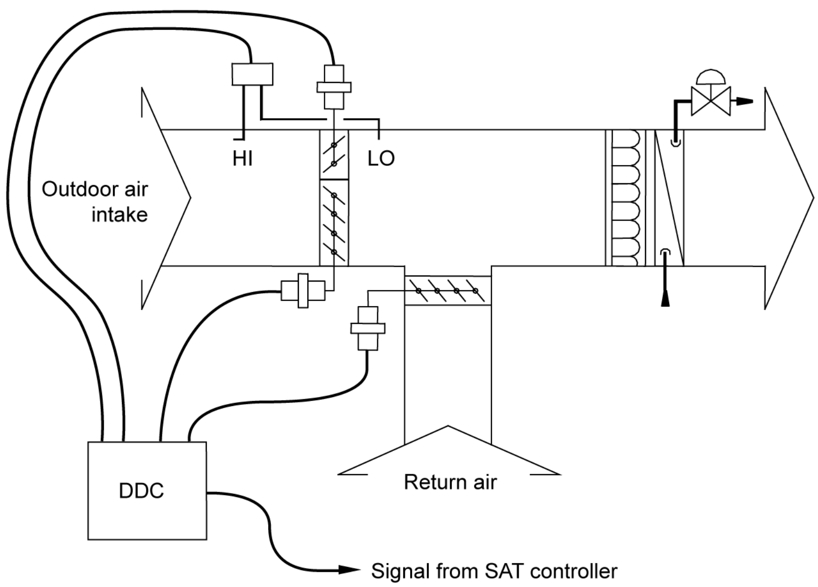
G. Dedicated Minimum Ventilation Damper with Pressure Control

This approach is low cost and takes little space. It can be accurate if the differential setpoint corresponding to the minimum outdoor air rate is properly set in the field. An inexpensive but effective design uses a minimum ventilation damper with differential pressure control (Figure 4-7). In this method, the economizer damper is broken into two pieces: a small two position damper controlled for minimum ventilation air and a larger, modulating, maximum outdoor air damper that is used in economizer mode. A differential pressure transducer is placed across the minimum outdoor air damper. During start-up, the air balancer opens the minimum outside air (OA) damper and return air damper, closes the economizer OA damper, runs the supply fan at design airflow, measures the OA airflow (using a hand-held velometer) and adjusts the minimum OA damper position until the OA airflow equals the design minimum OA airflow. The linkages on the minimum OA damper are then adjusted so that the current position is the “full open” actuator position. At this point the design pressure (DP) across the minimum OA damper is measured. This value becomes the DP setpoint. The principle used here is that airflow is constant across a fixed orifice (the open damper) at fixed DP.

As the supply fan modulates when the economizer is off, the return air damper is controlled to maintain the DP setpoint across the minimum ventilation damper.

The main downside to this method is the complexity of controls and the potential problems determining the DP setpoint in the field. It is often difficult to measure the outdoor air rate due to turbulence and space constraints.

Figure 4-7: Minimum Outdoor Air Damper with Pressure Control



Example 4-10

Question

Minimum VAV cfm:

If the minimum required ventilation rate for a space is 150 cfm, what is the minimum allowed airflow for its VAV box when the design percentage of outdoor air in the supply is 20 percent?

Answer

The minimum allowed airflow may be as low as 150 cfm provided that enough outdoor air is supplied to all spaces combined to meet the requirements of §120.1(b)2 for each space individually.

4.3.6 Pre-Occupancy Purge

§120.1(c)2

Since many indoor air pollutants are out-gassed from the building materials and furnishings, the Energy Standards require that buildings having a scheduled operation be purged before occupancy §120.1(c)2. Immediately prior to occupancy, outdoor ventilation must be provided in an amount equal to the lesser of:

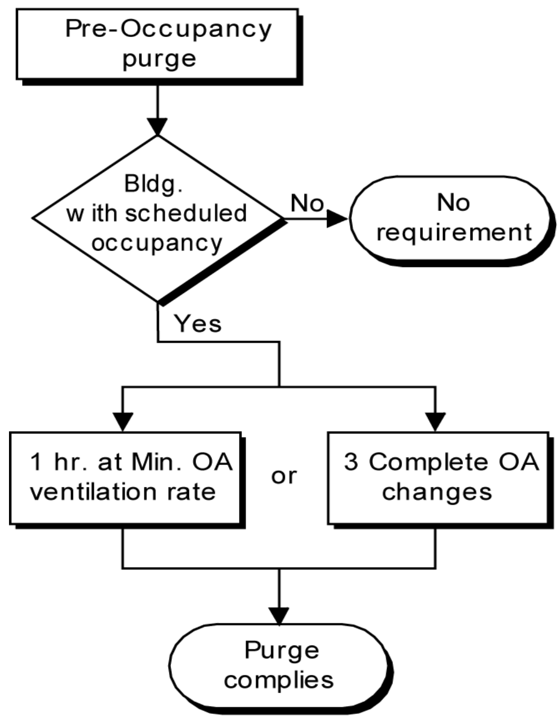
1. The minimum required ventilation rate for 1 hour.
2. 3 complete air changes.

Either criterion can be used to comply with the Energy Standards. Three complete air changes means an amount of ventilation air equal to 3 times the volume of the occupied space. This air may be introduced at any rate provided for and allowed by the system, so that the actual purge period may be less than an hour.

A pre-occupancy purge is not required for buildings or spaces that are not occupied on a scheduled basis, such as storage rooms. Also, a purge is not required for spaces provided with natural ventilation.

Where pre-occupancy purge is required, it does not have to be coincident with morning warm-up (or cool-down). The simplest means to integrate the two controls is to simply schedule the system to be occupied one hour prior to the actual time of anticipated occupancy. This allows the optimal start, warm-up or pull-down routines to bring the spaces up to (or down to) desired temperatures before opening the outdoor air damper for ventilation. This will reduce the required system heating capacity and ensure that the spaces will be at the desired temperatures and fully purged at the start of occupancy.

Figure 4-8: Pre-Occupancy Purge Flowchart



Example 4-11

Question

Purge Period:

What is the length of time required to purge a space 10 ft. high with an outdoor ventilation rate of 1.5 cfm/ft²?

Answer

For 3 air changes, each ft² of space must be provided with:

OA volume = 3 x 10 = 30 cf/ft²

At a rate of 1.5 cfm/ft², the time required is:

Time = 30 cf/ft² / 1.5 cfm/ft² = 20 minutes

Example 4-12

Question

Purge with Natural Ventilation:

In a building with natural ventilation, do the windows need to be left open all night to accomplish a building purge?

Answer

No. A building purge is required only for buildings with mechanical ventilation systems.

Example 4-13

Question

Purge with Occupancy Timer:

How is a purge accomplished in a building without a regularly scheduled occupancy whose system operation is controlled by an occupancy sensor?

Answer

There is no purge requirement for this building. Note that occupancy sensors and manual timers can only be used to control ventilation systems in buildings that are intermittently occupied without a predictable schedule.

4.3.7 Demand Controlled Ventilation

§120.1(c)3 and 4

Demand controlled ventilation (DCV) systems reduce the amount of ventilation supply air in response to a measured level of carbon dioxide (CO_2) in the breathing zone. The Energy Standards only permit CO_2 sensors for the purpose of meeting this requirement; VOC and so-called “IAQ” sensors are not approved as alternative devices to meet this requirement. The Energy Standards only permit DCV systems to vary the ventilation component that corresponds to occupant bioeffluents (this is basis for the 15 cfm/person portion of the ventilation requirement). The purpose of CO_2 sensors is to track occupancy in a space; however, there are many factors that must be considered when designing a DCV system. There is often a lag time in the detection of occupancy through the build-up of CO_2. This lag time may be increased by any factors that affect mixing, such as short circuiting of supply air or inadequate air circulation, as well as sensor placement and sensor accuracy. Build-up of odors, bioeffluents, and other health concerns may also lag changes in occupancy; therefore, the designers must be careful to specify CO_2 based DCV systems that are designed to provide adequate ventilation to the space by ensuring proper mixing, avoiding short circuiting, and proper placement and calibration of the sensors.

A. The Energy Standards requires the use of DVC systems for spaces with all of the following characteristics:

1. Served by single zone units with any controls or multiple zone systems with Direct Digital Controls (DDC) to the zone level, and
2. Has a design occupancy of 40 ft²/person or smaller (for areas without fixed seating where the design density for egress purposes in the CBC is 40 ft²/person or smaller), and
3. Has an air economizer.

B. There are five exceptions to this requirement:

1. The following spaces are permitted to use DCV but are not required to: classrooms, call centers, office spaces served by multiple zone systems that are continuously occupied during normal business hours with occupant density greater than 25 people per 1000 ft² per §120.1(b)2B (Table 4-13 and Table 4-14 above), healthcare facilities and medical buildings, and public areas of social services buildings.

   These spaces are exempted either due to concerns about equipment maintenance practices (schools and public buildings) or concerns about high levels of pathogens (social service buildings, medical buildings, healthcare facilities and to some extent classrooms).

2. Where the space exhaust is greater than the required ventilation rate minus 0.2 cfm/ft².

   This relates to the fact that spaces with high exhaust requirements won't be able to provide sufficient turndown to justify the cost of the DCV controls. An example of this is a restaurant seating area where the seating area air is used as make-up air for the kitchen hood exhaust.

3. DCV devices are not allowed in the following spaces: 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, or beauty salons.

   This exception recognizes that some spaces may need additional ventilation due to contaminants that are not occupant borne. It addresses spaces like theater stages where theatrical fog may be used or movie theater lobbies where unvented popcorn machines may be emitting odors and vapors into the space in either case justifying the need for higher ventilation rates. DCV devices shall not be installed in spaces included in Exception 3.

4. Spaces with an area of less than 150 ft², or a design occupancy of less than 10 people per §120.1(b)2B (Table 4-13 and Table 4-14 above).

   This recognizes the fact that DCV devices may not be cost effective in small spaces such as a 15 ft x 10 ft conference room or spaces with only a few occupants at design conditions.

5. Spaces less than 1500 ft² that comply with §120.1(c)5 - Occupant Sensor Ventilation Control Devices.

   This exception states that an occupant sensor is allowed to reduce the amount of ventilation supply air in a vacant room.

Although not required, the Energy Standards permit design professionals to apply DCV on any intermittently occupied spaces served by either single-zone or multiple-zone equipment. §120.1(b)2 requires a minimum of 15 cfm of outdoor air per person times the expected number of occupants; however, it must be noted that these are minimum ventilation levels and the designers may specify higher ventilation levels if there are health related concerns that warrant higher ventilation rates.

CO_2 based DCV is based on several studies (Berg-Munch et al. 1986, Cain et al. 1983, Fanger 1983 and 1988, Iwashita et al. 1990, Rasmussen et al. 1985) that concluded that about 15 cfm of outdoor air ventilation per person will control human body odor such that roughly 80 percent of unadapted persons (visitors) will find the odor to be at an acceptable level. As activity level increases and bioeffluents increase, the rate of outdoor air required to provide acceptable air quality increases proportionally, resulting in the same differential CO2 concentration.

Note that CO_2 concentration only tracks indoor contaminants that are generated by occupants themselves and, to a lesser extent, their activities. It will not track other pollutants, particularly volatile organic compounds (VOCs) that off-gas from furnishings and building materials. Hence, where permitted or required by the Energy Standards, demand controlled ventilation systems cannot reduce the outdoor air ventilation rate below the floor rate listed in Energy Standards Table 120.1-A (typically 0.15 cfm/ft^2) during normally occupied times.

DCV systems save energy if the occupancy varies significantly over time. Hence they are most cost effective when applied to densely occupied spaces like auditoriums, conference rooms, lounges or theaters. Because DCV systems must maintain the floor ventilation rate listed in Energy Standards Table 120.1-A, they will not be applicable to sparsely occupied buildings such as offices where the floor rate always exceeds the minimum rate required by the occupants (See Table 4-14).

C. Where DCV is employed (whether mandated or not) the controls must meet all of the following requirements:

1. Sensors must be provided in each room served by the system that has a design occupancy of 40 ft^2/person or less, with no less than one sensor per 10,000 ft^2 of floor space. When a zone or a space is served by more than one sensor, signal from any sensor indicating that CO_2 is near or at the setpoint within a space, must trigger an increase in ventilation to the space. This requirement ensures that the space is adequately ventilated in case a sensor malfunctions. Design professional should ensure that sensors are placed throughout a large space, so that all areas are monitored by a sensor.
2. The CO_2 sensors must be located in the breathing zone (between 3 and 6 ft. above the floor or at the anticipated height of the occupant's head). Sensors in return air ducts are not allowed since they can result in under-ventilation due to CO_2 measurement error caused by short-circuiting of supply air into return grilles and leakage of outdoor air (or return air from other spaces) into return air ducts.
3. The ventilation must be maintained that will result in a concentration of CO_2 at or below 600 ppm above the ambient level. The ambient levels can either be assumed to be 400 ppm or dynamically measured by a sensor that is installed within four feet of the outdoor air intake. At 400 ppm outside CO_2 concentration, the resulting DCV CO_2 setpoint would be 1000 ppm. (Note that a 600 ppm differential is less than the 700 ppm that corresponds to the 15 cfm/person ventilation rate. This provides a margin of safety against sensor error, and because 1000 ppm CO_2 is a commonly recognized guideline value and referenced in earlier versions of ASHRAE Standard 62.)
4. Regardless of the CO_2 sensor's reading, the system is not required to provide more than the minimum ventilation rate required by §120.1(b). This prevents a faulty sensor reading from causing a system to provide more than the code required ventilation for system without DCV control. This high limit can be implemented in the controls.
5. The system shall always provide a minimum ventilation of the sum of the Energy Standards Table 120.1-A values for all rooms with DCV and §120.1(b)2 (Table

4-13) for all other spaces served by the system. This is a low limit setting that must be implemented in the controls.

6. The CO_2 sensors must be factory-certified to have an accuracy within plus or minus 75 ppm at 600 and 1000 ppm concentration when measured at sea level and 25°C (77°F), factory calibrated or calibrated at start-up, and certified by the manufacturer to require calibration no more frequently than once every 5 years. A number of manufacturers now have “self-calibrating” sensors that either adjust to ambient levels during unoccupied times or adjust to the decrease in sensor bulb output through use of dual sources or dual sensors. For all systems, the manufacturers of sensors must provide a document to installers that their sensors meet these requirements. The installer must make this certification information available to the builder, building inspectors and, if specific sensors are specified on the plans, to plan checkers.
7. When a sensor failure is detected, the system must provide a signal to reset the system to provide the minimum quantity of outside air levels required by §120.1(b)2 to the zone(s) serviced by the sensor at all times that the zone is occupied. This requirement ensures that the space is adequately ventilated in case a sensor malfunctions. A sensor that provides a high CO_2 signal on sensor failure will comply with this requirement.
8. For systems that are equipped with DDC to the zone level, the CO_2 sensor(s) reading for each zone must be displayed continuously, and recorded. The EMCS may be used to display and record the sensors’ readings. The display(s) must be readily available to maintenance staff so they can monitor the systems performance.

4.3.8 Occupant Sensor Ventilation Control Devices

§120.1(c)5

The use of occupant sensor ventilation control devices are mandated for multipurpose rooms less than 1000 ft^2 ; classrooms over 750 ft^2; and conference, convention, auditorium and meeting center rooms greater than 750 ft^2 that do not have processes or operations that generate dusts, fumes, vapors or gasses(by reference to §120.2(e)3). They are also an alternate method of compliance for spaces mandated to have DCV that are less than 1,500 ft^2 (Exception 5 to §120.1(c)3).

There are a few spaces where it appears that both DCV and occupant sensor ventilation controls are mandated (e.g. auditoriums greater than 750 ft^2). Exception 1 to §120.1(c)5 exempts occupant sensor ventilation controls if DCV is implemented as required by §120.1(c)4.

Where occupant sensor ventilation control devices are employed (whether mandated or not) the controls must meet all of the following requirements:

1. Sensors must meet the requirements of §110.9(b)4 and shall have suitable coverage to detect occupants in the entire space.
2. Sensors that are used for lighting can be used for ventilation as well as long as the ventilation system is controlled directly from the occupant sensor and is not subject to lighting overrides.
3. If a terminal unit serves several enclosed spaces, each space shall have its own occupant sensor and all sensors must indicate lack of occupancy before the zone airflow is cut off.

4. The occupant sensor override shall be disabled during preoccupancy purge (i.e. the terminal unit and central ventilation shall be active regardless of occupant status).
5. Supply fans on systems with all zones provided with occupant sensor ventilation control devices can cycle off if all zones are vacant provided that minimum ventilation to all zones is provided as follows:
6. For spaces with a design occupant density greater than or equal to 25 people per 1000 ft² (40 square foot or less per person); 25 percent of the rate listed in Table 120.1-A: Minimum Ventilation Rates.

To implement the last provision the supply fan on the unit serving the zones would have to cycle on for at least 15 minutes of every hour with the outside air damper at or above minimum position.

4.3.9 Fan Cycling

§120.1(c)5E

While §120.1(c)1 requires that ventilation be continuous during normally occupied hours when the space is usually occupied, Exception 2 allows the ventilation to be disrupted for not more than 30 minutes at a time. In this case the ventilation rate during the time the system is ventilating must be increased so the average rate over the hour is equal to the required rate.

It is important to review any related ventilation and fan cycling requirements in Title 8, which is the Division of Occupational Safety and Health (Cal/OSHA) regulations. Section 5142 specifies the operational requirements related to HVAC minimum ventilation. It states:

Operation:

1. The HVAC system shall be maintained and operated to provide at least the quantity of outdoor air required by the State Building Standards Code, Title 24, Part 2, California Administrative Code, in effect at the time the building permit was issued.
2. The HVAC system shall be operated continuously during working hours except:
   a. During scheduled maintenance and emergency repairs;
   b. During periods not exceeding a total of 90 hours per calendar year when a serving electric utility by contractual arrangement requests its customers to decrease electrical power demand; or
   c. During periods for which the employer can demonstrate that the quantity of outdoor air supplied by nonmechanical means meets the outdoor air supply rate required by (a)(1) of this Section. The employer must have available a record of calculations and/or measurements substantiating that the required outdoor air supply rate is satisfied by infiltration and/or by a nonmechanically driven outdoor air supply system.

Title 8 Section 5142(a)(1) refers to Title 24, Part 2 (the California Building Code) for the minimum ventilation requirements. Section 1203 in the California Building Code specifies the ventilation requirements, but simply refers to the California Mechanical Code, which is Title 24, Part 4.

Chapter 4 in the California Mechanical Code specifies the ventilation requirements. Section 402.3 states, “The system shall operate so that all rooms and spaces are continuously provided with the required ventilation rate while occupied.” Section 403.5.1 states, “Ventilation systems shall be designed to be capable of providing the required ventilation rates in the breathing zone whenever the zones served by the system are occupied, including all full and part-load conditions." The required ventilation rates are thus not required whenever the zones are unoccupied. This section affirms that ventilation fans may be turned off during unoccupied periods. In addition, Section 403.6 states, "The system shall be permitted to be designed to vary the design outdoor air intake flow or the space or zone airflow as operating conditions change." This provides further validation to fan cycling as operating conditions change between occupied and unoccupied. A vacant zone has no workers present and is thus not subject to working hour's requirements until the zone is actually occupied by a worker. Finally, Title 24, Part 4, states; "Ventilation air supply requirements for occupancies regulated by the California Energy Commission are found in the California Energy Code." Thus, it refers to Title 24, Part 6 as the authority on ventilation.

Title 8 Section 5142(a)(2) states, "The HVAC system shall be operated continuously during working hours." This regulation does not indicate that the airflow, cooling, or heating needs to be continuous. If the HVAC system is designed to maintain average ventilation with a fan cycling algorithm, and is active in that mode, providing average ventilation air as required during working hours, it is considered to be operating continuously per its mode and sequence. During unoccupied periods, the HVAC system is turned off except for setback and it no longer operates continuously. During the occupied period, occupant sensors or CO2 sensors in the space provide continuous monitoring and the sequence is operating, cycling the fan and dampers as needed to maintain the ventilation during the occupied period. The HVAC system is operating with the purpose of providing ventilation, heating, and cooling continuously during the working hours. The heater, air conditioner, fans, and dampers all cycle on and off subject to their system controls to meet the requirements during the working hours.

Exceptions A, B, and C to Title 8 Section 5142(a)(2) all refer to a complete system shutdown where the required ventilation is not maintained.

Example 4-14

Question

Does a single zone air-handling unit serving a 2,000 ft² auditorium with fixed seating for 240 people require demand controlled ventilation?

Answer

Yes if it has an air-side economizer. There are three tests for the requirement.

The first test is whether the design occupancy is 40 ft²/person or less. This space has 2,000 ft²/240 people or 8.3 ft² /person.

The second test is that the unit is single zone.

The third is that it has an air-side economizer.

A single CO_2 sensor could be used for this space provided it is certified by the manufacturer to cover 2,000 ft² of space. The sensor must be placed directly in the space.

Example 4-15

Question

If two separate units are used to condition the auditorium in the previous example, is demand controlled ventilation required?

Answer

Yes, if they each meet the three tests.

Example 4-16

Question

The 2,000 ft^2 auditorium in the previous examples appears to require both demand controlled ventilation per Section 4.3.7 and occupant sensor ventilation control devices per Section 4.3.8? Is this the case?

Answer

No, the exception in Section 4.3.8 exempts occupant sensor ventilation controls if implemented as required in Section 4.3.7. Only demand controlled ventilation is required.

Example 4-17

Question

If a central AHU supplies five zones of office space (with a design occupant density of 100 ft^2/person and two zones with conference rooms (with a design occupant density of 35 ft^2/person) is it required to have demand controlled ventilation and if so, on which zones?

Answer

If the AHU has DDC controls to the zone and an airside economizer it is required to have DCV controls in both of the conference room zones.

The minimum OSA will be set for 0.15 cfm/ft^2 times the total area of all seven zones (the office and conference room zones) and the maximum required OSA does not need to exceed the sum of 0.15 cfm/ft^2 for the 5 office zones plus 15 cfm per person for the two conference rooms.

4.3.9.1 Variable Air Volume (VAV) Changeover Systems

Some VAV systems provide conditioned supply air, either heated or cooled, through a single set of ducting. These systems are called VAV changeover systems or, perhaps more commonly, variable volume and temperature (VVT™) systems, named after a control system distributed by Carrier Corp. In the event that heating is needed in some spaces at the same time that cooling is needed in others, the system must alternate between supplying heated and cooled air. When the supply air is heated, for example, the spaces requiring cooling are isolated (cut off) by the VAV dampers and must wait until the system switches back to cooling mode. In the meantime, they are generally not supplied with ventilation air.

Systems of this type may not meet the ventilation requirements if improperly applied. Where changeover systems span multiple orientations, the designer must make control provisions to ensure that no zone is shut off for more than 30 minutes at a time and that ventilation rates are increased during the remaining time to compensate. Alternatively, minimum damper position or airflow setpoints can be set for each zone to maintain supply air rates, but this can result in temperature control problems since warm air will be supplied to spaces that require cooling, and vice versa. Changeover systems that are applied to a common building orientation (e.g., all east or all interior) are generally the most successful since zones will usually have similar loads, allowing minimum airflow rates to be maintained without causing temperature control problems.

4.3.10 Adjustment of Ventilation Rate

§120.1(b) specifies the minimum required outdoor ventilation rate, but does not restrict the maximum. However, if the designer elects to have the space-conditioning system operate at a ventilation rate higher than the rate required by the Energy Standards, then the Energy Standards require that the space-conditioning system must be adjustable so that in the future the ventilation rate can be reduced to the amount required by the Energy Standards or the rate required for make-up of exhaust systems that are required for a process, for control of odors, or for the removal of contaminants within the space §120.1(e).

In other words, a system can be designed to supply higher than minimum outside air volumes provided dampers or fan speed can be adjusted to allow no more than the minimum volume if, at a later time, someone decides it is desirable. The Energy Standards preclude a system designed for 100 percent outdoor air, with no provision for any return air, unless the supply air quantity can be adjusted to be equal to the designed minimum outdoor air volume. The intent is to prevent systems from being designed that will permanently over-ventilate spaces.

4.3.11 Acceptance Requirements

§120.5

The Energy Standards have acceptance test requirements for:

1. Ventilation quantities at design airflow for constant volume systems §120.5(a)1 and NA7.5.1.2.
2. Ventilation quantities at design and minimum airflow for VAV systems §120.5(a)1 and NA7.5.1.1.
3. Ventilation system time controls §120.5(a)2 and NA7.5.2.
4. Demand controlled ventilation systems §120.5(a)5 and NA7.5.5.

These test requirements are described in Chapter 13 and the Reference Nonresidential Appendix NA7.5. They are described briefly in the following paragraphs.

Example 4-18

Question

Maintenance of Ventilation System:

In addition to these commissioning requirements for the ventilation system, are there any periodic requirements for inspection?

Answer

The Energy Standards do not contain any such requirements since they apply to the design and commissioning of buildings, not to its later operation. However, Section 5142 of the General Industry Safety Orders, Title 8, California Safety Code: Mechanically Driven Heating, Ventilating and Air Conditioning (HVAC) Systems to Provide Minimum Building Ventilation, states the following:

Inspection and Maintenance

(1) The HVAC system shall be inspected at least annually, and problems found during these inspections shall be corrected within a reasonable time.

(2) Inspections and maintenance of the HVAC systems shall be documented in writing. The employer shall record the name of the individual(s) inspecting and/or maintaining the system, the date of the inspection and/or maintenance, and the specific findings and actions taken. The employer shall ensure that such records are retained for at least five years.

(3) The employer shall make all records required by this section available for examination and copying, within 48 hours of a request, to any authorized representative of the Division (as defined in Section 3207 of Title 8), to any employee of the employer affected by this section, and to any designated representative of said employee of the employer affected by this Section.

4.3.11.1 **Ventilation Airflow**

NA7.5.1

Ventilation airflow has to be certified to be measured within 10 percent of the design airflow quantities at two points of operation: full design supply airflow (all systems) and (for VAV systems) at airflow with all VAV boxes at or near minimum position.
If airflow monitoring stations are provided, they can be used for these measurements.

4.3.11.2 **Ventilation System Time Controls and Preoccupancy Purge**

NA7.5.2

Programming for preoccupancy purge and HVAC schedules are checked and certified as part of the acceptance requirements. The sequences are also required to be identified by specification section paragraph number (or drawing sheet number) in the compliance documents.

4.3.11.3 **Demand Controlled Ventilation System**

NA7.5.5

Demand controlled ventilation systems are checked for compliance with sensor location, calibration (either factory certificate or field validation) and tested for system response with both a high signal (produced by a certified calibration test gas applied to the sensor) and low signal (by increasing the setpoint above the ambient level). A certificate of acceptance must be provided to the enforcement agency that the demand control ventilation system meets the Acceptance Requirements for Code Compliance. The certificate of acceptance must include certification from the manufacturers of sensor devices that they will meet the requirements of §120.1(c)4F and that they will provide a signal that indicates the CO_2 level in the range required by §120.1(c)4, certification from the controls manufacturer that they respond to the type of signal that the installed sensors supply and that they can be calibrated to the CO_2 levels specified in §120.1(c)4, and that the CO_2 sensors have an accuracy of within plus or minus 75 ppm at 600 and 1,000 ppm concentrations, and require calibration no more frequently than once every 5 years.

4.4 Pipe and Duct Distribution Systems

4.4.1 Mandatory Measures

4.4.1.1 **Requirements for Pipe Insulation**

§120.3
Energy Standards Table 120.3-A

Most piping conveying either mechanically heated or chilled fluids for space conditioning or service water heating must be insulated. The required thickness of piping insulation depends on the temperature of the fluid passing through the pipe, the pipe diameter, the function of the pipe within the system, and the insulation's thermal conductivity.

Table 4-15 specifies the requirements in terms of inches of insulation with conductivity within a specific range. These conductivities are typical for fiberglass or foam pipe insulation. In this table, runouts are defined as being less than 2 inches in diameter, less than 12 ft long, and connected to fixtures or individual terminal units. Piping within fan coil units and within other heating or cooling equipment may be considered runouts for the purposes of determining the required pipe insulation.

Piping that does not require insulation includes the following:

1. Factory installed piping within space-conditioning equipment certified under §110.1 or §110.2, see Section 4.2 of this chapter. Nationally recognized certification programs that are accepted by the Energy Commission for certifying efficiencies of appliances and equipment are considered to meet the requirements for this exception.
2. Piping that conveys fluid with a design operating temperature range between 60°F and 105°F, such as cooling tower piping or piping in water loop heat pump systems.
3. Piping that serves process loads, gas piping, cold domestic water piping, condensate drains, roof drains, vents or waste piping.

   Note: Designers may specify exempt piping conveying cold fluids to be insulated in order to control condensation on the surface of the pipe. Examples may include cold domestic water piping, condensate drains and roof drains. In these cases, the insulation R-value is specified by the designer and is not subject to these regulations.
4. Where the heat gain or heat loss, to or from piping without insulation, will not increase building source energy use. For example, piping connecting fin-tube radiators within the same space would be exempt, as would liquid piping in a split system air conditioning unit.

   This exception would not exempt piping in solar systems. Solar systems typically have backup devices that will operate more frequently if piping losses are not minimized.
5. 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.

Conductivities and thicknesses listed in Table 4-15 are typical for fiberglass and foam. When insulating materials are used that have conductivities different from those listed here for the applicable fluid range, such as calcium silicate, Equation 4-1 may be used to calculate the required insulation thickness.

When a pipe carries cold fluids, condensation of water vapor within the insulation material may impair the effectiveness of the insulation, particularly for applications in very humid environments or for fluid temperatures below 40°F. Examples include refrigerant suction piping and low-temperature Thermal Energy Storage (TES) systems. In these cases, manufacturers should be consulted and consideration given to low permeability vapor barriers, or closed-cell foams.

The Energy Standards also require that exposed pipe insulation be protected from damage by moisture, UV and physical abrasion including but not limited to the following:

1. Insulation exposed to weather shall be installed with a cover suitable for outdoor service. The cover shall be water retardant and provides shielding from solar radiation that can cause degradation of the material. Insulation must be protected by an external covering unless the insulation has been approved for exterior use using a recognized federal test procedure. Adhesive tape should not be used as insulation protection because during preventive maintenance, removal of the tape will damage the integrity of the original insulation.
2. Insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall have a Class I or Class II vapor retarder. All penetrations and joints of which shall be sealed.

If the conductivity of the proposed insulation does not fall into the conductivity range listed in Table 4-15, the minimum thickness must be adjusted using the following equation:

Equation 4-7: Insulation Thickness

$$T = PR[(1 + t/PR)K/k - 1]$$

Where:

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

PR = Pipe actual outside radius, inches.

t = Insulation thickness, inches (Table 4-15 for conductivity k).

K = Conductivity of alternate material at the mean rating temperature indicated in Table 4-15 for the applicable fluid temperature range, in Btu-in./(h-ft² -°F).

k = The lower value of the conductivity range listed in Table 4-15 for the applicable fluid temperature, Btu-in/(h-ft² -°F).

Table 4-15: Pipe Insulation Thickness

FLUID TEMPERATURE RANGE (°F)	**CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)**	**INSULATION MEAN RATING TEMPERATURE (°F)**	**NOMINAL PIPE DIAMETER (in inches)**						
			<1		1 to <1.5		1.5 to <4	4 to <8	≥8
			INSULATION THICKNESS REQUIRED (in inches)						
Space heating and service water heating systems (steam, steam condensate and hot water);									
Above 350	0.32-0.34	250	4.5		5.0		5.0	5.0	5.0
251-350	0.29-0.32	200	3.0		4.0		4.5	4.5	4.5
201-250	0.27-0.30	150	2.5		2.5		2.5	3.0	3.0
141-200	0.25-0.29	125	1.5		1.5		2.0	2.0	2.0
105-140	0.22-0.28	100	1.0		1.5		1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)									
			Nonres	Res	Nonres	Res			
40-60	0.21-0.27	75	0.5	0.75	0.5	0.75	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0		1.5		1.5	1.5	1.5

Energy Standards Table 120.3-A

Example 4-19

Question

What is the required thickness for calcium silicate insulation on a 4 inches diameter pipe carrying a 300°F fluid?

Answer

From Table 4-15, the required insulation thickness is 4.5 inches for a 4 inches pipe in the range of 251-350°F.

The lower of the range for mean conductivity at this temperature is listed as 0.29 (Btu-in.)/(h-ft²-°F). From manufacturer's data, it is determined that the conductivity of calcium silicate at 300°F is 0.45 Btu-in./(h-ft²-°F). The required thickness from equation 4-2 is therefore:

$$T = PR[(1 + t/PR)^{K/k} – 1]$$

$$T = 4[(1 + 4.5/4)^{(0.\ 45/0.31)} – 1]$$

$$T = 8.9 \text{ inches}$$

When insulation is not available in the exact thickness calculated, the installed thickness should be the next larger available size.

4.4.1.2 Requirements for Air Distribution System Ducts and Plenums

§120.4

Poorly sealed or poorly insulated duct work can cause substantial losses of air volume and energy. All air distribution system ducts and plenums, including building cavities, mechanical closets, air handler boxes and support platforms used as ducts or plenums, are required to be installed, sealed, and insulated in accordance with the California Mechanical Code (CMC) Sections 601, 602, 603, 604, 605 and ANSI/SMACNA-006-2006 HVAC Duct Construction Standards Metal and Flexible 3rd Edition.

A. Installation and Insulation

§120.4(a)

Portions of supply-air and return-air ducts ductwork 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:

1. Outdoors, or
2. In a space between the roof and an insulated ceiling; or
3. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces; or
4. In an unconditioned crawlspace; or
5. In other unconditioned spaces.

Portions of supply-air ducts ductwork that are not in one of these spaces shall be insulated to a minimum installed level of R-4.2 (or any higher level required by CMC Section 605) or be enclosed in directly conditioned space.

B. CMC insulation requirements are reproduced in Table 4-16. The following are also required:

1. Mechanically fasten connections between metal ducts and the inner core of flexible ducts.
2. Joint and Seal openings with mastic, tape, aerosol sealant or other duct closure system that meets the applicable requirements of UL 181, UL 181A, UL 181B or UL 723 (aerosol sealant).

All joints must be made airtight by use of mastic, tape, aerosol sealant, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A, UL 181B, or UL 723. Duct systems shall not use cloth-back, rubber adhesive duct tape regardless of UL designation, unless it is installed in combination with mastic and clamps.

When mastic or tape is used to seal openings greater than 1/4 in., a combination of mastic and mesh or mastic and tape must be used.

The Energy Commission has approved two cloth-backed duct tapes with special butyl or synthetic adhesives rather than rubber adhesive to seal flex duct to fittings. These tapes are:

1. Polyken 558CA or Nashua 558CA, manufactured by Berry Plastics, Tapes and Coatings Division; and
2. Shurtape PC 858CA, manufactured by Shurtape Technologies, Inc.

These tapes passed Lawrence Berkeley National Laboratory (LBNL) tests comparable to those that cloth-back rubber-adhesive duct tapes failed (the LBNL test procedure has been adopted by the American Society of Testing and Materials as ASTM E2342-03). These tapes are allowed to be used to seal flex duct to fittings without being in combination with mastic. These tapes cannot be used to seal other duct system joints, such as the attachment of fittings to plenums and junction boxes. These tapes have on their backing the phrase "CEC Approved," and a drawing of a fitting to plenum joint in a red circle with a slash through it (the international symbol of prohibition) to illustrate where they are not allowed to be used, and installation instructions in their packing boxes that explain how to install them on duct core to fittings and a statement that the tapes cannot be used to seal fitting to plenum and junction box joints.

C. Factory-Fabricated Duct Systems

§120.4(b)1

Factory-fabricated duct systems must meet the following requirements:

1. 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 UL181. UL181 testing may be performed by UL laboratories or a laboratory approved by the Executive Director.
2. Pressure-sensitive tapes, heat-activated tapes, and mastics used in the manufacture of rigid fiberglass ducts comply with UL 181 and UL181A.
3. Pressure-sensitive tapes and mastics used with flexible ducts comply with UL181 and UL181B.
4. 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.

D. Field-Fabricated Duct Systems

§120.4(b)2

Field-fabricated duct systems must meet the following requirements:

1. Factory-made rigid fiberglass and flexible ducts for field-fabricated duct systems comply with UL 181. Pressure-sensitive tapes, mastics, aerosol sealants or other closure systems shall meet applicable requirements of UL 181, UL 181A and UL 181B.
2. Mastic Sealants and Mesh:
   a. Sealants comply with the applicable requirements of UL 181, UL 181A, and UL 181B, and shall be non-toxic and water resistant.

   b. Sealants for interior applications shall pass ASTM C 731(extrudability after aging) and D 2202 (slump test on vertical surfaces), incorporated herein by reference.
   c. Sealants for exterior applications shall pass ASTM C 731, C 732 (artificial weathering test) and D 2202, incorporated herein by reference.
   d. Sealants and meshes shall be rated for exterior use.
3. Pressure-sensitive tapes shall comply with the applicable requirements of UL 181, UL 181A and UL 181B.
4. Drawbands used with flexible duct shall:
   a. Be either stainless-steel worm-drive hose clamps or UV-resistant nylon duct ties.
   b. Have a minimum tensile strength rating of 150 lbs.
   c. Be tightened as recommended by the manufacturer with an adjustable tensioning tool.
5. Aerosol-Sealant Closures.
   a. Aerosol sealants meet applicable requirements of UL 723 and must be applied according to manufacturer specifications.
   b. Tapes or mastics used in combination with aerosol sealing shall meet the requirements of this section.
6. 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. Duct Insulation R-Values

§120.4(c), §120.4(d), §120.4(e)

Since 2001, the Energy Standards have included the following requirements for the labeling, measurement and rating of duct insulation:

1. Insulation R-values shall be based on the insulation only and not include air-films or the R-values of other components of the duct system.
2. Insulation R-values shall be tested C-values at 75°F mean temperature at the installed thickness, in accordance with ASTM C 518 or ASTM C 177.
3. The installed thickness of duct insulation for purpose of compliance shall be the nominal thickness for duct board, duct liner, factory made flexible air ducts and factory-made rigid ducts. 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.
4. The installed thickness of duct insulation for purpose of compliance shall be 75 percent of its nominal thickness for duct wrap.
5. Insulated flexible air ducts must bear labels no further than 3 ft. apart that state the installed R-value (as determined per the requirements of the Energy Standards).

A typical duct wrap, nominal 1-1/2 inches and 0.75 pcf will have an installed rating of R-4.2 with 25 percent compression.

F. Protection of Duct Insulation

§120.4(f)

The Energy Standards require that exposed duct insulation be protected from damage by moisture, UV and physical abrasion including but not limited to the following:

1. Insulation exposed to weather shall be suitable for outdoor service; e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Insulation must be protected by an external covering unless the insulation has been approved for exterior use using a recognized federal test procedure.
2. 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.

Example 4-20

Question

What are the sealing requirements in a VAV system having a static pressure setpoint of 1.25 inches w.g. and a plenum return?

Answer

All duct work located within the return plenum must be sealed in accordance with the California Mechanical Code (CMC) Sections 601, 602, 603, 604, 605 and ANSI/SMACNA-006-2006 HVAC Duct Construction Standards Metal and Flexible 3rd Edition (refer to §120.4). Pressure-sensitive tape, heat-seal tape and mastic may be used, if it meets the applicable requirement of UL 181, 181A, 181B, to seal joints and seams which are mechanically fastened per the CMC.

Table 4-16: Duct Insulation Requirements

DUCT LOCATION[1]	INSULATION R-VALUE MECHANICALLY COOLED	HEATING ZONE	INSULATION R-VALUE HEATING ONLY
On roof on exterior building	6.3	<4,500 DD	2.1
		< 8,000 DD	4.2
Attics, garages, and crawl spaces	2.1	<4,500 DD	2.1
		<8,000 DD	4.2
In walks[2] and within floor to ceiling spaces[2]	2.1	<4,500 DD	2.1
		<8,000 DD	4.2
Within the conditioned space or in basements: return ducts in air plenums	None Required		None Required
Cement slab or within ground	None Required		None Required

[1]Vapor barriers shall be installed on supply ducts in spaces vented to the outside in geographic areas where the average July, August and September mean dew point temperature exceeds 60 degrees Fahrenheit.
[2] Insulation may be omitted on that portion of a duct which is located within a wall or a floor to ceiling space where:
a. Both sides of the space are exposed to conditioned air.
b. The space is not ventilated.
c. The spaces is not used as a return plenum.
d. The space is not exposed to unconditioned air.

Ceiling which form plenums need not be insulated
Note: Where ducts are used for both heating and cooling, the minimum insulation shall be as required for the most restrictive condition.

Source: Uniform Mechanical Code §605

4.4.2 Prescriptive Requirements for Space Conditioning Ducts

Each of these prescriptive requirements, as applicable, must be met. If one or more applicable requirements cannot be met, the performance method may be used as explained in Chapter 11.

4.4.2.1 Duct Leakage

§140.4(l)

Ducts on small single zone systems with portions of the ductwork either outdoors or in uninsulated or vented ceiling spaces are required to be sealed and leak tested as specified in Reference Nonresidential Appendix NA1. This will generally only apply to small commercial projects that are one or two stories with packaged single zone units or split systems. Duct leakage testing only applies when all of the following are true:

1. The system is constant volume.
2. It serves occupiable space.
3. It serves less than 5,000 ft^2 of conditioned floor area.
4. 25 percent or more of the duct surface area is located in the outdoors, unconditioned space, a ventilated attic, in a crawl space or where the U-factor of the roof is greater than the U-factor of the ceiling, or the roof does not meet the requirements of §140.3(a)1B.

Where duct sealing and leakage testing is required, the ducts must be tested by a HERS certified agency to demonstrate a leakage rate of no more than 6 percent of the nominal supply fan flow.

Alterations to an existing space conditioning system may trigger the duct sealing requirement. For more information see Section 4.9.4.2.

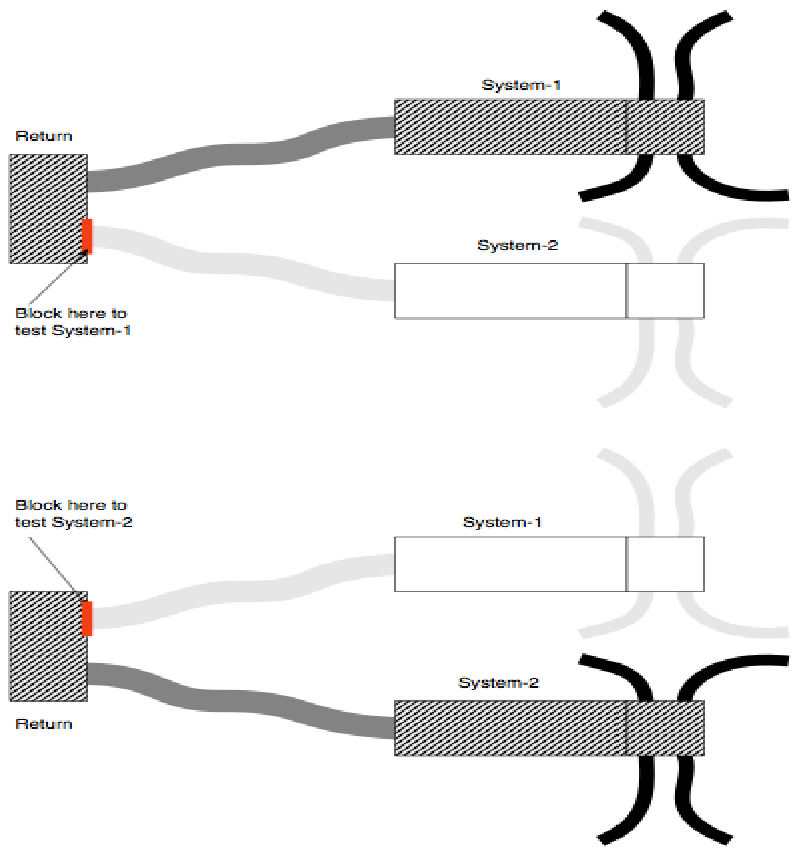
A. Duct Leakage Testing For Multiple Duct Systems With Common Return Ducts

If there are two or more duct systems in a building that are tied together at a common return duct, then each duct system should be tested separately, including the shared portion of the return duct system in each test. Under this scenario, the portions of the second duct system that is not being tested must be completely isolated from the portions of the ducts that are being tested, so the leakage from second duct system does not affect the leakage rate from the side that is being tested.

The diagram below represents the systems that are attached to a shared return boot or remote return plenum. In this case, the point in the return system that needs to be blocked off is readily accessible through the return grille.

The "duct leakage averaging" where both system are tested together as though it is one large system and divide by the combined tonnage to get the target leakage may not be used as it allows a duct system with more the 6% leakage to pass if the combined system's leakage is 6% or less.

Figure 4-9: Example of Two Duct Systems with a Common Return



Example 4-21

Question

A new 20 ton single zone system with new ductwork serving an auditorium is being installed. Approximately ½ of its ductwork on the roof. Does it need to be leak tested?

Answer

Probably not; although this system meets the criteria of being single zone and having more than ¼ of the duct surface area on the roof, the unit probably serves more than 5,000 ft² of space. Most 15 and 20 ton units will serve spaces that are significantly larger than 5,000 ft². If the space is 5,000 ft² or less the ducts do need to be leak tested per §140.4(l).

Example 4-22

Question

A new 5 ton single zone system with new ductwork serving a 2,000 ft² office is being installed. The unit is a down discharge configuration and the roof has insulation over the deck. Does the ductwork need to be leak tested?

Answer

Probably not. Although this system meets the criteria of being single zone and serving less than 5,000 ft² of space, it does not have ¼ of its duct area in one of the spaces listed in §140.4(l). With the insulation on the roof and not on the ceiling, the plenum area likely meets the criteria of indirectly conditioned so no leakage testing is required.

B. Acceptance Requirements

The Energy Standards have acceptance requirements where duct sealing and leakage testing is required by §140.4(l).

These tests are described in the Chapter 13, Acceptance Requirements and the Reference Nonresidential Appendix NA7.

4.5 HVAC System Control Requirements

4.5.1 Mandatory Measures

This section covers controls that are mandatory for all system types, including:

- Heat pump controls for the auxiliary heaters.
- Zone thermostatic control including special requirements for hotel/motel guest rooms and perimeter systems.
- Shut-off and setback/setup controls.
- Infiltration control.
- Off-hours space isolation.
- Economizer fault detection and diagnostics (FDD).
- Control equipment certification.
- Direct Digital Controls (DDC).
- Optimum start/stop controls.

4.5.1.1 **Zone Thermostatic Controls**

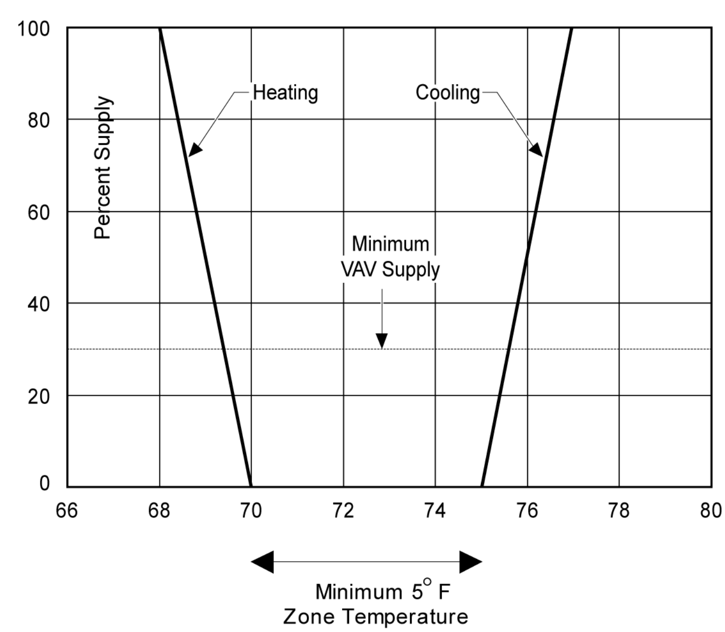
§120.2(a), (b) and (c)

Thermostatic controls must be provided for each space-conditioning zone or dwelling unit to control the supply of heating and cooling energy within that zone. The controls must have the following characteristics:

1. When used to control **heating**, the thermostatic control must be adjustable down to 55°F or lower.
2. When used to control **cooling**, the thermostatic control must be adjustable up to 85°F or higher.
3. When used to control both **heating and cooling**, the thermostatic control must be adjustable from 55°F to 85°F and also provide a temperature range or **dead band** of at least 5°F. When the space temperature is within the dead band, heating and cooling energy must be shut off or reduced to a minimum. A dead band is not required if the thermostat requires a manual changeover between the heating and cooling modes Exception to §120.2(b)*3*.
4. For all single zone, air conditioners and heat pumps all thermostats shall have setback capabilities with a minimum of four separate setpoints per 24 hour period. Also the thermostat must comply with the Occupant Controlled Smart Thermostat requirements of Reference Joint Appendix JA5, which is capable of responding to demand response signals in the event of grid congestion and shortages during high electrical demand periods.
5. Systems equipped with DDC to the zone level, rather than zone thermostats, must be equipped with automatic demand shed controls as described later in Section 4.5.1.7.

The setpoint may be adjustable either locally or remotely, by continuous adjustment or by selection of sensors.

Figure 4-10: Proportional Control Zone Thermostat



Supplemental perimeter heating or cooling systems are sometimes used to augment a space-conditioning system serving both interior and perimeter zones. This is allowed provided controls are incorporated to prevent the two systems from conflicting with each other. If that were the case, then the Energy Standards require that:

1. The perimeter system must be designed solely to offset envelope heat losses or gains; and
2. The perimeter system must have at least one thermostatic control for each building orientation of 50 ft. or more; and
3. The perimeter system is controlled by at least one thermostat located in one of the zones served by the system.

The intent is that all major exposures be controlled by their own thermostat, and that the thermostat be located within the conditioned perimeter zone. Other temperature controls, such as outdoor temperature reset or solar compensated outdoor reset, do not meet these requirements of the Energy Standards.

Example 4-23

Question

Can an energy management system be used to control the space temperatures?

Answer

Yes, provided the space temperature setpoints can be adjusted, either locally or remotely. This section sets requirements for “thermostatic controls” which need not be a single device like a thermostat; the control system can be a broader system like a direct digital control (DDC) system. Note that some DDC systems employ a single cooling setpoint and a fixed or adjustable deadband. These systems comply if the deadband is adjustable or fixed at 5°F or greater.

Thermostats with adjustable setpoints and deadband capability are not required for zones that must have constant temperatures to prevent the degradation of materials, an exempt process, or plants or animals (Exception 1 to §120.2(b)4). Included in this category are manufacturing facilities, hospital patient rooms, museums, computer rooms, etc. Chapter 13 describes mandated acceptance test requirements for thermostat control for packaged HVAC systems.

4.5.1.2 Hotel/Motel Guest Rooms and High-Rise Residential Dwellings Thermostats

§120.2(c)

The Energy Standards require that thermostats in hotel and motel guest rooms have:

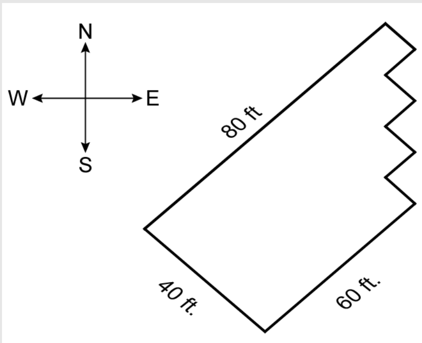
1. Numeric temperature setpoints in °F and °C, and
2. Setpoint stops that prevent the thermostat from being adjusted outside the normal comfort range (± 5ºF or ± 3ºC). These stops must be concealed so that they are accessible only to authorized personnel, and
3. Setback capabilities with a minimum of four separate setpoints per 24 hour period; in additions, for nonresidential buildings, The Energy Standards effectively prohibit thermostats

The Energy Standards require that thermostats in high-rise residential dwelling units have setback capabilities with a minimum of four separate setpoints per 24 hour period; in additions, for nonresidential buildings, the Energy Standards effectively prohibit thermostats.

Example 4-24

Question

What is the perimeter zoning required for the building shown here?



Answer

The southeast and northwest exposures must each have at least one perimeter system control zone, since they are more than 50 ft. in length. The southwest exposure and the serrated east exposure do not face one direction for more than 50 continuous ft. in length. They are therefore “minor” exposures and need not be served by separate perimeter system zones, but may be served from either of the adjacent zones.

Example 4-25

Question

Pneumatic thermostats are proposed to be used for zone control. However, the model specified cannot be adjusted to meet the range required by §120.2(a) to (c). How can this system comply?

Answer

§120.2(a) to (c) applies to “thermostatic controls” which can be a system of thermostats or control devices, not necessarily a single device. In this case, the requirement could be met by using multiple thermostats. The pneumatic thermostats could be used for zone control during occupied hours and need only have a range consistent with occupied temperatures (e.g. 68°F to 78°F), while two additional electric thermostats could be provided, one for setback control (adjustable down to 55°F) and one for set-up (adjustable up to 85°F). These auxiliary thermostats would be wired to temporarily override the system to maintain the setback/setup setpoints during off-hours.

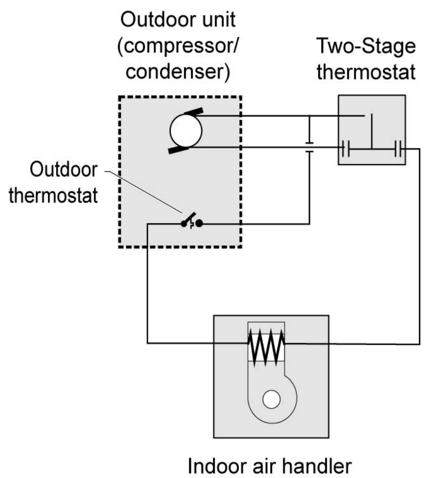
4.5.1.3 **Heat Pump Controls**

§110.2(b) and §120.2(d)

Heat pumps with electric resistance supplemental heaters must have controls that limit the operation of the supplemental heater to defrost and as a second stage of heating when the heat pump alone cannot satisfy the load. The most effective solution is to specify an electronic thermostat designed specifically for use with heat pumps. This “anticipatory” thermostat can detect if the heat pump is raising the space temperature during warm-up fast enough to warrant locking out the auxiliary electric resistance heater.

This requirement can also be met using conventional electronic controls with a two-stage thermostat and an outdoor lockout thermostat wired in series with the auxiliary heater. The outdoor thermostat must be set to a temperature where the heat pump capacity is sufficient to warm up the space in a reasonable time (e.g., above 40°F). This conventional control system is depicted schematically below in Figure 4-11.

Figure 4-11: Heat Pump Auxiliary Heat Control, Two-Stage and Outdoor Air Thermostats



4.5.1.4 **Shut-off and Temperature Setup/Setback**

§120.2(e)1,2 and 3

For specific occupancies and conditions, each space-conditioning system must be provided with controls that comply with the following requirements:

A. The control can automatically shut off the equipment during unoccupied hours and shall have one of the following:

1. An automatic time switch device must with the same characteristics that lighting devices must have, as described in Chapter 5, and a manual override accessible to the occupants that allows the system to operate up to four hours. The manual override can be included as a part of the control device, or as a separate override control.
2. An occupancy sensor. Since a building ventilation purge is required prior to normal occupancy, an occupancy sensor may be used to control the availability of heating and cooling, but should not be used to control the outdoor ventilation system.
3. A 4-hour timer that can be manually operated to start the system. As with occupancy sensors, the same restrictions apply to controlling outdoor air ventilation systems.

Exception to §120.2(e)1: The mechanical system serving retail stores and associated malls, restaurants, grocery stores, churches, or theaters equipped with 7-day programmable timers do not have to comply with the above requirements.

B. When shut down, the controls shall automatically restart the system to maintain:

1. A setback heating thermostat setpoint, if the system provides mechanical heating. *Exception:* Thermostat setback controls are not required in nonresidential buildings in areas where the Winter Median of Extremes outdoor air temperature is greater than 32°F.
2. A setup cooling thermostat setpoint, if the system provides mechanical cooling. *Exception:* Thermostat setup controls are not required in nonresidential buildings in areas where the Summer Design Dry Bulb 0.5 percent temperature is less than 100°F.

C. Occupant Sensor Ventilation Coil and Setback

Multipurpose room less than 1,000 ft^2, classrooms greater than 750 ft^2, conference, convention, auditorium and meeting center rooms greater than 750 ft^2 that do not have processes or operations that generate dusts, fumes, vapors or gasses shall be equipped with occupant sensor(s) to accomplish the following when occupants are not present:

1. Slightly widen the thermal deadband: Automatically setup the operating cooling temperature set point by 2°F or more and setback the operating heating temperature set point by 2˚F or more; and
2. Automatically reset the minimum required ventilation rate with an occupant sensor ventilation control device according to Section 4.3.8.

This scenario requires an additional control sequence for built-up VAV systems or a thermostat that can accept an occupancy sensor input and has three scheduling modes (occupied, standby, and unoccupied) for packaged equipment. A thermostat with three scheduling modes works as follows:

- The unoccupied period is scheduled as usual for the normal unoccupied period, e.g. nighttime.
- The occupied period is scheduled as usual for the normal occupied period, e.g. daytime.
- When the morning warm-up occurs, the thermostat's occupied schedule is used to establish the heating/cooling temperature setpoints.
- Upon completion of the morning warm-up, the standby setpoint schedule on the thermostat is enabled.

This schedule remains in effect until occupancy is sensed (then enabling the occupied setpoint schedule) or until the normally scheduled unoccupied period occurs. After the period of occupancy ends (e.g. a conference room is vacated) and the time delay expires as programmed into the occupancy sensor, the standby setpoint schedule on the thermostat is enabled.

The following chart shows an example of how the three scheduling modes might be programmed for a cooling setup of 4°F and a heating setback of 4°F.

Example Thermostat Setpoints for Three Modes

	Cooling, °F	Heating, °F
Occupied	75	70
Standby	78	67
Unoccupied	80	62

E. Exceptions for automatic shut-off, setback and setup, and occupant sensor setback:

1. *Exception to 1, 2 and 3:* It can be demonstrated to the satisfaction of the enforcement agency that the system serves an area that must operate continuously
2. *Exception to 1, 2 and 3:* It can be demonstrated to the satisfaction of the enforcement agency that shutdown, setback, and setup will not result in a decrease in overall building source energy use
3. *Exception to 1, 2 and 3:* Systems have a full load demand less than 2 kW, or 6,826 Btu/h, if they have a readily accessible manual shut-off switch. Included is the

energy consumed within all associated space-conditioning systems including compressors, as well as the energy consumed by any boilers or chillers that are part of the system.

4. *Exception to 1 and 2:* Systems serve hotel/motel guest rooms, if they have a readily accessible manual shut-off switch.
5. *Exception to 3:* If demand control ventilation is implemented as required by 4.3.7.

F. Hotel/Motel Guest Room Controls:

§120.2(e)4

Hotel and motel guest rooms shall have captive card key controls, occupancy sensing controls, or automatic controls such that, no longer than 30 minutes after the guest room has been vacated, setpoints are setup at least +5°F (+3°C) in cooling mode and set-down at least -5°F (-3°C) in heating mode.

Example 4-26

Question

Can occupancy sensors be used in an office to shut off the VAV boxes during periods the spaces are unoccupied?

Answer

Yes, only if the ventilation is provided through operable openings. With a mechanical ventilation design the occupancy sensor could be used to reduce the VAV box airflow to the minimum allowed for ventilation. It should not shut the airflow off completely, ventilation must be supplied to each space at all times when the space is usually occupied.

Example 4-27

Question

Must a 48,000 ft² building with 35 fan coil units have 35 time switches?

Answer

No. More than one space-conditioning system may be grouped on a single time switch, subject to the area limitations required by the isolation requirements (see Isolation). In this case, the building would need two isolation zones, each no larger than 25,000 ft², and each having its own time switch.

Example 4-28

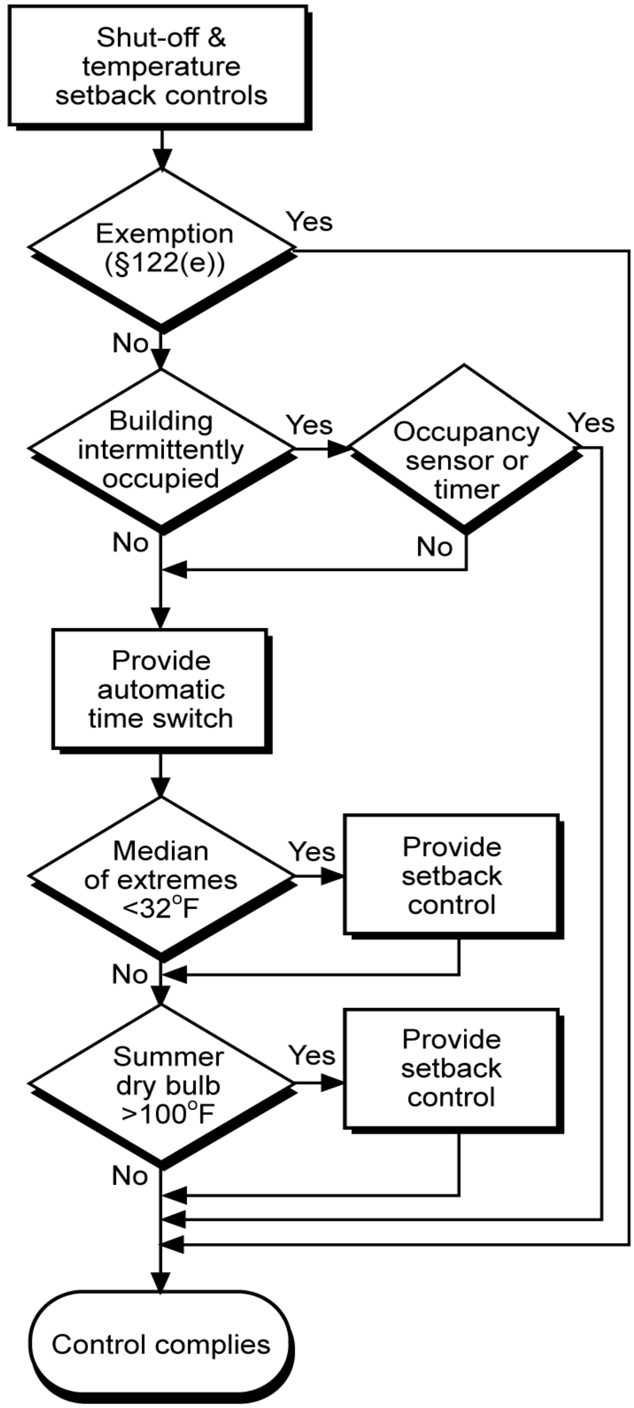
Question

Can a thermostat with setpoints determined by sensors (such as a bi-metal sensor encased in a bulb) be used to accomplish a night setback?

Answer

Yes. The thermostat must have two heating sensors, one each for the occupied and unoccupied temperatures. The controls must allow the setback sensor to override the system shutdown.

Figure 4-12: Shut-Off and Setback Controls Flowchart



These provisions are required by the Energy Standards to reduce the likelihood that shut-off controls will be circumvented to cause equipment to operate continuously during unoccupied hours.

Example 4-29

Question

If a building has a system comprised of 30 fan coil units, each with a 300-watt fan, a 500,000 Btu/h boiler, and a 30-ton chiller, can an automatic time switch be used to control only the boiler and chiller (fan coils operate continuously)?

Answer

No. The 2 kW criteria applies to the system as a whole, and is not applied to each component independently. While each fan coil only draws 300 W, they are served by a boiler and chiller that draw much more. The consumption for the system is well in excess of 2 kW.

Assuming the units serve a total area of less than 25,000 ft² (see Isolation), one time switch may control the entire system.

4.5.1.5 **Infiltration Control**

§120.2(f)

Outdoor air supply and exhaust equipment must incorporate dampers that automatically close when fans shut down.

Fans shut down when ventilation or conditioned air is not necessary for the building, which only occurs when a normally scheduled unoccupied period begins (such as overnight or a weekend for office buildings. The dampers may either be motorized, or of the gravity type, however only motorized dampers that remain closed when the fan turns on would be capable of accomplishing the best practice below

Best Practice

Though the Energy Standards only specify fan shut down, as a best practice outside air dampers should also remain completely closed during the unoccupied periods, even when the fan turns on to provide setback heating or cooling. However, to avoid instances of insufficient ventilation, or sick building syndrome, the designer should specify that the outside air dampers open and provide ventilation if:

- The unoccupied period is a 1-hour pre-occupancy purge ventilation, as per §120.1(c)2.
- The damper is enabled by an occupant sensor in the building as per §120.1(c)5, indicating that there are occupants that demand ventilation air.
- The damper is enabled by an override signal as per §120.2(e)1, which includes an occupancy sensor but also an automatic time switch control device or manually operated 4-hour timer.

Exception 1: Damper control is not required where it can be demonstrated to the satisfaction of the enforcement agency that the space-conditioning system must operate continuously.

Exception 2: Nor is damper control required on gravity ventilators or other non-electrical equipment, provided that readily accessible manual controls are incorporated..

Exceptions 3 and 4: Damper control is also not required at combustion air intakes and shaft vents, or where prohibited by other provisions of law. If the designer elects to install dampers or shaft vents to help control stack-induced infiltration, the damper should be motorized and controlled to open in a fire in accordance with applicable fire codes.

4.5.1.6 Isolation Area Controls

§120.2(g)

Large space-conditioning systems serving multiple zones may waste considerable quantities of energy by conditioning all zones when only a few zones are occupied. Typically, this occurs during evenings or weekends when only a few people are working. When the total area served by a system exceeds 25,000 ft², the Energy Standards require that the system be designed, installed and controlled with area isolation devices to minimize energy consumption during these times. The requirements are:

1. The building shall be divided into isolation areas, the area of each not exceeding 25,000 ft². An isolation area may consist of one or more zones.
2. An isolation area cannot include spaces on different floors.
3. Each isolation area shall be provided with isolations devices such as valves or dampers that allow the supply of heating or cooling to be setback or shut off independently of other isolation areas.
4. Each isolation area shall be controlled with an automatic time switch, occupancy sensor, or manual timer. The requirements for these shut-off devices are the same as described previously in 4.5.1.4. As discussed previously for occupancy sensors, a building purge must be incorporated into the control sequences for normally occupied spaces, so occupancy sensors and manual timers are best limited to use in those areas that are intermittently occupied.

Any zones requiring continuous operation do not have to be included in an isolation area.

Example 4-30

Question

How many isolation zones does a 55,000-ft² building require?

Answer

At least three. Each isolation zone may not exceed 25,000-ft².

A. Isolation of Zonal Systems

Small zonal type systems such as water loop heat pumps or fan coils may be grouped on automatic time switch devices, with control interlocks that start the central plant equipment whenever any isolation area is occupied. The isolation requirements apply to equipment supplying heating and cooling only; central ventilation systems serving zonal type systems do not require these devices.

B. Isolation of Central Air Systems

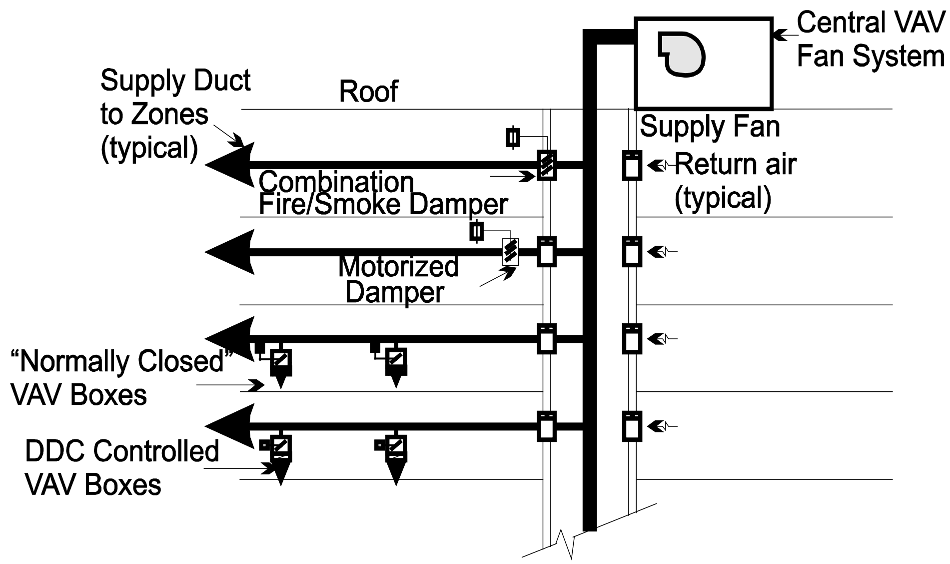
Figure 4-13 below depicts four methods of area isolation with a central variable air volume system:

1. On the lowest floor, programmable DDC boxes can be switched on a separate time schedule for each zone or blocks of zones. When unoccupied, the boxes can be programmed to have zero minimum volume setpoints and unoccupied setback/setup setpoints. Note this form of isolation can be used for sections of a single floor distribution system.
2. On the second floor, normally closed pneumatic or electric VAV boxes are used to isolate zones or groups of zones. In this scheme the control source (pneumatic air or control power) for each group is switched on a separate control signal from an

individual time schedule. Again this form of isolation can be used for sections of a single floor distribution system.

3. On the third floor, isolation is achieved by inserting a single motorized damper on the trunk of the distribution ductwork. With the code requirement for fire/smoke dampers (see next bullet) this method is somewhat obsolete. When applied this method can only control a single trunk duct as a whole. Care must be taken to integrate the motorized damper controls into the fire/life safety system.
4. On the top floor, a combination fire smoke damper is controlled to provide the isolation. Again this control can only be used on a single trunk duct as a whole. Fire/smoke dampers required by code can be used for isolation at virtually no cost provided that they are wired so that the fire life-safety controls take precedence over off-hour controls. (Local fire officials generally allow this dual usage of smoke dampers since it increases the likelihood that the dampers will be in good working order in the event of a fire.) Note that no isolation devices are required on the return.

Figure 4-13: Isolation Methods for a Central VAV System



Example 4-31

Question

Does each isolation area require a ventilation purge?

Answer

Yes. Consider each isolation area as if it were a separate air handling system, each with its own time schedule, setback and setup control, etc.

C. Turndown of Central Equipment

Where isolation areas are provided it is critical that the designer design the central systems (fans, pumps, boilers and chillers) to have sufficient stages of capacity or turndown controls to operate stably as required to serve the smallest isolation area on the system. Failure to do so may cause fans to operate in surge, excessive equipment cycling and loss of temperature control. Schemes include:

1. Application of demand based supply pressure reset for VAV fan systems. This will generally keep variable speed driven fans out of surge and can provide 10:1 turndown.
2. Use of pony chillers, an additional small chiller to be used at partial load conditions, or unevenly split capacities in chilled water plants. This may be required anyway to serve 24/7 loads.
3. Unevenly split boiler plants.

4.5.1.7 **Automatic Demand Shed Controls**

§120.2(h)

HVAC systems with DDC to the zone level must be programmed to allow centralized demand shed for non-critical zones as follows:

1. The controls shall have a capability to remotely setup the operating cooling temperature set points by four degrees or more in all non-critical zones on signal from a centralized contact or software point within an Energy Management Control System (EMCS).
2. The controls shall be capable of remotely setdown the operating heating temperature set points by four degrees or more in all non-critical zones on signal from a centralized contact or software point within an EMCS.
3. The controls shall have capabilities to remotely reset the temperatures in all non-critical zones to original operating levels on signal from a centralized contact or software point within an EMCS.
4. The controls shall be programmed to provide an adjustable rate of change for the temperature setup and reset.
5. The controls shall have the following features:
   a. Disabled. Disabled by authorized facility operators; and
   b. Manual control. Manual control by authorized facility operators to allow adjustment of heating and cooling set points globally from a single point in the EMCS; and
   c. Automatic Demand Shed Control. Upon receipt of a demand response signal, the space-conditioning systems shall conduct a centralized demand shed, as specified in 1 and 2 above, for non-critical zones during the demand response period.

The Energy Standards defines a critical zone as a zone serving a process where reset of the zone temperature setpoint during a demand shed event might disrupt the process, including but not limited to data centers, telecom/private branch exchange (PBX) rooms, and laboratories.

To comply with this requirement, each non-critical zone temperature control loop will need a switch that adds in an offset on the cooling temperature setpoint on call from a central demand shed signal. A rate of change limiter can either be built into the zone control or into the functional block for the central offset value. The central demand shed signal can be activated either through a global software point or a hardwired digital contact.

This requirement is enhanced with an acceptance test to ensure that the system was programmed as required.

4.5.1.8 **Economizer Fault Detection and Diagnostics**

§120.2(i)

Economizer Fault Detection and Diagnostics (FDD) is a mandatory requirement for all newly installed air-cooled packaged direct-expansion units with the following:

- an air handler mechanical cooling capacity greater than or equal to 54,000 Btu/hr.
- an air economizer.

The FDD system can be either a stand-alone unit or integrated. A stand-alone FDD unit is added onto the air handler, while an integrated FDD system is included in the air handler system controller or is part of the EMCS.

Where required, the FDD system shall meet the following requirements:

1. The following temperature sensors shall be permanently installed to monitor system operation: outside air, supply air, and return air; and
2. Temperature sensors shall have an accuracy of ±2°F over the range of 40°F to 80°F; and
3. The controller shall have the capability of displaying the value of each sensor; and
4. 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.
    e. Mixed air low limit cycle active.
5. The unit controller shall manually initiate each operating mode so that the operation of compressors, economizers, fans, and heating system can be independently tested and verified; and
6. Faults shall be reported using one of the following options:
    a. An EMCS that is regularly monitored by facility personnel.
    b. Displayed locally on one or more zone thermostats or a device within 5 feet of a zone thermostat, clearly visible, at eye level and meet the following requirements:
        i. On the thermostat, device, or an adjacent written sign, there must be instructions displayed for how to contact the appropriate building personnel or an HVAC technician to service the fault.
        ii. In buildings with multiple tenants, the fault notification 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 that automatically provides notification of the fault to a remote HVAC service provider. This allows the service provider to coordinate with an HVAC technician to service the fault.
7. The FDD system shall have the minimum capability of detecting the following faults:
    a. Air temperature sensor failure/fault. This failure mode is a malfunctioning air temperature sensor, such as the outside air, discharge air, or return air

temperature sensor. This could include mis-calibration, complete failure either through damage to the sensor or its wiring, or failure due to disconnected wiring.

b. Not economizing when it should. In this case, the economizer should be enabled, but for some reason it's not providing free cooling. This leads to an unnecessary increase in mechanical cooling energy. Two examples are the economizer high limit setpoint is too low, say 55˚F, or the economizer is stuck closed.

c. Economizing when it should not. This is opposite to the previous case of not economizing when it should. In this case, conditions are such that the economizer should be at minimum ventilation position but for some reason it is open beyond the correct position. This leads to an unnecessary increase in heating and cooling energy. Two examples are the economizer high limit setpoint is too high, say 82˚F, or the economizer is stuck open.

d. Damper not modulating. This issue represents a stuck, disconnected, or otherwise inoperable damper that does not modulate open and closed. It is a combination of the previous two faults: not economizing when it should, and economizing when it should not.

e. Excess outdoor air. This failure mode is the economizer provides an excessive level of ventilation, usually much higher than is needed for design minimum ventilation. It causes an energy penalty during periods when the economizer should not be enabled, that is, during cooling mode when outdoor conditions are higher than the economizer high limit setpoint. During heating mode, excess outdoor air will increase heating energy.

8. The FDD system shall be certified to the Energy Commission, by the manufacturer of the FDD system, to meet the requirements 1 through 7 above. The manufacturer submittal package is available in Joint Appendices *JA6.3 Economizer Fault Detection and Diagnostics Certification Submittal Requirements*.

4.5.1.9 **Direct Digital Controls**

§120.2(j)

New to the 2016 Energy Standards is the requirement to include Direct Digital Controls in buildings for new construction, additions or alterations. Previously, the Energy Standards did not require the installation of DDC, however if a builder did install DDC it would trigger code sections of Title 24 requiring specific energy saving measures that can be effectively implemented with DDC. This new requirement (for DDC systems in building applications, where appropriate) will increase building energy savings that were not previously captured.

The requirement for DDC will mostly impact smaller buildings, since it is already common practice to install DDC in medium and large buildings; primarily due to the size and complexity of HVAC systems of medium and large buildings, which DDC is well suited to operate. Small buildings in the past did not require DDC and therefore could not take advantage of basic energy savings strategies.

DDC systems facilitate energy saving measures through monitoring and regulating the HVAC systems and optimizing their efficient operation. With most buildings requiring DDC, the following energy saving measures will be triggered if DDC is to the zone level:

1. Demand Control Ventilation (mandatory) - Section 4.3.7
2. Automatic Demand Shed Controls (mandatory) - Section 4.5.1.7
3. Optimum Start/Stop Controls (mandatory) - Section 4.5.1.10

4. Setpoint Reset Controls for Variable Air Volume Systems (prescriptive) - Section 4.5.2.3

For further explanation, see the appropriate compliance manual sections for the measures listed above.

The Energy Standards mandate DDC for only certain building applications with minimum qualifications or equipment capacities, as specified in Table 120.2-A of the Energy Standards, see Table 4-17 below for a duplicate of this table.

Table 4-17: 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 with design heating or cooling capacity of 300 kBtu/h and larger and supplying more than three zones and more than 75 percent of zones are new
Additions or Alterations	New or upgraded chilled water plant	Where all chillers are new and plant design cooling capacity is 300 kBtu/h (87.9 kW) and larger
Additions or Alterations	New or upgraded hot water plant	Where all boilers are new and plant design heating capacity is 300 kBtu/h (87.9 kW) and larger

Table 120.2-A of the Energy Standards

Buildings that do not meet the specified minimum qualifications are not required to install DDC.

Follow the logic flowchart in Figure 4-14 to determine if a DDC system is required for newly constructed buildings or for additions or alterations to buildings. The Building Status Flowchart will indicate which equipment flowchart (Figure 4-15 through Figure 4-19) should be used for each type of HVAC equipment that will be installed in the building.

The logic of the equipment flowcharts will indicate whether DDC is required for the building, how DDC should be applied to the equipment and whether DDC is required to be installed to the zone level.

Figure 4-14: Building Status Flowchart

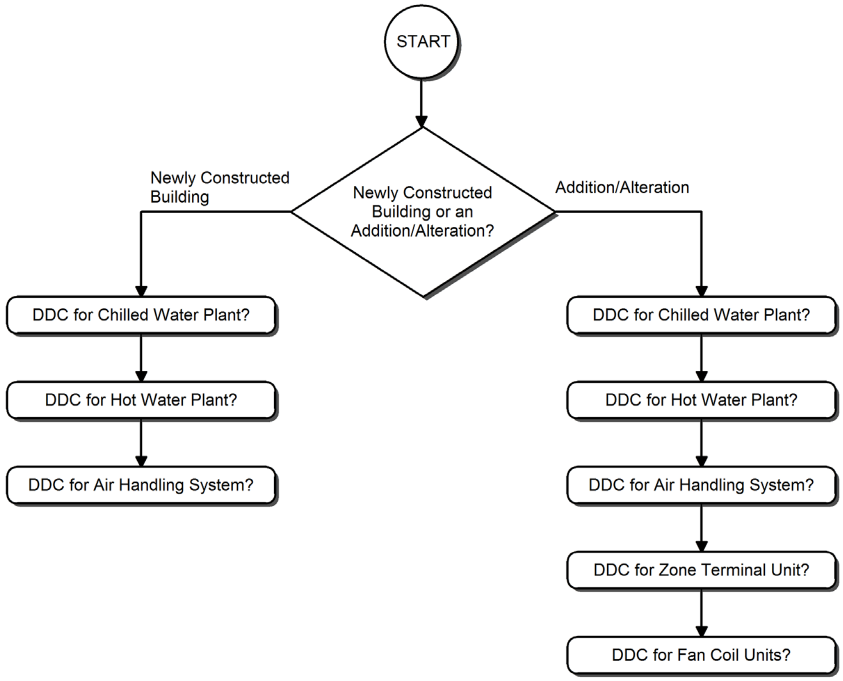


Figure 4-15: Chilled Water Plant Flowchart

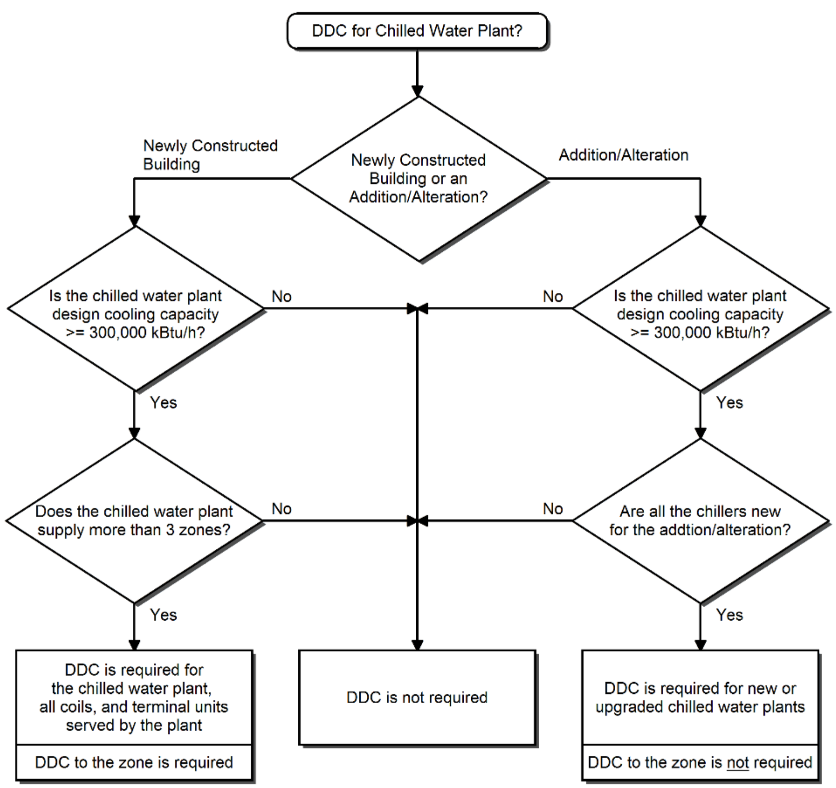


Figure 4-16: Hot Water Plant Flowchart

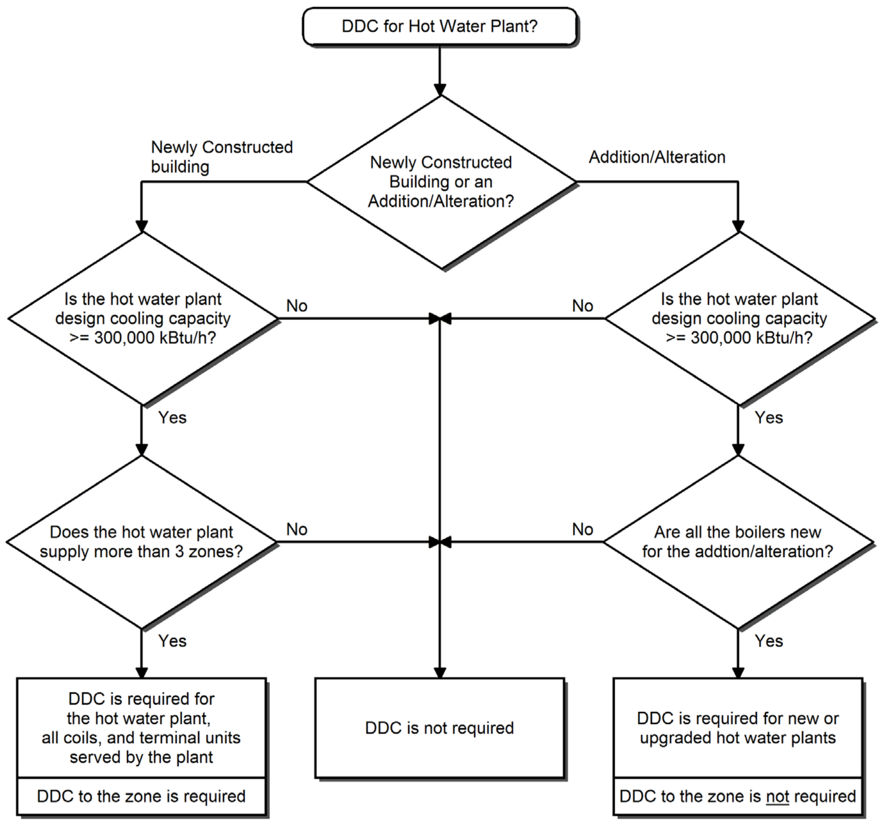


Figure 4-17: Air Handling System Flowchart

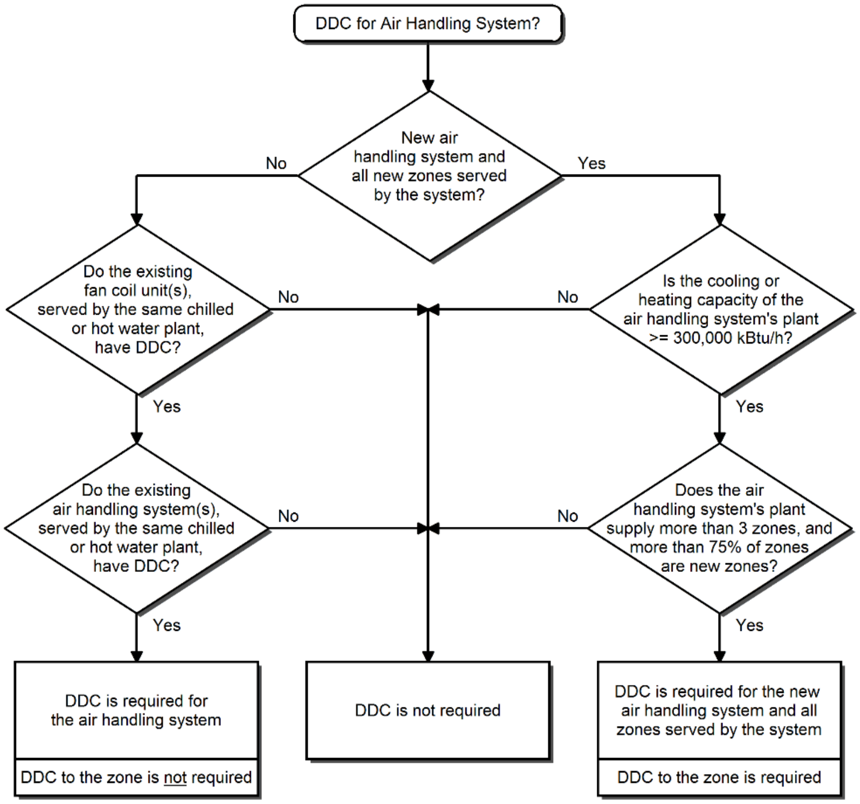


Figure 4-18: Zone Terminal Unit Flowchart

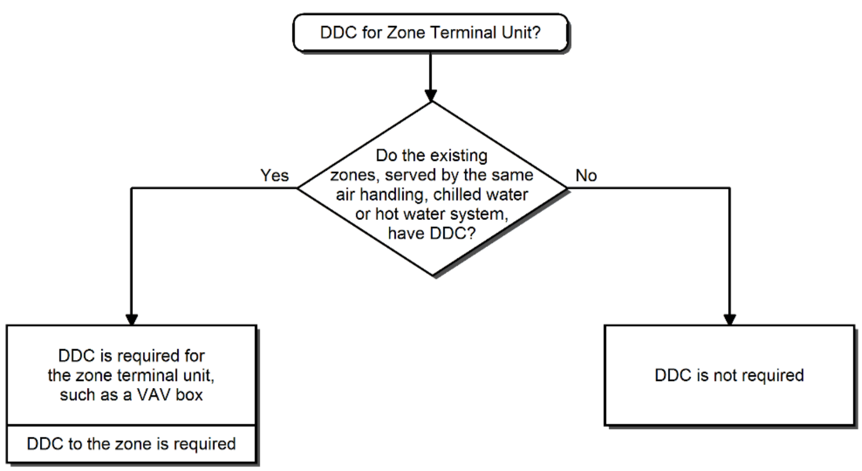
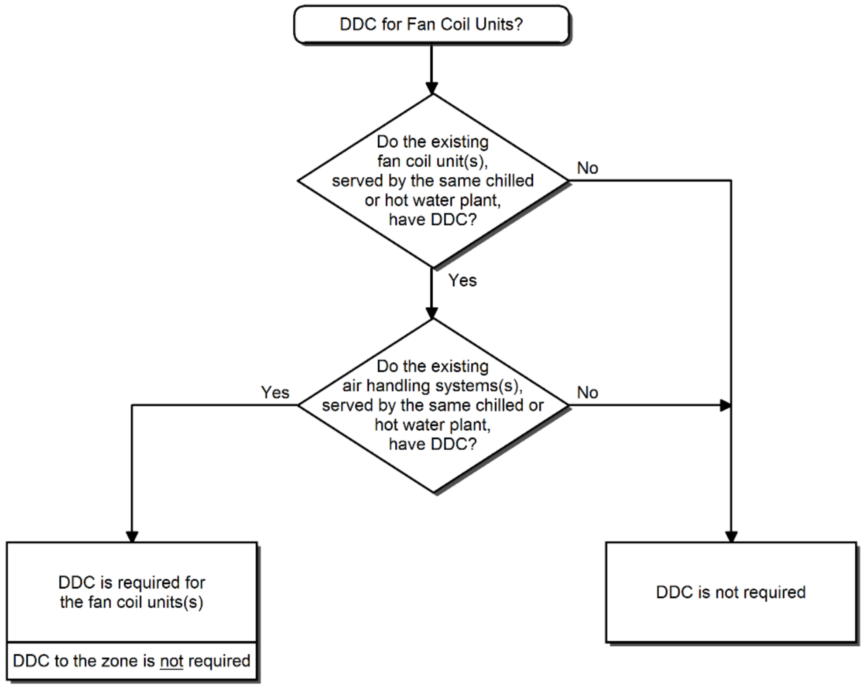


Figure 4-19: Fan Coil Units Flowchart



For additions or alterations to buildings, zones that are not part of the addition or alteration are not required to be retrofitted with DDC. Pre-existing DDC systems in buildings are not required to be retrofitted so DDC is to the zone.

Example 4-32

Question

If a newly constructed building has a HVAC system comprised of an air handling system, serving 4 zones and a chilled water plant with a design cooling capacity of 250,000 Btu/h, is DDC required?

Answer

No. Although the HVAC system is serving more than 3 zones, the chilled water plant does not meet the minimum design cooling capacity of 300,000 Btu/h (300 kBtu/h). A DDC system would be required if the design cooling capacity was 300,000 Btu/h or larger.

Example 4-33

Question

If an addition to a building requires a new VAV box, is DDC required?

Answer

Yes or No. The answer is dependent upon whether there is already a DDC system for the zones served by the same air handling, chilled water or hot water system. Essentially this is to ensure that if a DDC system is already installed, than it must be continued throughout the building, including the addition.

Example 4-34

Question

If a building's chilled water plant is upgraded with new chillers that have a design capacity of 500 kBtu/h and serves 3 zones, is DDC required?

Answer

Yes. The criteria that triggers the DDC requirement is that the plant upgrade is installing **new** chillers with a cooling capacity greater than 300 kBtu/h. In this case, the number of zones is irrelevant for determining if DDC is required.

The Energy Standards now require the mandated DDC system to have the following capabilities to ensure that the full energy saving benefits of DDC:

1. Monitor zone and system demand for fan pressure, pump pressure, heating and cooling
2. Transfer zone and system demand information from zones to air distribution system controllers and from air distribution systems to heating and cooling plant controllers
3. Automatically detect those zones and systems that may be excessively driving the reset logic and generate an alarm or other indication to the system operator
4. Readily allow operator removal of zone(s) from the reset algorithm
5. For new buildings, trending and graphically displaying input and output points, and
6. Resetting setpoints in non-critical zones upon a signal; from a centralized contract or software point as described in 4.5.1.7.

4.5.1.10 **Optimum Start/Stop Controls**

§120.2(k)

New to the 2016 Energy Standards are requirements for optimum start/stop controls when DDC is to the zone level.

Optimum start/stop controls are an energy saving technique where the HVAC system determines the optimum time to turn on or turn off the HVAC system so that the space reaches the appropriate temperature during occupied hours only, without wasting energy to condition the space during unoccupied hours; applies both to heating and cooling.

Optimum start controls are designed to automatically adjust the start time of a space conditioning system each day with the intent of bringing the space temperature to the desired occupied temperature levels at the beginning of scheduled occupancy. The controls shall take in to account the space temperature, outside ambient temperature, occupied temperature, amount of time prior to scheduled occupancy, and if present, the floor temperatures of a mass radiant floor slab systems.

Optimum stop controls are designed to automatically adjust the stop time of a space conditioning system each day with the intent of letting the space temperature coast to the unoccupied temperature levels after the end of scheduled occupancy. The controls shall take in to account the space temperature, outside ambient temperature, unoccupied temperature, and the amount of time prior to scheduled occupancy.

4.5.2 Prescriptive Requirements

4.5.2.1 Space Conditioning Zone Controls

§140.4(d)

Each space-conditioning zone shall have controls that prevent:

1. Reheating of air that has been previously cooled by mechanical cooling equipment or an economizer.
2. Recooling of air that has been previously heated. This does not apply to air returned from heated spaces.
3. Simultaneous heating and cooling in 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.

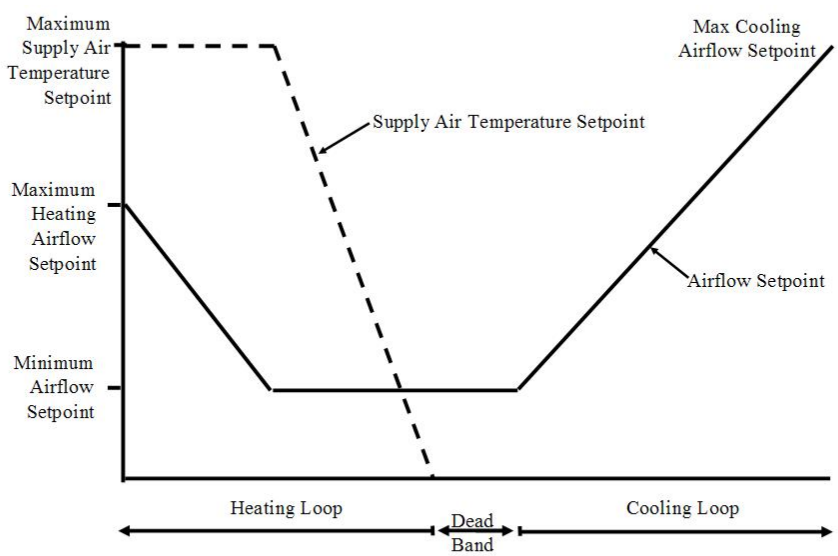
Certain exceptions exist for space conditioned zones with one of the following:

1. Special pressurization relationships or cross contamination control needs. Laboratories are an example of spaces that might fall in this category.
2. Site-recovered or site-solar energy providing at least 75 percent of the energy for reheating, or providing warm air in mixing systems.
3. Specific humidity requirements to satisfy exempt process needs. Computer rooms are explicitly not covered by this exception.
4. Zones with a peak supply air quantity of 300 cfm or less.
5. Zones served by variable air volume systems that are designed and controlled to reduce the volume of reheated, recooled or mixed air to a minimum. The controls must meet all of the following:
   a. For each zone with direct digital controls (DDC):
      i. The volume of primary air that is reheated, re-cooled, or mixed air supply shall not exceed the larger of:
         1. 50 percent of the peak primary airflow; or
         2. The design zone outdoor airflow rate per Section 4.3
      ii. The volume of primary air in the dead band shall not exceed the larger of:
         1. 20 percent of the peak primary airflow; or
         2. The design zone outdoor airflow rate per Section 4.3
      iii. The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint no higher than 95ºF while the airflow is maintained at the deadband flow rate
      iv. The second stage of heating consists of modulating the airflow rate from the deadband flow rate up to the heating maximum flow rate.
   b. For each zone without DDC, the volume of primary air that is reheated, re-cooled, or mixed air supply shall not exceed the larger of the following:
      i. 30 percent of the peak primary airflow; or
      ii. The design zone outdoor airflow rate per Section 4.3.

For systems with DDC to the zone level, the controls must be able to support two different maximums: one each for heating and cooling. This control is depicted in Figure 4-20 below. In cooling, this control scheme is similar to a traditional VAV reheat box control. The difference is what occurs in the deadband between heating and cooling and in the heating mode. With traditional VAV control logic, the minimum airflow rate is typically set to the largest rate allowed by code. This airflow rate is supplied to the space in the deadband and heating modes. With the "dual maximum" logic, the minimum rate is the lowest allowed by code (e.g. the minimum ventilation rate) or the minimum rate the controls system can be set to (which is a function of the VAV box velocity pressure sensor amplification factor and the accuracy of the controller to convert the velocity pressure into a digital signal). As the heating demand increases, the dual maximum control first resets the discharge air temperature (typically from the design cold deck temperature up to 85 or 90°F) as a first stage of heating then, if more heat is required, it increases airflow rate up to a “heating” maximum airflow setpoint, which is the same value as what traditional control logic uses as the minimum airflow setpoint. Using this control can save significant fan, reheat and cooling energy while maintaining better ventilation effectiveness as the discharge heating air is controlled to a temperature that will minimize stratification.

This control requires a discharge air sensor and may require a programmable VAV box controller. The discharge air sensor is very useful for diagnosing control and heating system problems even if they are not actively used for control.

Figure 4-20: Dual-Maximum VAV Box Control Diagram



For systems without DDC to the zone (such as electric or pneumatic thermostats), the airflow that is reheated is limited to a maximum of the larger either 30 percent of the peak primary airflow or the minimum airflow required to ventilate the space.

Example 4-35

Question

What are the limitations on VAV box minimum airflow setpoint for a 1,000 ft² office having a design supply of 1,100 cfm and 8 people?

Answer

For a zone with pneumatic thermostats, the minimum cfm cannot exceed the larger of:

a. 1,100 cfm x 30 percent = 330 cfm; or

b. The minimum ventilation rate which is the larger of

1) 1,000 ft^2 x 0.15 cfm/ft^2 = 150 cfm; and

2) 8 people x 15 cfm/person = 120 cfm

Thus the minimum airflow setpoint can be no larger than 330 cfm.

For a zone with DDC to the zone, the minimum cfm in the deadband cannot exceed the larger of:

a. 1,100 cfm x 20 percent = 220 cfm; or

b. The minimum ventilation rate which is the larger of

1) 1,000 ft^2 x 0.15 cfm/ft^2 = 150 cfm; and

2) 8 people x 15 cfm/person = 120 cfm

Thus the minimum airflow setpoint in the dead band can be no larger than 220 cfm. And this can rise to 1100 cfm X 50 percent or 550 cfm at peak heating.

For either control system, based on ventilation requirements, the lowest minimum airflow setpoint must be at least 150 cfm, or transfer air must be provided in this amount.

4.5.2.2 Economizers

§140.4(e)

An economizer must be fully integrated and must be provided for each individual cooling air handler system that has a total mechanical cooling capacity over 54,000 Btu/h. The economizer may be either:

1. 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
2. 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.

Depicted below in Figure 4-21 is a schematic of an air-side economizer. All air-side economizers have modulating dampers on the return and outdoor air streams.

Best Practice:

To provide 100 percent of the design supply air, designers will need to specify an economizer with a nominal capacity sufficient to deliver the design air flow rate when the supply air damper is in the full open position, and the return air damper is completely closed.

An appropriately sized economizer can also be estimated by determining the face velocity passing through the economizer by using the design airflow and the area of the economizer damper/duct opening.

The design airflow (cfm) should be available from the mechanical drawings or air handler cutsheet. The minimum area (ft^2) through which air is flowing from the outside to the fan can be measured in the field, or it can be found on the economizer damper cutsheet if the economizer damper is the smallest area. Dividing the design airflow by the smallest area will give the velocity of the air in ft/min.
Appropriately sized economizers that can supply 100% of the supply airflow without large pressure drops typically have face velocities of less than 2,000 ft/min.

To maintain acceptable building pressure, systems with an airside economizer must have provisions to relieve or exhaust air from the building. In Figure 4-21, three common forms of building pressure control are depicted:

- Option 1 barometric relief.
- Option 2 a relief fan generally controlled by building static pressure.
- Option 3 a return fan often controlled by tracking the supply.

Figure 4-22 depicts an integrated air-side economizer control sequence. On first call for cooling the outdoor air damper is modulated from minimum position to 100 percent outdoor air. As more cooling is required, the damper remains at 100 percent outdoor air as the cooling coil is sequenced on.

Graphics of water-side economizers are presented in Section 4.10.7.2 at the end of this chapter.

Figure 4-21: Air-Side Economizer Schematic

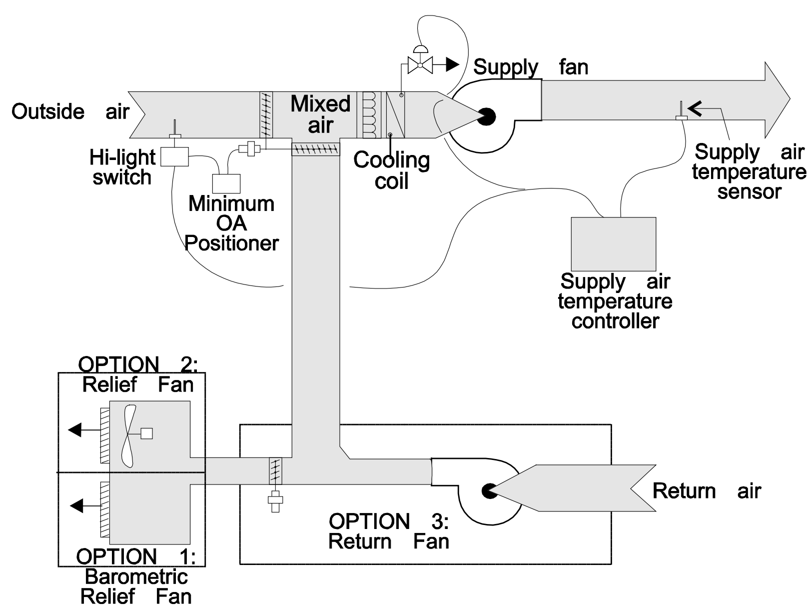
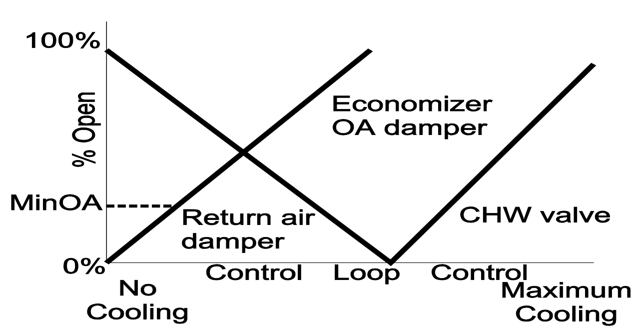


Figure 4-22: Typical Air-Side Economizer Control Sequencing



A. Economizers are not required where:

Exceptions to §140.4(e)1

1. Outside air filtration and treatment for the reduction and treatment of unusual outdoor contaminants make compliance infeasible.
2. Increased overall building TDV energy use results. This may occur where economizers adversely impact other systems, such as humidification, dehumidification or supermarket refrigeration systems.
3. Systems serving high-rise residential living quarters and hotel/motel guest rooms.
4. If cooling capacity is less than or equal to 54,000 Btu/h
5. Where cooling systems have the cooling efficiency that meets or exceeds the cooling efficiency improvement requirements in Table 4-18.
6. Fan systems primarily serving computer room(s). See §140.9 (a) for computer room economizer requirements.

B. If an economizer is required, it must be:

§140.4(e)2

1. Designed and equipped with controls that do not increase the building heating energy use during normal operation. This prohibits the application of single-fan dual-duct systems and traditional multizone systems using the Prescriptive Approach of compliance. With these systems, the operation of the economizer to pre-cool the air entering the cold deck also precools the air entering the hot deck and thereby increases the heating energy.

   Exception: when at least 75 percent of the annual heating is provided by site-recovered or site-solar energy.
2. Fully integrated into the cooling system controls so that the economizer can provide partial cooling even when mechanical cooling is required to meet the remainder of the cooling load. On packaged units with stand-alone economizers, a two-stage thermostat is necessary to meet this requirement.

The requirement that economizers be designed for concurrent operation is not met by some popular water economizer systems, such as those that use the chilled water system to convey evaporatively-cooled condenser water for “free” cooling. Such systems can provide 100 percent of the cooling load, but when the point is reached where condenser water temperatures cannot be sufficiently cooled by evaporation; the system controls throw the entire load to the mechanical chillers. Because this design cannot allow simultaneous economizer and refrigeration system operation, it does not meet the requirements of this section. An integrated water-side economizer which uses condenser water to precool the CHWR before it reaches the chillers (typically using a plate-and-frame heat exchanger) can meet this integrated operation requirement.

Table 4-18: 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%

Energy Standards Table 140.4-A

[a] If a unit is rated with an IPLV, IEER or SEER, then to eliminate the required air or water economizer, the applicable minimum cooling efficiency of the HVAC unit must be increased by the percentage shown. If the HVAC unit is only rated with a full load metric, such as EER or COP cooling, then that metric must be increased by the percentage shown.

C. Air-Side Economizer High Limit Switches

§140.4(e)3

If an economizer is required by §140.4(e)1, and an air economizer is used to meet the requirement, the air side economizer is required to have high-limit shut-off controls that comply with Table 4-19.

1. The first column identifies the high limit control category. There are three categories allowed in this prescriptive requirement: Fixed Dry Bulb; Differential Dry Bulb; and Fixed Enthalpy + Fixed Dry Bulb.
2. The second column represents the California climate zone. “All” indicates that this control type complies in every California climate.
3. The third and fourth columns present the high-limit control setpoints required.

The Energy Standards eliminated the use of Fixed Enthalpy, Differential Enthalpy and Electronic Enthalpy controls. Research on the accuracy and stability of enthalpy controls led to their elimination (with the exception of use when combined with a fixed dry-bulb sensor). The enthalpy based controls can be employed if the project uses the performance approach however the performance model will show a penalty due to the inaccuracy of the enthalpy sensors.

Table 4-19: Air Economizer High Limit Shut Off Control Requirements

Device Type[a]	Climate Zones	Required High Limit (Economizer Off When): Equation[b]	Description
Fixed Dry Bulb	1, 3, 5, 11-16	$T_{OA} > 75°F$	Outdoor air temperature exceeds 75°F
	2, 4, 10	$T_{OA} > 73°F$	Outdoor air temperature exceeds 73°F
	6, 8, 9	$T_{OA} > 71°F$	Outdoor air temperature exceeds 71°F
	7	$T_{OA} > 69°F$	Outdoor air temperature exceeds 69°F
Differential Dry Bulb	1, 3, 5, 11-16	$T_{OA} > T_{RA}°F$	Outdoor air temperature exceeds return air temperature
	2, 4, 10	$T_{OA} > T_{RA}-2°F$	Outdoor air temperature exceeds return air temperature minus 2°F
	6, 8, 9	$T_{OA} > T_{RA}-4°F$	Outdoor air temperature exceeds return air temperature minus 4°F
	7	$T_{OA} > T_{RA}-6°F$	Outdoor air temperature exceeds return air temperature minus 6°F
Fixed Enthalpy[c] + Fixed Drybulb	All	$h_{OA} > 28$ Btu/lb[c] or $T_{OA} > 75°F$	Outdoor air enthalpy exceeds 28 Btu/lb of dry air[c] or Outdoor air temperature exceeds 75°F

[a] Only the high limit control devices listed are allowed to be used and at the setpoints listed. Others such as Dew Point, Fixed Enthalpy, Electronic Enthalpy, and Differential Enthalpy Controls, may not be used in any climate zone for compliance with §140.4(e)1. 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 50percent relative humidity. As an example, at approximately 6,000 foot elevation, the fixed enthalpy limit is approximately 30.7 Btu/lb.

Energy Standards Table 140.4-B

D. Air Economizer Construction

§140.4(e)4

If an economizer is required by §140.4(e)1, and an air economizer is used to meet the requirement, then the air economizer, and all air dampers shall have the following features:

1. A 5-year factory warranty for the economizer assembly.
2. Certification by the manufacturer that the 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 at least 60,000 damper opening and closing cycles.
3. Economizer outside air and return air dampers shall have a maximum leakage rate of 10 cfm/sf at 250 Pascals (1.0 in. w.g) when tested in accordance with AMCA Standard 500-D. The leakage rates for the outside and return dampers shall be certified to the Energy Commission in accordance with §110.0.

4. If the high-limit control uses either a fixed dry-bulb, or fixed enthalpy control, the control shall have an adjustable setpoint.

5. Economizer sensors shall be calibrated within the following accuracies.
   a. Drybulb and wetbulb temperatures accurate to ±2°F over the range of 40°F to 80°F.
   b. Enthalpy accurate to ±3 Btu/lb over the range of 20 Btu/lb to 36 Btu/lb.
   c. Relative Humidity (RH) accurate to ± 5 percent over the range of 20 percent to 80 percent RH
4. Data of sensors used for control of the economizer shall be plotted on a sensor performance curve.
5. Sensors used for the high limit control shall be located to prevent false readings, e.g. including but not limited to being properly shielded from direct sunlight.
6. Relief air systems shall be capable of providing 100 percent outside air without over-pressurizing the building.

E. Compressor Unloading

§140.4(e)5

Systems that include and air economizer must comply with the following requirements:

1. Unit controls shall have mechanical capacity controls interlocked with economizer controls such that the economizer is at 100 percent open position when mechanical cooling is on and does not begin to close until the leaving air temperature is less than 45°F.
2. 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.
3. DX units not within the scope of 2, shall comply with the requirements in Table 4-20, and 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 4-20: Direct Expansion (DX) Unit Requirements For Cooling Stages And Compressor Displacement

Cooling Capacity	Minimum Number of Mechanical Cooling Stages	Minimum Compressor Displacement
≥65,000 Btu/h and < 240,000 Btu/h	3 stages	≤ 35% full load
≥ 240,000 Btu/h	4 stages	≤ 25% full load

Energy Standards Table 140.4-C

Chapter 13 of this manual describes mandated acceptance test requirements for economizers.

If the economizer is factory-calibrated the economizer acceptance test is not required at installation. A calibration certificate of economizer control sensors (outdoor air temperature, return air temperature, etc.) must be submitted to the local code enforcement agency in the permit application.

Figure 4-23: Economizer Flowchart

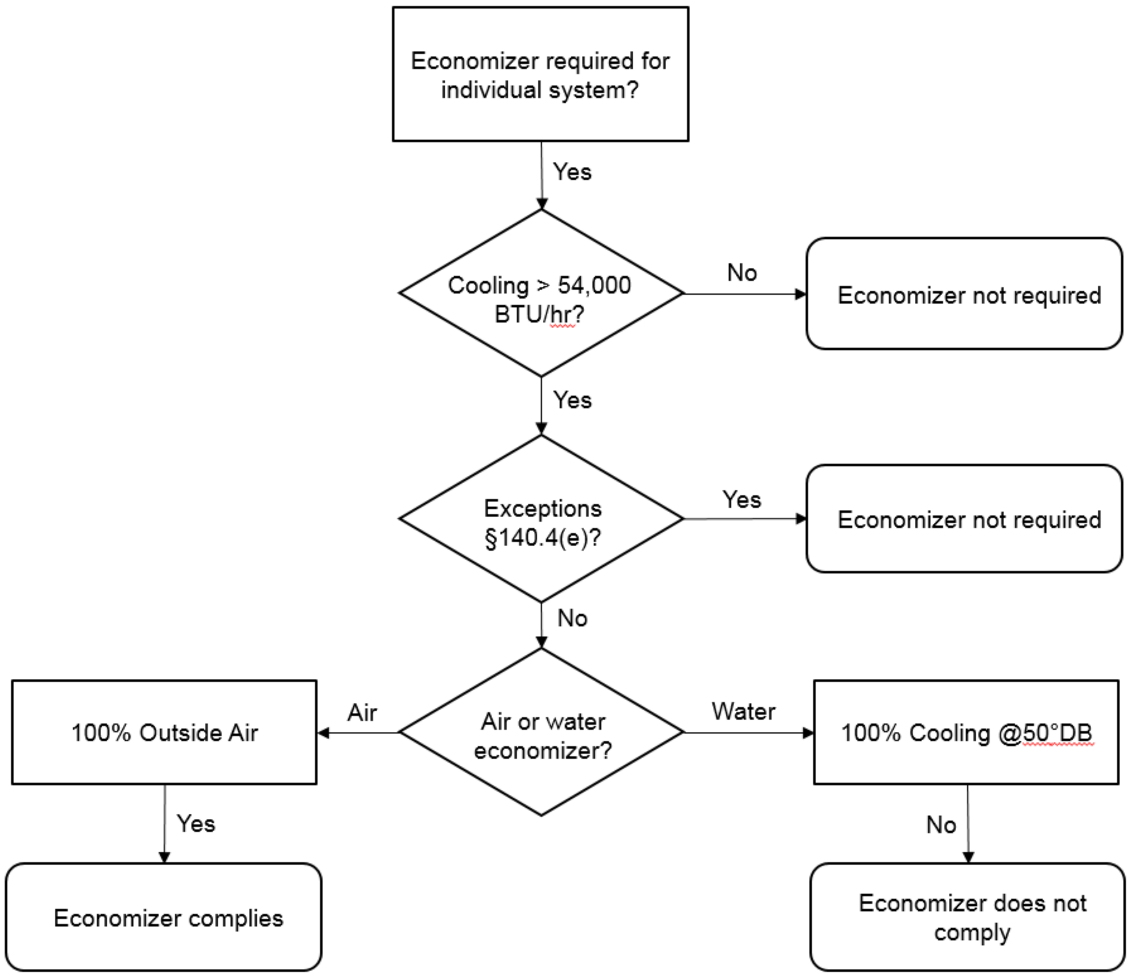
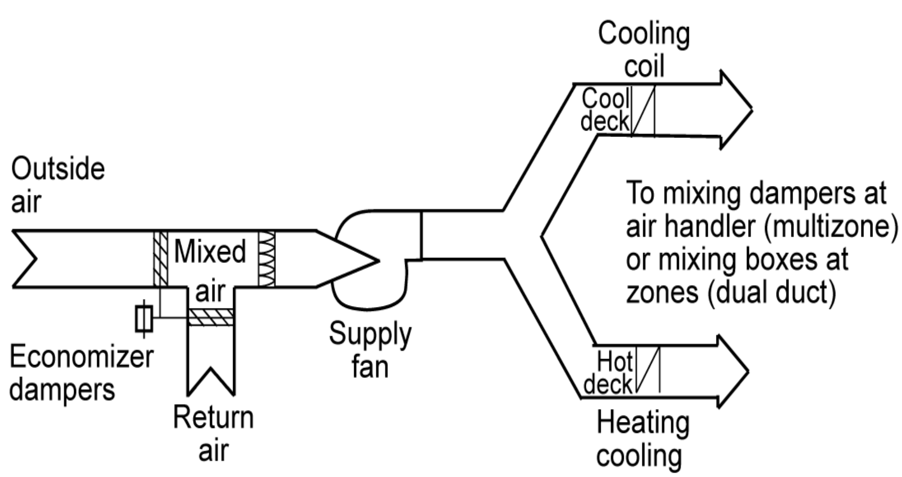


Figure 4-24: Single-Fan Dual-Duct System



Example 4-36

Question

If my design conditions are 94°Fdb/82°Fwb can I use my design cooling loads to size a water-side economizer?

Answer

No. The design cooling load calculations must be rerun with the outdoor air temperature set to 50°Fdb/45°Fwb. The specified tower, as well as cooling coils and other devices, must be checked to determine if it has adequate capacity at this lower load and wet-bulb condition.

Example 4-37

Question

Will a strainer cycle water-side economizer meet the prescriptive economizer requirements? (Refer to Figure 4-33)

Answer

No. It cannot be integrated to cool simultaneously with the chillers.

Example 4-38

Question

Does a 12 ton packaged AC unit in climate zone 10 need an economizer?

Answer

Yes and the economizer must be equipped with an economizer fault detection and diagnostic system. However the requirement for an economizer can be waived if the AC unit's efficiency is greater than or equal to an EER of 14.3. Refer to Table 4-18

4.5.2.3 VAV Supply Fan Controls

§140.4(c)2 and §140.4(m)

Both single and multiple zone systems are required to have VAV supply based on the system type as described in Table 4-21. The VAV requirements for supply fans are as follows:

1. Single zone systems (where the fans are controlled directly by the space thermostat) shall have a minimum of 2 stages of fan speed with no more than 66 percent speed when operating on stage 1 while drawing no more than 40 percent full fan power when running at 66 percent speed.
2. All systems with air-side economizers to satisfy Section 4.5.2.2 are required to have a minimum of 2 speeds of fan control during economizer operation.
3. Multiple zone systems shall limit the fan motor demand to no more than 30 percent of design wattage at 50 percent design air volume.

Variable speed drives can be used to meet any of these three requirements.

Actual fan part load performance, available from the fan manufacturer, should be used to test for compliance with item 3 above. Figure 4-25 shows typical performance curves for different types of fans. As can be seen, both air foil fans and backward inclined fans using either discharge dampers or inlet vanes consume more than 30 percent power at 50 percent flow when static pressure set point is one-third of total design static pressure using certified manufacturer’s test data. These fans will not normally comply with these requirements unless a variable speed drive is used.

VAV fan systems that don’t have DDC to the zone level are required to have the static pressure sensor located in a position such that the control setpoint is ≤1/3 of the design static pressure of the fan. For systems without static pressure reset the further the sensor is from the fan the more energy will be saved. For systems with multiple duct branches in the distribution you must provide separate sensors in each branch and control the fan to satisfy the sensor with the greatest demand. When locating sensors, care should be taken to have at least one sensor between the fan and all operable dampers (e.g. at the bottom of a supply shaft riser before the floor fire/smoke damper) to prevent loss of fan static pressure control.

For systems with DDC to the zone level the sensor(s) may be anywhere in the distribution system and the duct static pressure setpoint must be reset by the zone demand. Typically this is done by one of the following methods:

1. Controlling so that the most open VAV box damper is 95 percent open.
2. Using a “trim and respond” algorithm to continually reduce the pressure until one or more zones indicate that they are unable to maintain airflow rate setpoints.
3. Other methods that dynamically reduce duct static pressure setpoint as low as possible while maintaining adequate pressure at the VAV box zone(s) of greatest demand.

Reset of supply pressure by demand not only saves energy but it also protects fans from operation in surge at low loads. Chapter 13, Acceptance Requirements, describes mandated acceptance test requirements for VAV system fan control.

Figure 4-25: VAV Fan Performance Curve

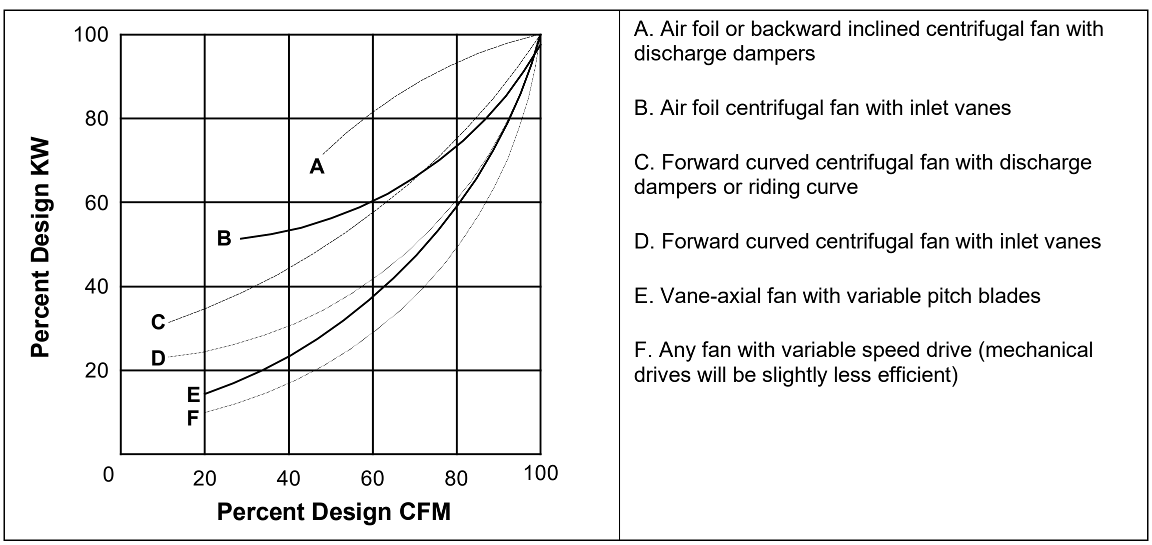


Table 4-21: Fan Control Systems

Cooling System Type	Fan Motor Size	Cooling Capacity
DX Cooling	any	≥ 65,000 Btu/hr
Chilled Water and Evaporative	≥ 1/4 HP	any

Energy Standards Table 140.4-D

4.5.2.4 Supply-Air Temperature Reset Control

§140.4(f)

Mechanical space-conditioning systems supplying heated or cooled air to multiple zones must include controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperature. The controls must be capable of resetting the supply-air temperature by at least 25 percent of the difference between the design supply-air temperature and the design room air temperature.

For example, if the design supply temperature is 55°F and the design room temperature is 75°F, then the difference is 20°F, and 25 percent is 5°F. Therefore, the controls must be capable of resetting the supply temperature from 55°F to 60°F.

Air distribution zones that are likely to have constant loads, such as interior zones, shall have airflow rates designed to meet the load at the fully reset temperature. Otherwise, these zones may prevent the controls from fully resetting the temperature, or will unnecessarily limit the hours when the reset can be used.

Supply air reset is required for VAV reheat systems even if they have VSD fan controls. The recommended control sequence is to lead with supply temperature setpoint reset in cool weather where reheat might dominate the equation and to keep the chillers off as long as possible, then return to a fixed low setpoint in warmer weather when the chillers are likely to be on. During reset, employ a demand-based control that uses the warmest supply air temperature that satisfies all of the zones in cooling.

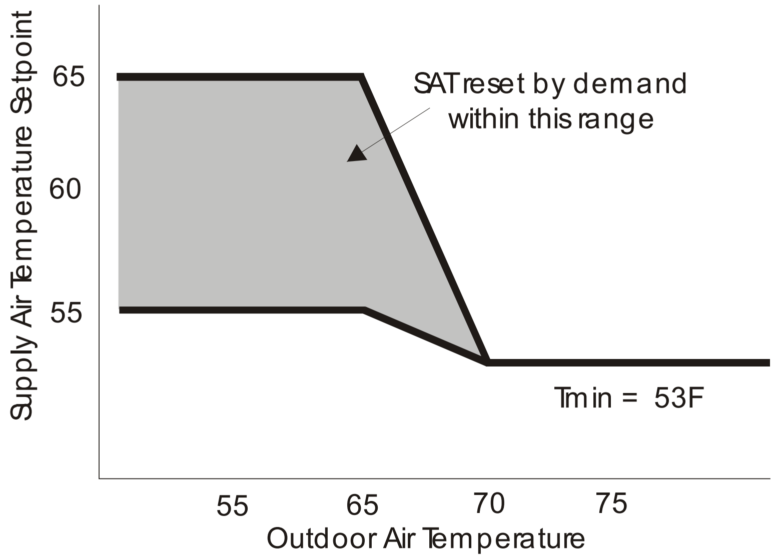
This sequence is described as follows: during occupied mode, the setpoint is reset from T-min (53°F) when the outdoor air temperature is 70°F and above, proportionally up to T-max when the outdoor air temperature is 65°F and below. T-max shall range from 55°F to 65°F and shall be the output of a slow reverse-acting proportional-integral (PI) loop that maintains the cooling loop of the zone served by the system with the highest cooling loop at a setpoint of 90 percent (See Figure 4-26).

Supply temperature reset is also required for constant volume systems with reheat justified on the basis of special zone pressurization relationships or cross-contamination control needs.

Supply-air temperature reset is not required when:

1. The zone(s) must have specific humidity levels required to meet exempt process needs. Computer rooms cannot use this exception.
2. Where it can be demonstrated to the satisfaction of the enforcement agency that supply air reset would increase overall building energy use.
3. The space-conditioning zone has controls that prevent reheating and recooling and simultaneously provide heating and cooling to the same zone.

Figure 4-26: Energy Efficient Supply Air Temperature Reset Control for VAV Systems



Recommended Supply Air Temperature Reset Method

4.5.2.5 Heat Rejection Fan Control

§140.4(h)

When the fans on cooling towers, closed-circuit fluid coolers, air-cooled condensers and evaporative condensers are powered by a fan motor or 7.5 hp or larger, the system must be capable of operating at 2/3 of full speed or less and have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature or pressure of the heat rejection device. Fan speed controls are exempt when:

1. Fans powered by motors smaller than 7.5 hp.
2. Heat rejection devices included as an integral part of the equipment listed in Table 4-1 through Table 4-11.
3. Condenser fans serving multiple refrigerant circuits or flooded condensers.
4. Up to 1/3 of the fans on a condenser or tower with multiple fans where the lead fans comply with the speed control requirement.

Example 4-39

Question

A chilled water plant has a three-cell tower with 10 hp motors on each cell. Are speed controls required?

Answer

Yes. At minimum the designer must provide 2-speed motors, pony motors or variable speed drives on two of the three fans for this tower.

4.5.2.6 **Hydronic System Measures**

§140.4(k)

A. Hydronic Variable Flow Systems

§140.4(k)1

Hot water and chilled water systems are required to be designed for variable flow. Variable flow is provided by using 2-way control valves. The Energy Standards only require that flow is reduced to the greater of 50 percent design flow (or less) or the minimum flow required by the equipment manufacturer for operation of the central plant equipment.

There are two exceptions for this requirement:

1. Systems that include no more than three control valves.
2. Systems having a total pump system power less than or equal to 1.5 hp.

It is not necessary for each individual pump to meet the variable flow requirement. These requirements can be met by varying the total flow for the entire pumping system in the plant. Strategies that can be used to meet these requirements include but are not limited to variable frequency drives on pumps and staging of the pumps.

It should be noted that the primary loop on a primary/secondary or primary/secondary/tertiary system could be designed for constant flow even if the secondary or tertiary loop serves more than 3 control valves. This is allowed because the primary loop does not directly serve any coil control valves. However the secondary (and tertiary loops) of these systems must be designed for variable flow if they have 4 or more control valves.

The flow limitations are provided for primary-only variable flow chilled water systems where a minimum flow is typically required to keep a chiller on-line. In these systems minimum flow can be provided with either a bypass with a control valve or some 3-way valves to ensure minimum flow at all times. The system with a bypass valve is more efficient as it only provides bypass when absolutely required to keep the plant on line.

For hot water systems application of slant-tube or bent tube boilers will provide the greatest flow turndown. Typically copper fin tube boilers require a higher minimum flow.

Example 4-40

Question

In my plant, I am trying to meet the variable flow requirements of Section 4.5.2.6. Must each individual pump meet these requirements for the plant to comply with the Energy Standards?

Answer

No, individual pumps do not need to meet the variable flow requirements of this section. As long as the entire plant meets the variable flow requirements, the plant is in compliance. For example, the larger pumps may be equipped with variable frequency drives or the pumps can be staged in a way that can meet these requirements.

B. Isolation for Chillers and Boilers

§140.4(k)2 and3

Plants with multiple chillers or boilers are required to provide either isolation valves or dedicated pumps and check valves to ensure that flow will only go through the chillers or boilers that are staged on. Chillers that are piped-in series for the purpose of increased temperature differential shall be considered as one chiller.

C. Chilled and Hot Water Reset

§140.4(k)4

Similar to the requirements for supply air temperature reset, chilled and hot water systems that have a design capacity > 500,000 Btu/h are required to provide controls to reset the hot or cold water temperature setpoints as a function of building loads or the outdoor air temperature. This reset can be achieved either using a direct indication of demand (usually cooling or heating valve position) or an indirect indication of demand (typically outdoor air temperature). On systems with DDC controls reset using valve position is recommended.

There is an exception to this requirement for hydronic systems that are designed for variable flow complying with 4.5.2.6.A (§140.4(k)1).

D. Isolation Valves for Water-Loop Heat Pump Systems

§140.4(k)5

Water circulation systems serving water-cooled air conditioner and hydronic heat pump systems that have a design circulation pump brake horsepower >5 bhp are required to be provided with 2-way isolation valves that close whenever the compressor is off. These systems are also required to be provided with the variable speed drives and pressure controls described in the following section.

Although this is not required on central tenant condenser water systems (for water-cooled AC units and HPs) it is a good idea to provide the 2-way isolation valves on these systems as well. In addition to providing pump energy savings, these 2-way valves can double as head-pressure control valves to allow aggressive condenser water reset for energy savings in chilled water plants that are also cooled by the towers.

E. VSDs for Pumps Serving Variable Flow Systems

§140.4(k)6

Variable Flow Controls - Pumps on variable flow systems that have a design circulation pump brake horsepower > 5 bhp are required to have either variable speed drives or a different control that will result in pump motor demand of no more than 30 percent of design wattage at 50 percent of design water flow.

Pressure Sensor Location and Setpoint

1. For systems without direct digital control of individual coils reporting to the central control panel, differential pressure must be measured at the most remote heat exchanger or the heat exchanger requiring the most pressure. This includes chilled water systems, condenser water systems serving water-cooled air conditioning (AC) loads and water-loop heat pump systems.
2. For systems with direct digital control of individual coils with a central control panel, the static pressure set point must be reset based on the valve requiring the most pressure and the setpoint shall be no less than 80 percent open. The pressure sensor(s) may be mounted anywhere.

Exceptions are provided for hot-water systems and condenser water systems that only serve water-cooled chillers. The hot water systems are exempted because the heat from the added pumping energy of the pump riding the curve provides a beneficial heat that reduces the boiler use. This reduces the benefit from the reduced pumping energy.

F. Hydronic Heat Pump (WLHP) Controls

§140.4(k)7

Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition must have controls that are capable of providing a heat pump water supply temperature dead band of at least 20°F between initiation of heat rejection and heat addition by the central devices. Exceptions are provided 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.

4.5.2.7 Window/Door Switches for Mechanical System Shut-off

§140.4(n)

If a directly conditioned zone has a thermostat and has one or more manually operable wall or roof openings to the outdoors, then the openings must all have sensors that communicate to the HVAC system. The HVAC controller must be capable of shutting off the heating or cooling to that zone if the sensor detects that the opening has remained open for more than 5 minutes. This can be accomplished by either the resetting the heating setpoint to 55°F or the heating can be disabled altogether. If the HVAC system is in cooling mode, then similarly this requirement can be satisfied by resetting the cooling setpoint to 90°F unless the outside air temperature is less than the space temperature, in which case the cooling setpoint can be reset or not. If the zone is in cooling and the outside air temperature is less than the space temperature then additional infiltration from the opening provides economizer free cooling and is not an additional cooling load on the mechanical system.

This requirement does not require that any openings be operable but if there are operable openings then they must comply with this requirement.

Note that mechanical ventilation as required by Section 4.3.2 must still be provided. The mechanical system shut off pertains to the space conditioning equipment only. Mechanical ventilation must still be provided if the space does not fall under the natural ventilation criteria. Systems that meet the ventilation requirements with natural ventilation, rather than mechanical ventilation, are not exempt from the window/door switch requirement. Thus, in the same way that most homeowners typically choose between opening the windows and running the heating/cooling, window/door switches will now cause occupants to choose between opening windows/doors and allowing full heating/cooling.

Manually operable openings to the outdoors include manually operable windows, skylights, and doors that do not have automatic closing devices (e.g. sliding balcony doors). Motorized openings (e.g. motorized skylights) are still considered manually operable if occupants can open the openings as desired and they will stay open until manually closed.

If a zone serves more than one room then only the openings in the room with the thermostat are required to be interlocked. For example, if three perimeter private offices are served by a single VAV box then only the operable openings in the office with the thermostat need to be interlocked. The windows in the offices that do not have a thermostat do not need to be interlocked.

If there is a large room with more than one zone then only the zones with operable windows in them need to be interlocked. For example, if a large open office has a perimeter zone and an interior zone in the same room and there are operable windows in the perimeter zone but not the interior zone then only the perimeter zone needs to be interlocked to the windows.

Alterations to existing buildings are exempt from this requirement. Additions to existing buildings only have to comply if the operable opening(s) and associated zone are new.

4.5.3 Acceptance Requirements

There are a number of acceptance requirements related to control systems. These include:

1. Automatic time switch control devices.
2. Constant volume package unit.
3. Air-side economizers.
4. VAV supply fan controls.
5. Hydronic system controls.

These tests are described in Chapter 13 as well as the Reference Nonresidential Appendix NA7.

4.6 HVAC System Requirements

There are no acceptance tests for these requirements.

4.6.1 Mandatory Requirements

4.6.1.1 Water Conservation Measures for Cooling Towers

§110.2(e)

§110.2(e) establishes mandatory requirements for the efficient use of water in the operation of open (direct) and closed (indirect) cooling towers. The building standard applies to the new construction and retrofit of commercial, industrial and institutional cooling towers with a rated capacity of 150 tons or greater. For these towers all of the following are required:

1. The towers shall be equipped with either conductivity or flow-based controls to control cycles of concentration based on local water quality conditions. The controls shall automate system bleed and chemical feed based on conductivity, or in proportion to metered makeup volume, metered bleed volume, recirculating pump run time, or bleed time. Where employed, conductivity controllers shall be installed in accordance with manufacturer's specifications.

2. Design documents have to document maximum achievable cycles of concentration based on local water supply as reported by the local water supplier, and using a calculator approved by the Energy Commission. The calculator shall determine maximum cycles based on a Langelier Saturation Index (LSI) of 2.5 or less. An approved calculator can be downloaded from the Energy Commission's website: http://www.energy.ca.gov/title24/2013standards/documents/maximum_cycles_calculator.xls

3. The towers shall be equipped with a flow meter with an analog output for flow. This can be connected to the water treatment control system using either a hardwired connection or gateway.

4. The towers shall be equipped with an overflow alarm to prevent overflow of the sump in case of makeup water valve failure. This requires either a water level sensor or a moisture detector in the overflow drain. The alarm contact should be connected to the building Energy Management Control System to initiate an EMCS alarm to alert the operators.

5. The towers shall be equipped with drift eliminators that achieve a maximum rated drift of 0.002 percent of the circulated water volume for counter-flow towers and 0.005percent for cross-flow towers.

As water is evaporated off the tower, the concentration of dissolved solids like calcium carbonate and silica will increase. The pH of the water will also change. With high levels of silica or dissolved solids you will get deposits on the tower fill or clogging in the tower nozzles which will reduce the tower's heat rejection capacity. High pH is a concern for metal tower basins and structural members. As the thresholds of these contaminants of concern are approached the automated controls should bleed some of the concentrated water out and dilute it with make-up water. The bleed can be controlled by measurement of make-up water flow (an indirect measurement of water drift and evaporation) or through conductivity (a measurement of the dissolved solids). The term "*cycles of concentration*" is the metric of how concentrated the contaminants are at the controlled level. The right value depends on the characteristics of the supply water, the rate of tower drift, the weather characteristics, and the load on the tower. Good practice is to maintain the following levels:

- Silica levels should be maintained at ≤ 150 ppm
- The Langelier Saturation Index should be maintained at ≤ 2.5 (see explanation of LSI below)
- pH in new cooling towers using galvanized metal should be maintained at ≤ 8.3 until metal is passivated, which occurs after 3-6 months of operation

To meet compliance, an Energy Commission-approved calculator (NRCC-MCH-06-E) allows the building owner to enter makeup water quality parameters including conductivity, alkalinity, calcium hardness, magnesium hardness, and silica. These values are available from the local water supplier in the most recent annual Consumer Confidence Report or Water Quality Report. These reports are generally posted on the water supplier’s website, or by contacting the local water supplier by telephone. Many water districts have multiple sources of water which often are changed seasonally. For example many water districts use a reservoir in the winter and spring then switch to well water in the summer and fall. Each supply will typically have different characteristics so the water treatment and control cycles of concentration should be seasonally shifted as well.

After entering the required water quality data, the user must also enter skin temperature; the default value of 110 degrees Fahrenheit is acceptable. Lastly, target tower cycles of concentration is entered into the calculator. The calculator calculates the Langelier Saturation Index (LSI) based on the cycles of concentration entered by the user. The maximum value of the LSI is 2.5; therefore, the user should enter the highest cycles of concentration value in 0.10 units that results in a calculated LSI not to exceed 2.5. The resulting cycles of concentration is considered by the Commission to be the Maximum Achievable Cycles of Concentration and must be recorded on the mechanical compliance document (NRCC-MCH-06-E), to which a copy of the Consumer Confidence Report or Water Quality Report must be attached. The Professional Engineer of Record must sign the compliance document (NRCC-MCH-06-E) attesting to the calculated maximum cycles of concentration.

Example 4-41

Question

What is the Langelier Saturation Index (LSI)?

Answer

The Langelier Saturation Index (LSI) predicts scaling. The LSI indicates whether water will precipitate, dissolve, or be in equilibrium with calcium carbonate, and is a function of hardness, alkalinity, conductivity, pH and temperature. LSI is expressed as the difference between the actual system pH and the saturation pH.

Example 4-42

Question

Where can I find data for makeup water quality?

Answer

Water agencies are required to make their annual water quality data available to the public. Water quality data is generally organized into an annual Consumer Confidence Report or Water Quality Report, which can often be found posted on the water agency's website by searching for the key words "water quality". Since many water districts have more than one water supply ask for a report for each source

Example 4-43

Question

What if all, or some, of the water quality data is not provided in the Consumer Confidence Report or Water Quality Report?

Answer

Some data may be available by calling the local water agency's Water Quality Division. For example, agencies are not required to test for and report alkalinity; however, they often do test for it and will provide data over the phone or in an email. You can also check with water treatment firms that are doing business in the area. They often have test data that they will share. Finally you can hire a water treatment firm to take samples of the water to test.

4.6.1.2 Low Leakage Air Handling Unit (AHU)

§110.2(f), §140.1 and §150.1(b)

The standard provides a compliance credit for low leakage AHUs. To achieve this credit you must meet the qualifications in Reference Joint Appendix JA9 and verify installation in accordance with the procedures specified in Reference Residential Appendix RA3.1.4.3.9. In order for an AHU to qualify as low leakage the AHU manufacturer must certify to the Energy Commission that the AHU complies with ASHRAE Standard 193. Once installed the AHU and distribution system is pressurized and the leakage measured according to the testing methods in RA 3.1.4.3.1. The credit is achieved by specifying the leakage amount in the approved compliance software which would use the inputted amount of duct leakage rather than use the default duct leakage rates that are based on either new or altered ducts.

4.6.2 Prescriptive Requirements

4.6.2.1 Sizing and Equipment Selection

§140.4(a)

The Energy Standards require that mechanical heating and cooling equipment (including electric heaters and boilers) to be the smallest size available, within the available options of the desired equipment line that meets the design heating and cooling loads of the building or spaces being served. Depending on the equipment, oversizing can be either a penalty or benefit to energy usage. For vapor compression equipment, gross oversizing can drastically increase the energy usage and in some cases cause premature failure from short cycling of compressors. Boilers and water-heaters generally suffer lower efficiencies and higher standby losses if they are oversized. On the other hand, cooling towers, cooling coils, and variable speed driven cooling tower fans can actually improve in efficiency if oversized. Oversized distribution ductwork and piping can reduce system pressure losses and reduce fan and pump energy.

When equipment is offered in size increments, such that one size is too small and the next is too large, the larger size may be selected.

Packaged HVAC equipment may serve a space having substantially different heating and cooling loads. The unit size should be selected on the larger of the loads, based on either capacity or airflow. The capacity for the other load should be selected as required to meet the load, or if very small, should be the smallest capacity available in the selected unit. For example, packaged air-conditioning units with gas heat are usually sized on the basis of cooling loads. The furnace is sized on the basis of airflow, and is almost always larger than the design heating load.

Equipment may be oversized provided one or more of the following conditions are met:

1. It can be demonstrated to the satisfaction of the enforcing agency that oversizing will not increase building source energy use; or
2. Oversizing is the result of standby equipment that will operate only when the primary equipment is not operating. Controls must be provided that prevent the standby equipment from operating simultaneously with the primary equipment; or
3. Multiple units of the same equipment type are used, each having a capacity less than the design load, but in combination having a capacity greater than the design load. Controls must be provided to sequence or otherwise optimally control the operation of each unit based on load.

4.6.2.2 **Load Calculations**

§140.4(b)

For the purposes of sizing HVAC equipment, the designer shall use all of the following criteria for load calculations:

1. The heating and cooling system design loads must be calculated in accordance with the procedures described in the ASHRAE Handbook, Fundamentals Volume, Chapter 30, Table 1. Other load calculation methods, e.g. ACCA, SMACNA, etc., are acceptable provided that the method is ASHRAE-based. When submitting load calculations of this type, the designer must accompany the load calculations with a written affidavit certifying that the method used is ASHRAE-based. If the designer is unclear as to whether or not the calculation method is ASHRAE-based, the vendor or organization providing the calculation method should be contacted to verify that the method is derived from ASHRAE.
2. Indoor design conditions of temperature and relative humidity for general comfort applications are not explicitly defined. Designers are allowed to use any temperature conditions within the “comfort envelope” defined by ANSI/ASHRAE 55-1992 or Chapter 8 of the ASHRAE Handbook, Fundamentals Volume. Winter humidification or summer dehumidification is not required.
3. Outdoor design conditions shall be selected from Reference Joint Appendix JA2, which is based on data from the ASHRAE Climatic Data for Region X, for the following design conditions:
   a. Heating design temperatures shall be no lower than the temperature listed in the Heating Winter Median of Extremes value.
   b. Cooling design temperatures shall be no greater than the 0.5 percent Cooling Dry Bulb and Mean Coincident Wet Bulb values.

   c. Cooling design temperatures for cooling towers shall be no greater than the 0.5 percent cooling design wet bulb values.

4. Outdoor Air Ventilation loads must be calculated using the ventilation rates required in Section 4.3.
5. Envelope heating and cooling loads must 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.
6. Lighting loads shall be based on actual design lighting levels or power densities consistent with Chapter 5.
7. People sensible and latent gains must be based on the expected occupant density of the building and occupant activities as determined under Section 4.3. If ventilation requirements are based on a cfm/person basis, then people loads must be based on the same number of people as ventilation. Sensible and latent gains must be selected for the expected activities as listed in 2005 ASHRAE Handbook, Fundamentals Volume, Chapter 30, Table 1.
8. Loads caused by a process shall be based on actual information (not speculative) on the intended use of the building.
9. Miscellaneous equipment loads include such things as duct losses, process loads and infiltration and shall be calculated using design data compiled from one or more of the following sources:
   a. Actual information based on the intended use of the building; or
   b. Published data from manufacturer’s technical publications or from technical societies, such as the ASHRAE Handbook, HVAC Applications Volume; or
   c. Other data based on the designer’s experience of expected loads and occupancy patterns.
10. Internal heat gains may be ignored for heating load calculations.
11. A safety factor of up to 10 percent may be applied to design loads to account for unexpected loads or changes in space usage.
12. Other loads such as warm-up or cool-down shall be calculated using one of the following methods:
   a. A method using principles based on the heat capacity of the building and its contents, the degree of setback, and desired recovery time; or
   b. The steady state design loads may be increased by no more than 30 percent for heating and 10 percent for cooling. The steady state load may include a safety factor of up to 10 percent as discussed above in Item 11.
13. The combination of safety factor and other loads allows design cooling loads to be increased by up to 21 percent (1.10 safety x 1.10 other), and heating loads by up to 43 percent (1.10 safety x 1.30 other).

Example 4-44

Question

Do the sizing requirements restrict the size of duct work, coils, filter banks, etc. in a built-up system?

Answer

No. The intent of the Energy Standards is to limit the size of equipment, which if oversized will consume more energy on an annual basis. Coils with larger face areas will usually have lower pressure drops than otherwise, and may also allow the chilled water temperature to be higher, both of which may result in a decrease in energy usage. Larger filter banks will also usually save energy. Larger duct work will have lower static pressure losses, which may save energy, depending on the duct’s location, length, and degree of insulation.

Oversizing fans, on the other hand, may or may not improve energy performance. An oversized airfoil fan with inlet vanes will not usually save energy, as the part load characteristics of this device are poor. But the same fan with a variable frequency drive may save energy. Controls are also an important part of any system design.

The relationship between various energy consuming components may be complex, and is left to the designer’s professional judgment. Note however, that when components are oversized, it must be demonstrated to the satisfaction of the enforcement agency that energy usage will not increase.

4.6.2.3 **Fan Power Consumption**

§140.4(c)

Maximum fan power is regulated in individual fan systems where the total power of the supply (including fan-powered terminal units), return and exhaust fans within the ***fan system*** exceed 25 hp at design conditions (see Section 4.10 for definitions). A system consists of only the components that must function together to deliver air to a given area; fans that can operate independently of each other comprise separate systems. Included are all fans associated with moving air from a given space-conditioning ***system*** to the conditioned spaces and back to the source, or to exhaust it to the outdoors.

The 25 hp total criteria apply to:

1. All supply and return fans within the space-conditioning system that operate at peak load conditions.
2. All exhaust fans at the system level that operate at peak load conditions. Exhaust fans associated with economizers are not counted, provided they do not operate at peak conditions.
3. Fan-powered VAV boxes, if these fans run during the cooling peak. This is always the case for fans in series type boxes. Fans in parallel boxes may be ignored if they are controlled to operate only when zone heating is required, and are normally off during the cooling peak.
4. Elevator equipment room exhausts, or other exhausts that draw air from a conditioned space, through an otherwise unconditioned space, to the outdoors.

The criteria are applied individually to each space-conditioning system. In buildings having multiple space-conditioning systems, the criteria apply only to the systems having fans whose total demand exceeds 25 hp.

Not included are fans not directly associated with moving conditioned air to or from the space-conditioning system, or fans associated with a process within the building.

For the purposes of the 25 hp criteria, horsepower is the brake horsepower as listed by the manufacturer for the design conditions, plus any losses associated with the drive, including belt losses or variable frequency drive losses. If the brake horsepower is not known, then the nameplate horsepower should be used.

If drive losses are not known, the designer may assume that direct drive efficiencies are 1.0, and belt drives are 0.97. Variable speed drive efficiency should be taken from the manufacturer's literature; if it includes a belt drive, it should be multiplied by 0.97.

Total fan horsepower need not include the additional power demand caused solely by air treatment or filtering systems with final pressure drops of more than 1 inch water gauge (w.g.). It is assumed that conventional systems may have filter pressure drops as high as 1 inch w.g.; therefore only the horsepower associated with the portion of the pressure drop exceeding 1 in., or fan system power caused solely by process loads, may be excluded.

For buildings whose systems exceed the 25 hp criteria, the total space-conditioning system power requirements are:

1. Constant volume fan systems. The total fan power index at design conditions of each fan system with total horsepower over 25 hp shall not exceed 0.8 W/cfm of supply air.
2. Variable air volume (VAV) systems. The total fan power index at design conditions of each fan system with total horsepower over 25 hp shall not exceed 1.25 W/cfm of supply air; and
3. Air-treatment or filtering systems. For systems with air-treatment or filtering systems, calculate the adjusted fan power index using Energy Standards Equation 140.4-A:

Equation 4-8 – (Energy Standards Equation 140.4-A) Adjusted Total Fan Power Index

Adjusted total fan power index = Fan power index X Fan Adjustment

$$\text{Fan Adjustment} = 1 - \left(\frac{SP_a - 1}{SP_f}\right)$$

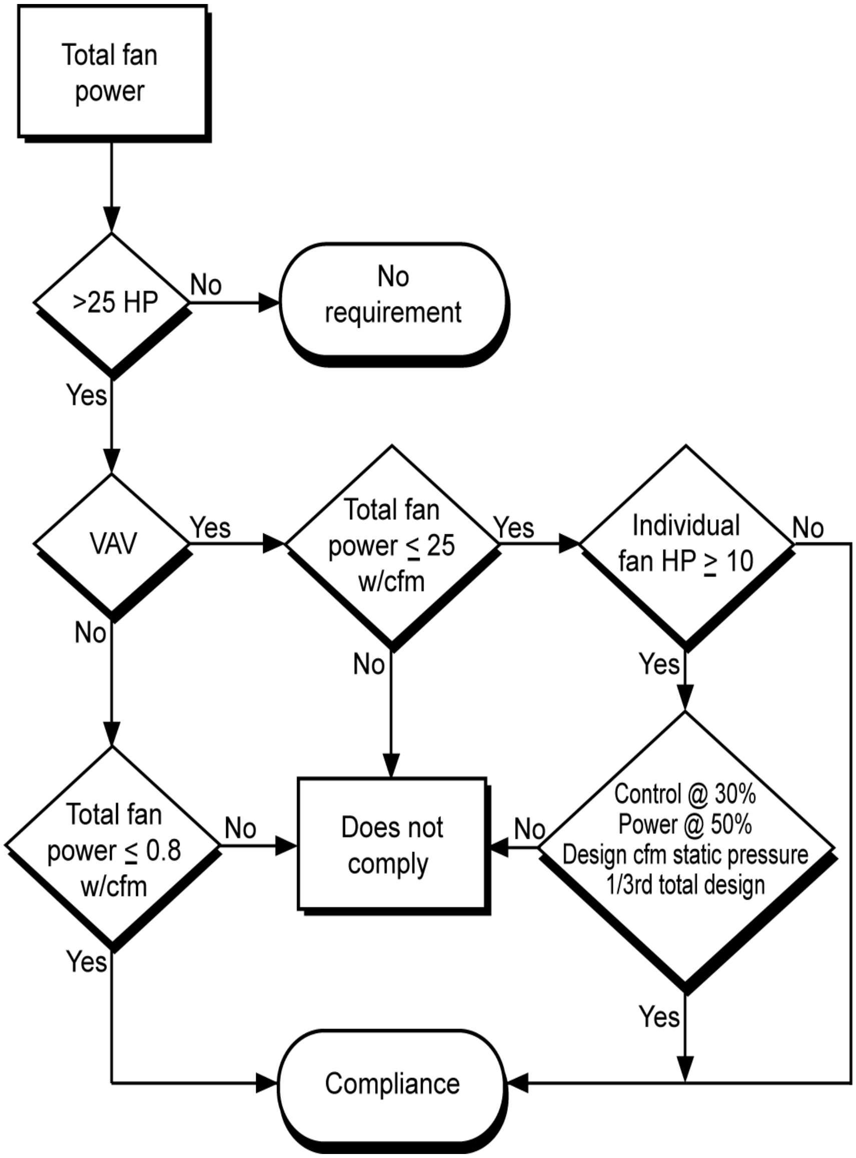
Where:

SP_a = Air pressure drop across the air-treatment or filtering system.

SP_f = Total pressure drop across the fan.

The total system power demand is based on brake horsepower at design static and cfm, and includes drive losses and motor efficiency. If the motor efficiency is not known, values from Reference Nonresidential Appendix NA3 may be used.

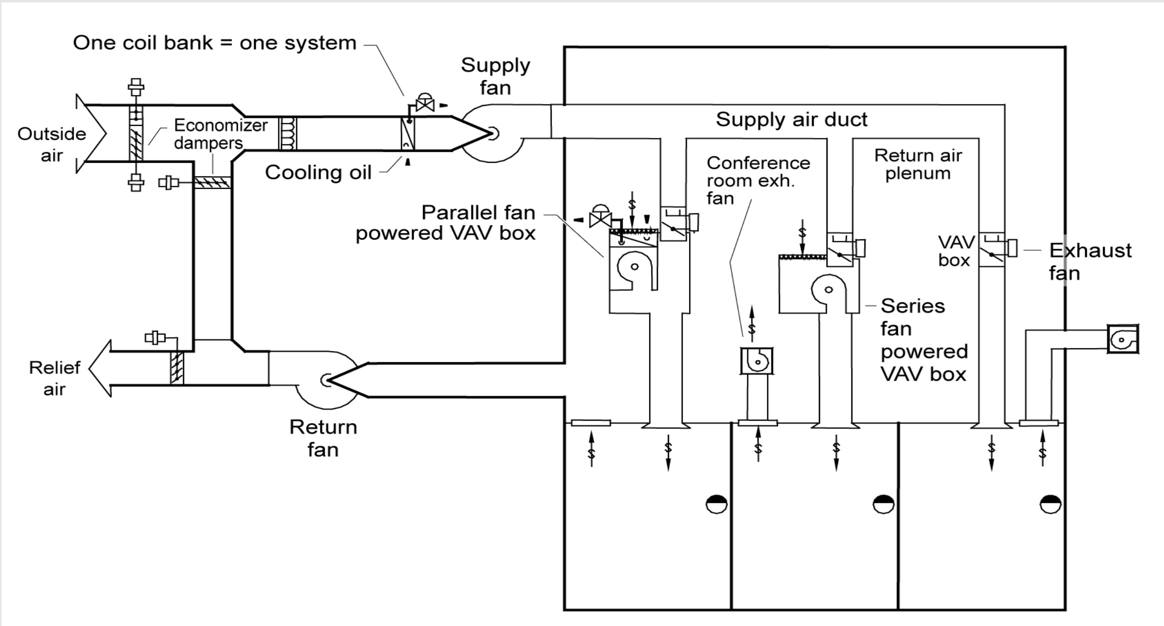
Figure 4-27: Fan Power Flowchart



Example 4-45

Question

In the system depicted below, which fans are included in the fan power criteria?



Answer

The fans included are those that operate during the design cooling load. These include the supply fan, the return fan, the series fan-powered VAV box(es), the general exhaust fan, and conference room exhaust fans other than those that are manually controlled. The parallel fan-powered VAV box(es) are not included as those fans only operate during a call for zone heating.

Example 4-46

Question

If a building has five zones with 15,000 cfm air handlers that are served by a common central plant, and each air handler has a 15 hp supply fan, does the 25 hp limit apply?

Answer

No. Each air handler, while served by a common central plant, is a separate fan system. Since the demand of each air handler is only 15 hp, the 25 hp criteria does not apply.

Example 4-47

Question

The space-conditioning system in a laboratory has a 30 percent filter with a design pressure drop at change out of 0.5 inch w.g., and an 80 percent filter with a design pressure drop of 1.2 inch w.g. The design total static pressure of the fan is 5.0 inch w.g. What percentage of the power may be excluded from the W/cfm calculation?

Answer

The total filter drop at change out (final pressure drop) is 0.5 inch + 1.2 inch = 1.7 inch w.g. The amount that may be excluded is 1.7 inch - 1.0 inch = 0.7 inch w.g. The percentage of the horsepower that may be excluded is 0.7 inch /5.0 inch = 14 percent

If the supply fan requires 45 BHP, the adjusted horsepower of the supply fan in the W/cfm calculation is

45 BHP x (1 – 14 percent) = 38.7 BHP

The horsepower of any associated return or exhaust fan is not adjusted by this factor, as the filters have no impact on these fans.

Example 4-48

Question

What is the maximum allowed power consumption for the fans in a VAV bypass system?

Answer

A VAV bypass, while variable volume at the zone level, is constant volume at the fan level. If the total fan power demand of this system exceeds 25 hp, then the fan power may not exceed 0.8 W/cfm.

Example 4-49

Question

What is the power consumption of a 20,000 cfm VAV system having an 18 bhp supply fan, a 5 bhp return fan, a 3 bhp economizer relief fan, a 2 hp outside air ventilation fan and a 1 hp toilet exhaust fan? Note that the exhaust and outside air ventilation fans are direct drive and listed in hp not bhp. The supply and return fans are controlled with variable frequency drives having an efficiency of 96 percent.

Answer

The economizer fan is excluded provided it does not run at the time of the cooling peak.

Power consumption is then based on the supply; return, outdoor and toilet exhaust fans. The ventilation fan is direct drive so its efficiency is 1. The supply and return fans have default drive efficiencies of 0.97. From Tables NA3-1 and NA3-2 from Reference Nonresidential Appendix NA3, the assumed efficiencies of the motors are 91.7 percent and 87.5 percent for a 25 and 7.5 hp 4-pole motor respectively. Fan power demand in units of horsepower must first be calculated to determine whether the requirements apply:

a. 18 bhp / (0.97 x 0.917 x 0.96) = 21.1 hp

b. 5 bhp / (0.97 x 0.875 x 0.96) = 6.1 hp

Total power consumption, adjusted for efficiencies, is calculated as:

21.1 hp + 6.1 hp + 2 hp + 1 hp = 30.2 hp

Since this is larger than 25 hp, the limitations apply. W/cfm is calculated as:

30.2 hp x 746 W/cfm/20,000 cfm = 1.13 W/cfm

The system complies because power consumption is below 1.25 W/cfm. Note that, while this system has variable frequency drives, they are only required by the Energy Standards for the 18 bhp fan since each other fan is less than 10 hp.

4.6.2.4 **Fractional HVAC Motors for Fans**

§140.4(c)4

HVAC fan motors that are less than1 hp or less 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.

This requirement can be met with either electronically commutated motors or brushless DC motors. These motors have higher efficiency than PSC motors and inherently have speed control that can be used for VAV operation or balancing.

This requirement includes fan-powered terminal units, fan-coil units, exhaust fans, transfer fans, and supply fans. There are two exceptions to this requirement:

1. Motors in fan-coil units and terminal units that operate only when providing heating to the space served. This includes parallel style fan-powered VAV boxes and heating only fan-coils.
2. Motors that are part of space conditioning equipment certified under §110.1 or §110.2. This includes supply fans, condenser fans, ventilation fans for boilers and other fans that are part of equipment that is rated as a whole.

4.6.2.5 **Electric-Resistance Heating**

§140.4(g), §141.0

The Energy Standards strongly discourage the use of electric-resistance space heat. Electric-resistance space heat is not allowed in the prescriptive approach except where:

1. Site-recovered or site-solar energy provides at least 60 percent of the annual heating energy requirements; or
2. A heat pump is supplemented by an electric-resistance heating system, and the heating capacity of the heat pump is more than 75 percent of the design heating load at the design outdoor temperature, determined in accordance with the Energy Standards; or
3. 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; or
4. The total capacity of all electric-resistance heating systems serving the building, excluding those that supplement a heat pump, is no more than 3 kW; or
5. An electric-resistance heating system serves an entire building that:
    a. Is not a high-rise residential or hotel/motel building.
    b. Has a conditioned floor area no greater than 5,000 ft².
    c. Has no mechanical cooling.
    d. Is in an area where natural gas is not currently available and an extension of a natural gas system is impractical, as determined by the natural gas utility.
6. In alterations where the existing mechanical systems use electric reheat (when adding variable air volume boxes) added capacity cannot exceed 20 percent of the existing installed electric capacity, under any one permit application.

7. In an addition where the existing variable air volume system with electric reheat is being expanded the added capacity cannot exceed 50 percent of the existing installed electric reheat capacity under any one permit.

The Energy Standards in effect allow a small amount of electric-resistance heat to be used for local space heating or reheating (provided reheat is in accordance with these regulations).

Example 4-50

Question

If a heat pump is used to condition a building having a design heating load of 100,000 Btu/h at 35°F, what are the sizing requirements for the compressor and heating coils?

Answer

The compressor must be sized to provide at least 75 percent of the heating load at the design heating conditions, or 75,000 Btu/h at 35°F. The Energy Standards do not address the size of the resistance heating coils. Normally, they will be sized based on heating requirements during defrost.

4.6.2.6 Cooling Tower Flow Turndown

§140.4(h)3

The Energy Standards require that open cooling towers with multiple condenser water pumps be designed so that all cells can be run in parallel with the larger of:

1. The flow that is produced by the smallest pump, or
2. 50 percent of the design flow for the cell.

Note that in a large plant at low load operation you would typically run less than all of the cells at once. This is allowed in the Energy Standards.

Cooling towers are very efficient at unloading (the fan energy drops off as the cube of the airflow). It is always more efficient to run the water through as many cells as possible; 2 fans at 1/2 speed use less than 1/3 of the energy of 1 fan at full speed for the same load. Unfortunately there is a limitation with flow on towers, the flow must be sufficient to provide full coverage of the fill. If the nozzles don’t fully wet the fill, air will go through the dry spots providing no cooling benefit and cause the water at the edge of the dry spot to flash evaporate depositing dissolved solids on the fill.

Luckily the cooling tower manufacturers do offer low-flow nozzles (and weirs on basin type towers) to provide better flow turndown. This typically only costs $100 to $150 per tower cell. As it can eliminate the need for a tower isolation control point this provides energy savings at a reduced first cost.

Example 4-51

Question

If a large central plant has five equally sized chillers and five equally sized cooling tower cells do all of the cooling tower cells need to operate when only one chiller is on-line?

Answer

No you would probably only run three cells with one chiller. The cooling tower cells must be designed to run at 33 percent of their nominal design flow. With two to five chillers running you would run all of the cells of cooling tower. With only one chiller running you would run three cells. In each case you would need to keep the tower flow above the minimum that it was designed for.

4.6.2.7 **Centrifugal Fan Limitation**

§140.4(h)4

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 are prohibited to use centrifugal fans. The 95°F condenser water return, 85°F condenser water supply and 75°F outdoor wet-bulb temperature are test conditions for determining the rated flow capacity in gpm. Centrifugal fans use approximately twice the energy as propeller fans for the same duty. There are a couple of exceptions to this requirement.

1. Cooling towers that are ducted (inlet or discharge) or have an external sound trap that requires external static pressure capability.
2. Cooling towers that meet the energy efficiency requirement for propeller fan towers in Table 4-7.

Centrifugal fans may be used on closed circuit fluid coolers.

As with all prescriptive requirements centrifugal fan cooling towers may be used when complying with the performance method. The budget building will be modeled using propeller towers.

4.6.2.8 **Chiller Efficiency**

§140.4(i)

In Table 4-4, there are two sets of efficiency for almost every size and type of chiller. Path A representing fixed speed compressors and Path B representing variable speed compressors. For each path there are two efficiency requirements: a full load efficiency and an integrated part-load efficiency. Path A typically has a higher full load efficiency and a lower part-load efficiency than Path B. In all of the California climates the cooling load varies enough to justify the added cost for a Path B chiller. This is a prescriptive requirement so Path B is used in the base case model in the Performance method.

There are a number of exceptions provided to this requirement:

1. Chillers with an electrical service of > 600V. This is due to the fact that the cost of VSDs is much higher on medium voltage service.
2. Chillers attached to a heat recovery system with a design heat recovery capacity >40 percent of the chiller's design cooling capacity. Heat recovery typically requires operation at higher lifts and compressor speeds.
3. Chillers used to charge thermal energy storage (TES) systems with a charging temperature of <40°F. This again requires a high lift operation for chillers
4. In a building with more than 3 chillers only 3 are required to meet the Path B efficiencies.

4.6.2.9 **Limitation on Air Cooled Chillers**

§140.4(j) and §141.0

New central cooling plants and cooling plant expansions will be limited on the use of air-cooled chillers. For both the limit is 300 tons per plant.

In the studies provided to support this requirement, air cooled chillers always provided a higher life-cycle cost than water cooled chillers even accounting for the water and chemical treatment costs.

There are a few exceptions to this requirement:

1. Where the water quality at the building site fails to meet manufacturer's specifications for the use of water-cooled chillers.

   This exception recognizes that some parts of the state have exceptionally high quantities of dissolved solids that could foul systems or cause excessive chemical treatment or blow down.

2. Chillers that are used to charge a thermal energy storage (TES) system with a design temperature of less than 40°F.

   This addresses the fact that air-cooled chillers can operate very efficiently at low ambient air temperatures. Since TES systems operate for long hours at night, these systems may be as efficient as a water-cooled plant. Note that the chiller must be provided with head pressure controls to achieve these savings.

3. Air cooled chillers with minimum efficiencies approved by the Energy Commission pursuant to §10-109(d).

   This exception was provided in the event that an exceptionally high efficiency air cooled chiller was developed. None of the high-efficiency air-cooled chillers currently evaluated are as efficient as a water-cooled systems using the lowest chiller efficiency allowed by §110.2.

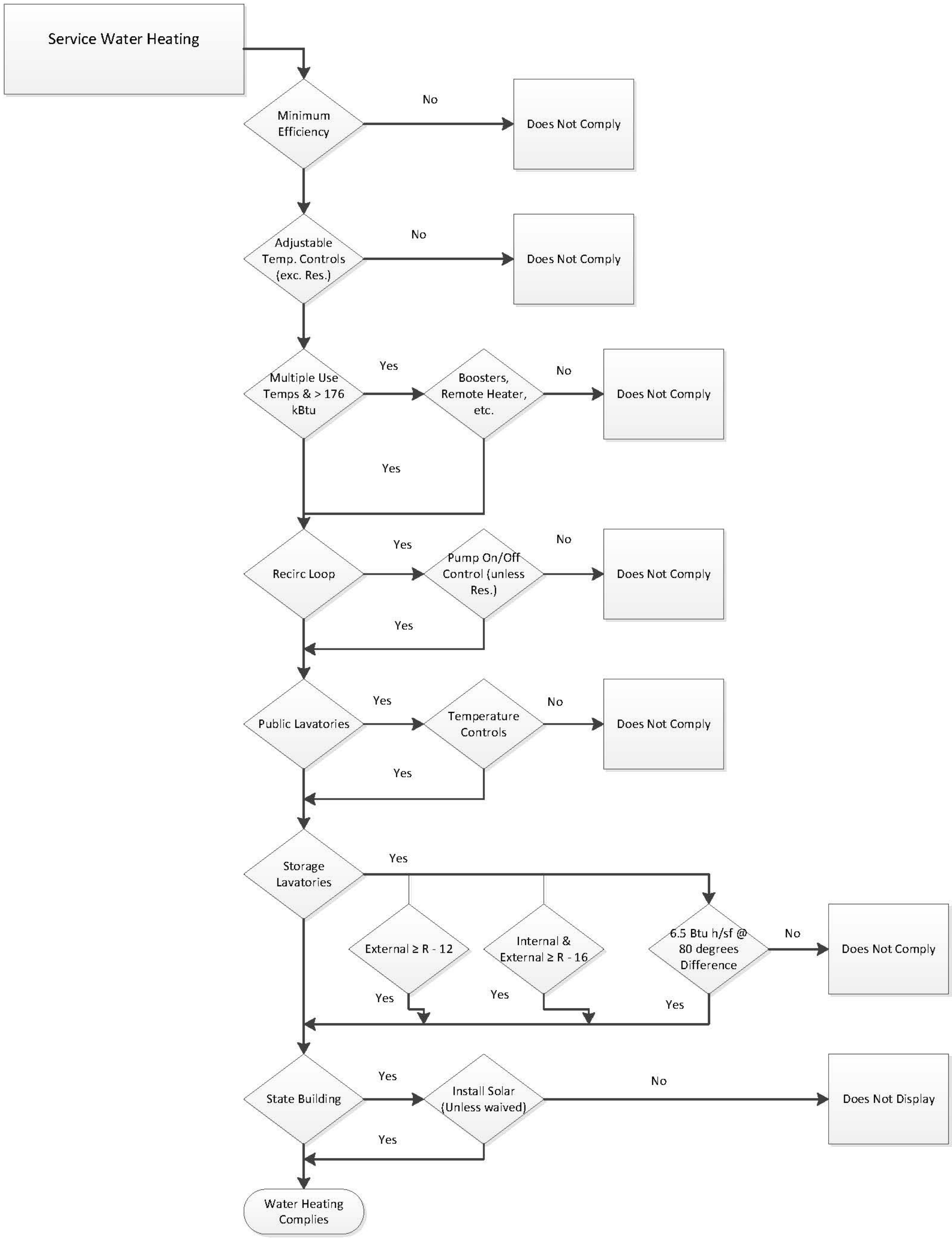
4.7 Water Heating Requirements

§140.5

All of the requirements for service hot water that apply to nonresidential occupancies are mandatory measures. There are additional requirements for high-rise residential, hotels and motels which must also comply with the Residential Energy Standards §150.1(c)8 which are described below, as well as in the Residential Compliance Manual.

There are no acceptance requirements for water heating systems or equipment, however, high-rise residential, hotels and motel water heating systems must meet the distribution system eligibility criteria for that portion of the system that is applicable.

Figure 4-28: Service Water Heating Flowchart



4.7.1 Service Water Systems Mandatory Requirements

4.7.1.1 Efficiency and Control

§110.3(a)

Any service water heating equipment must have integral automatic temperature controls that allow the temperature to be adjusted from the lowest to the highest allowed temperature settings for the intended use as listed in Table 3, Chapter 50 of the ASHRAE Handbook, HVAC Applications Volume.

Service water heaters installed in residential occupancies need not meet the temperature control requirement of §110.3(a)1.

4.7.1.2 Multiple Temperature Usage

§110.3(c)1

On systems that have a total capacity greater than 167,000 Btu/h, outlets requiring higher than service water temperatures as listed in the ASHRAE Handbook, HVAC Applications Volume shall have separate remote heaters, heat exchangers, or boosters to supply the outlet with the higher temperature. This requires the primary water heating system to supply water at the lowest temperature required by any of the demands served for service water heating. All other demands requiring higher temperatures should be served by separate systems, or by boosters that raise the temperature of the primary supply.

4.7.1.3 Controls for Hot Water Distribution Systems

§110.3(c)2

Service hot water systems with a circulating pump or with electrical heat trace shall include a control capable of automatically turning off the system when hot water is not required. Such controls include automatic time switches, interlocks with HVAC time switches, occupancy sensors, and other controls that accomplish the intended purpose.

4.7.1.4 Public Lavatories

§110.3(c)3

Lavatories in public restrooms must have controls that limit the water supply temperature at the fixtures to 110°F. Where service water heater supplies only restrooms, the heater thermostat may be set to no greater than 110°F to satisfy this requirement; otherwise controls such as automatic mixing valves must be installed.

4.7.1.5 Storage Tank Insulation

§110.3(c)4

Unfired water heater storage tanks and backup tanks for solar water heating systems must have one of the following:

1. External insulation with an installed R-value of at least R-12.
2. Internal and external insulation with a combined R-value of at least R-16.
3. The heat loss of the tank based on an 80 degree F water-air temperature difference shall be less than 6.5 Btu per hour per ft². This corresponds to an effective resistance of R-12.3.

4.7.1.6 **Service Water Heaters in State Buildings**

§110.3(c)6

High-rise residential buildings constructed by the State of California shall have solar water heating systems. The solar system shall be sized and designed to provide at least 60 percent of the energy needed for service water heating from site solar energy or recovered energy. There is an exception when buildings for which the state architect determines that service water heating is economically or physical infeasible. See the Compliance Options section below for more information about solar water heating systems.

4.7.1.7 **Pipe Insulation Thickness**

§120.3

There are updated pipe insulation thickness requirements applicable to nonresidential water heating pipes. For pipes with conductivity ranges within those specified in Table 4-17, the nominal pipe diameters grouping ranges are changed, as well as the thickness of insulation required for each pipe diameter range. The table is repeated below for ease of reference:

Table 4-22: Pipe Insulation

<table>
<tr><th rowspan="3">FLUID TEMPERATURE RANGE (°F)</th><th rowspan="3">CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)</th><th rowspan="3">INSULATION MEAN RATING TEMPERATURE (°F)</th><th colspan="7">NOMINAL PIPE DIAMETER (in inches)</th></tr>
<tr><th colspan="2">1 and less</th><th colspan="2">1 to <1.5</th><th>1.5 to < 4</th><th>4 to < 8</th><th>8 and larger</th></tr>
<tr><th colspan="7">INSULATION THICKNESS REQUIRED (in inches)</th></tr>
<tr><td colspan="10">Space heating, Hot Water systems (steam, steam condensate and hot water) and Service Water Heating Systems (recirculating sections, all piping in electric trace tape systems, and the first 8 feet of piping from the storage tank for nonrecirculating systems)</td></tr>
<tr><td>Above 350</td><td>0.32-0.34</td><td>250</td><td colspan="2">4.5</td><td colspan="2">5.0</td><td>5.0</td><td>5.0</td><td>5.0</td></tr>
<tr><td>251-350</td><td>0.29-0.31</td><td>200</td><td colspan="2">3.0</td><td colspan="2">4.0</td><td>4.5</td><td>4.5</td><td>4.5</td></tr>
<tr><td>201-250</td><td>0.27-0.30</td><td>150</td><td colspan="2">2.5</td><td colspan="2">2.5</td><td>2.5</td><td>3.0</td><td>3.0</td></tr>
<tr><td>141-200</td><td>0.25-0.29</td><td>125</td><td colspan="2">1.5</td><td colspan="2">1.5</td><td>2.0</td><td>2.0</td><td>2.0</td></tr>
<tr><td>105-140</td><td>0.22-0.28</td><td>100</td><td colspan="2">1.0</td><td colspan="2">1.5</td><td>1.5</td><td>1.5</td><td>1.5</td></tr>
<tr><td colspan="10"></td></tr>
<tr><td colspan="10">Space cooling systems (chilled water, refrigerant and brine)</td></tr>
<tr><td colspan="3"></td><td>Nonres</td><td>Res</td><td>Nonres</td><td>Res</td><td colspan="3"></td></tr>
<tr><td>40-60</td><td>0.21-0.27</td><td>75</td><td>0.5</td><td>0.75</td><td>0.5</td><td>0.75</td><td>1.0</td><td>1.0</td><td>1.0</td></tr>
<tr><td>Below 40</td><td>0.20-0.26</td><td>50</td><td colspan="2">1.0</td><td colspan="2">1.5</td><td>1.5</td><td>1.5</td><td>1.5</td></tr>
</table>

Energy Standards Table 120.3-A

4.7.1.8 **Systems with Recirculation Loops**

§110.3(c)5

Service water systems that have central recirculation distribution must include all of the following mandatory features. The intent of these measures is to optimize performance and allow for lower cost of maintenance. These requirements are applicable to nonresidential occupancies as well as high-rise residential and hotel/motel systems.

A. Air Release Valves

§110.3(c)5A

The constant supply of new water and leaks in system piping or components during normal operation of the pump may introduce air into the circulating water. Entrained air in the water can result in a loss of pump head pressure and pumping capacity, which adversely impacts the pumps' efficiency and life expectancy. Entrained air may also contribute to increased cavitation.

Cavitation is the formation of vapor bubbles in liquid on the low pressure (suction) side of the pump. The vapor bubbles generally condense back to the liquid state after they pass into the higher pressure side of the pump. Cavitation can contribute to a loss of head pressure and pumping capacity; may produce noise and vibration in the pump; may result in pump impeller corrosion; all of which impacts the pumps' efficiency and life expectancy.

Entrained air and cavitation should be minimized by the installation of an air release valve. The air release valve must be located no more than 4 ft from the inlet of the pump, and must be mounted on a vertical riser with a length of at least 12 inches. Alternatively, the pump shall be mounted on a vertical section of the return piping.

B. Recirculation Loop Backflow Prevention

§110.3(c)5B

Temperature and pressure differences in the water throughout a recirculation system can create potentials for backflows. This can result in cooler water from the bottom of the water heater tank and water near the end of the recirculation loop flowing backwards towards the hot water load and reducing the delivered water temperature.

To prevent this from occurring, the Energy Standards require that a check valve or similar device be located between the recirculation pump and the water heating equipment.

C. Equipment for Pump Priming/Pump Isolation Valves

§110.3(c)5C&D

A large number of systems are allowed to operate until complete failure simply because of the difficulty of repair or servicing. Repair labor costs can be reduced significantly by planning ahead and designing for easy pump replacement when the pump fails. Provision for pump priming and pump isolation valves help reduces maintenance costs.

To meet the pump priming equipment requirement, a hose bib must be installed between the pump and the water heater. In addition, an isolation valve shall be installed between the hose bib and the water heating equipment. This configuration will allow the flow from the water heater to be shut off, allowing the hose bib to be used for bleeding air out of the pump after pump replacement.

The requirement for the pump isolation valves will allow replacement of the pump without draining a large portion of the system. The isolation valves shall be installed on both sides of the pump. These valves may be part of the flange that attaches the pump to the pipe. One of the isolation valves may be the same isolation valve as in item C.

D. Connection of Recirculation Lines

§110.3(c)5E

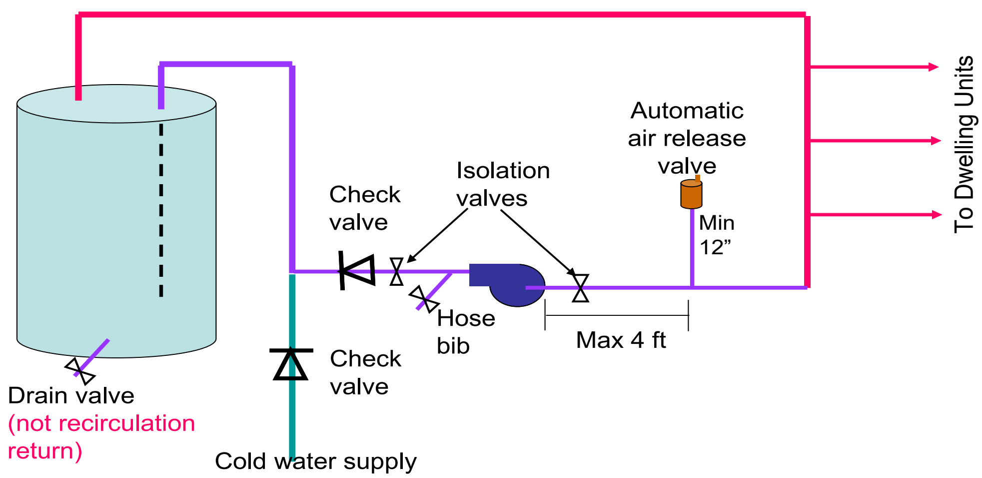
Manufacturer's specifications should always be followed to assure optimal performance of the system. The cold water piping and the recirculation loop piping should never be connected to the hot water storage tank drain port.

E. Backflow Prevention in Cold Water Supply

§110.3(c)5F

The dynamic between the water in the heater and the cold water supply are similar to those in the recirculation loop. Thermosyphoning can occur on this side of this loop just as it does on the recirculation side of the system. To prevent this, the Energy Standards require a check valve to be installed on the cold water supply line. The valve should be located between the hot water system and the next closest tee on the cold water supply line. Note that the system shall comply with the expansion tank requirements as described in the California Plumbing Code Section 608.3.

Figure 4-29: Backflow Prevention



4.7.2 Mandatory Requirements Applicable to High-Rise Residential and Hotel/Motel

In addition to the mandatory requirements listed above, there are mandatory requirements that will apply to water heating systems for hotels, motels and high-rise residential buildings only. All of these requirements are tied to the mandatory requirements in §150.1(c)8 for residential occupancies. Depending on whether the water heating system has a central system or uses individual water heaters will change whether the mandatory features that are listed above apply.

4.7.2.1 Storage Tank Insulation Requirements

§150.0(j)1

For unfired supplemental tanks R-12 must be installed if the internal insulation of the unfired tank is less than R-16.

4.7.2.2 **Water piping insulation thickness and conductivity**

§150.0(j)2

All domestic hot water system piping conditions listed below, whether buried or not-buried, must be insulated. The insulation thickness and conductivity shall be determined from the fluid temperature range and nominal pipe diameter as required by Table 4-22.

- The first five feet of pipe of hot and cold water from the storage tank must be insulated. In the case of a building with a central distribution system this requirement means that the cold supply line to the central water heater would have to be insulated. For building with central recirculation systems the hot water supply to each unit must be insulated to meet this requirement and the kitchen piping insulation requirement.
- Any pipe in the distribution system that is ¾ inch or larger must be insulated. This includes pipe in the central distribution system and in the distribution system serving the individual units.
- Any piping that is associated with a recirculation loop must be insulated. If the domestic hot water heater system serving the dwelling unit uses any type of recirculation insulation of the entire length of the distribution loop would be required. Insulation would also be required in the case of a dwelling unit with a combined hydronic system that uses any portion of the domestic hot water loop to circulate water for heating. Insulation would not be required on the branches or twig serving the point of use.
- All piping from the heating source to a storage tank or between storage tanks must be insulated.
- All hot water piping from the water heater or source of hot water for each dwelling unit to the kitchen must be insulated.
- All piping buried below grade must be insulated. In addition, all piping below grade must be installed in a waterproof and non-crushable casing or sleeve. The internal cross-section or diameter of the casing or sleeve shall be large enough to allow for insulation of the hot water piping. Pre-insulated pipe with integrated protection sleeve will also meet this requirement.

There are exceptions to the requirements for pipe insulation, as described below:

- In attics and crawlspaces, pipes completely covered with at least 4 inches of insulation are not required to have pipe insulation. Any section of pipe not covered with at least 4 inches of insulation must be insulated.
- In walls, all of the requirements must be met for compliance with Quality Insulatio Installation (QII) as specified in the Reference Residential Appendix RA3.5. Otherwise the section of pipe not meeting the QII specifications must be insulated.
- The last segment of piping that penetrates walls and delivers hot water to the sink or appliance does not require insulation.
- 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 butt securely against all framing members.

4.7.3 Prescriptive Requirements Applicable to High-Rise Residential and Hotel/Motel

For water heating recirculation systems for high-rise residential and hotel/motel buildings, the code actually references back to the Residential Prescriptive requirements. The following paragraphs recap these requirements.

4.7.3.1 **Solar Water Heating**

§150.1(c)8Biii

Solar water heating is prescriptively required for water heating systems serving multiple dwelling units, whether it is a motel/hotel or high-rise multifamily building. The minimum solar savings fraction (SSF) is dependent on the climate zone: 0.20 for CZ 1 through 9, and 0.35 for CZ 10 through 16. The Energy Standards do not limit the solar water heating equipment or system type, as long as they are SRCC certified and meet the orientation, tilt and shading requirement specified in RA 4.4. Installation of a solar water heating system exempts multifamily buildings from needing to set aside solar zone for future solar PV installation (§110.10(b)1B). The following paragraphs offer some high-level design considerations for multifamily building solar water heating systems.

A high-priority factor for solar water heating system design is component sizing. Proper sizing of the solar collectors and solar tank ensures that the system take full advantage of the sun's energy while avoiding the problem of overheating. While the issue of freeze protection has been widely explored (development of various solar water heating system types is a reflection of this evolution), the issue of overheating is often not considered as seriously as it should be. This is especially critical for multifamily-sized systems, due to load variability.

To be conservative, the highest SSF requirement called for by the 2016 Energy Standards is 35%. Industry standard sizing for an active system is generally 1.5 ft^2 collector area per gallon capacity for solar tank. For more detailed guidance and best practices, there are many publicly available industry design guidelines. Two such resources developed by/in association with government agencies are Building America Best Practices Series: Solar Thermal and Photovoltaic Systems[2] , and California Solar Initiative – Thermal: Program Handbook[3].Because of the new solar water heating requirement and prevalence of recirculation hot water systems in multifamily buildings, it is essential to re-iterate the importance of proper integration between the hot water recirculation system and the solar water heating system. Industry stakeholders recommend the recirculation hot water return to be connected back to the system *downstream* of the solar storage tank. This eliminates the unnecessary wasted energy used to heat up water routed back from the recirculation loop that may have been sitting in the solar water tank if no draw has occurred over a prolonged period of time.

Another design consideration is the layout and placement of collectors and solar tank. The design should minimize the length of plumbing, thus reduce pipe surface areas susceptible to heat loss and reduce the quantity of piping materials needed for the installation. The distance between collectors and solar tank should also be as short as practically possible.

4.7.3.2 **Dual Recirculation Loop Design**

150.1(c)8Bii

[2] http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/41085.pdf

[3] 3 http://www.gosolarcalifornia.ca.gov/documents/CSI-Thermal_Handbook.pdf

A dual-loop design is illustrated in Figure 4-30. In a dual-loop design, each loop serves half of the dwelling units. According to plumbing code requirements, the pipe diameters can be downsized compared to a loop serving all dwelling units. The total pipe surface area is effectively reduced, even though total pipe length is about the same as that of a single-loop design. For appropriate pipe sizing guidelines, please refer to the Universal Plumbing Code.

Figure 4-30: Example of a Dual-Loop Recirculation System

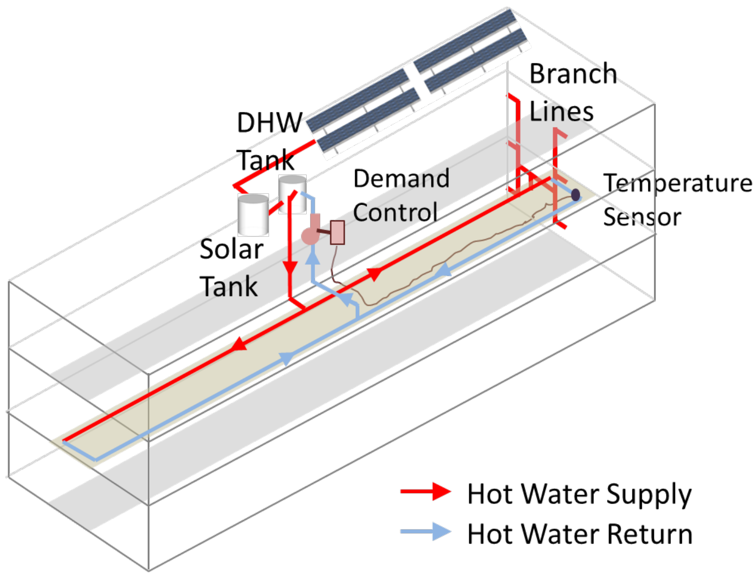
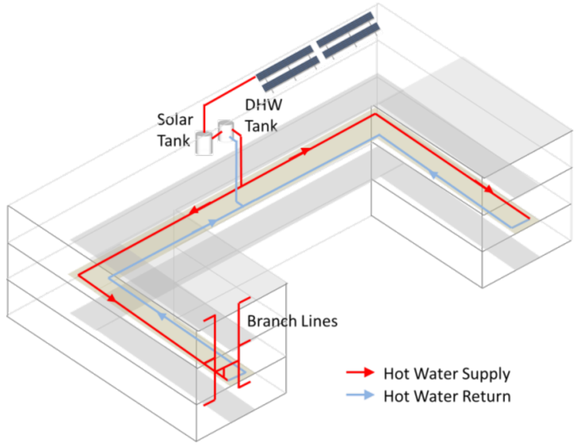
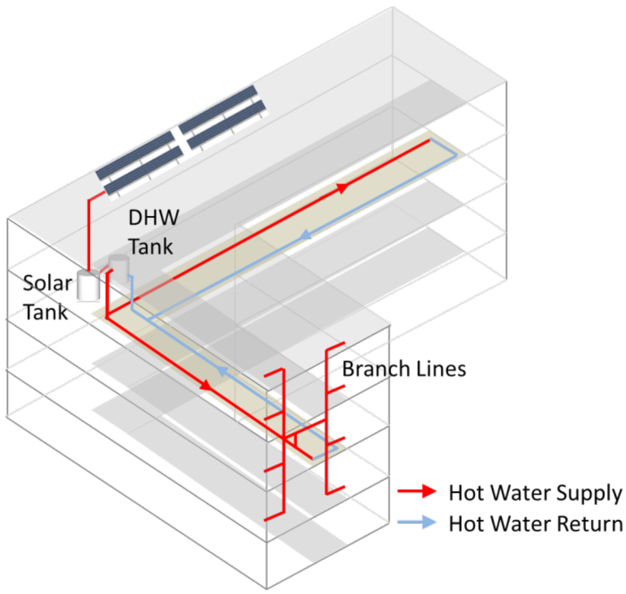


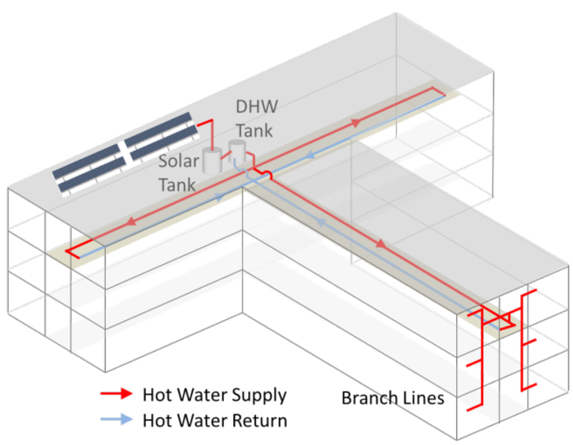
Figure 4-30 provides an example of how to implement dual-loop design in a low-rise multi-family building with a simple layout. In this example, the water heating equipment is located in the middle of top floor with each recirculation loop serving exactly half of the building. The recirculation loops are located in the middle floor to minimize branch pipe length to each of the dwelling units. The Figure 4-30 also illustrates how the solar water heating system and demand control are integrated.

For buildings with complicated layouts, an optimum design for recirculation loops depends on the building geometry. In general, the system should be designed to have each loop serving the equal number of dwelling units in order to minimize pipe sizes. For systems serving buildings with distinct sections, e.g. two wings in an “L” shaped building, it is better to dedicate a separate recirculation loop to each of the sections. Very large buildings and buildings with more than two sections should consider using separate central water heating systems for each section or part of the building. In all cases, a simplified routing of recirculation loops should be used to keep recirculation pipes as short as possible. Figure 4-31 shows examples of dual-loop recirculation system designs in buildings that have complicated floor planes.

Figure 4-31: Examples of dual-loop recirculation system designs in buildings that have complicated floor plans







Location of water heating equipment in the building should be carefully considered to properly implement the dual-loop design. The goal is to keep overall pipe length as short as possible, as an example, for buildings that do not have complicated floor plans; the designer should consider locating the water heating equipment at the center of the building footprint rather than at one end of the building which helps to minimize the pipe length needed. If a water heating system serves several distinct building sections, the water heating equipment would preferably nest in between these sections.

With the prescriptive solar water heating requirement in the 2016 Energy Standards it is especially important to consider the integration between the hot water recirculation system and the solar water heating system. Based on feedback from industry stakeholders, most solar water heating systems are only configured to operate as a pre-heater for the primary gas water heating equipment. In other words, recirculation hot water returns are usually plumbed back to the gas water heating storage tanks, not directly into the solar tank. This means recirculation loop designs should be mostly based on the building floor plan and are relatively independent of the solar water heating system. Consider that the system's gas water heating equipment and solar tank should be located close together to avoid heat loss from the piping that connects the two systems. The preferred configuration is to place both the gas water heating equipment and solar tank on the top floor near the solar collector so that the total system pipe length can be reduced. Minimizing pipe length helps to reduce DHW system energy use as well as system plumbing cost.

4.7.3.3 **Demand Recirculation Control**

The prescriptive requirement for DHW systems serving multiple dwelling units requires the installation of a demand recirculation control to minimize pump operation. Note that demand circulation control is different than the demand control used in single dwelling units. Demand controls for central recirculation systems are based on hot water demand and recirculation return temperatures. The temperature sensor should be installed at the last branch pipe along the recirculation loop.

Any system that does not meet the prescriptive requirements must instead meet the *Standard Design Building* energy budget or otherwise follow the performance compliance approach.

4.7.4 Pool and Spa Heating Systems

§110.4

Pool and spa heating systems must be certified by the manufacturer and listed by the Energy Commission as having:

1. An efficiency that complies with the Appliance Efficiency Regulations; and
2. An on-off switch mounted on the outside of the heater in a readily accessible location that allows the heater to be shut-off without adjusting the thermostat setting; and
3. A permanent, easily readable, and weatherproof plate or card that gives instructions for the energy efficient operation of the pool or spa, and for the proper care of the pool or spa water when a cover is used; and
4. No electric resistance heating. The only exceptions are:
    a. Listed packaged units with fully insulated enclosures and tight fitting covers that are insulated to at least R-6. Listed package units are defined in the National Electric Code and are typically sold as self-contained, UL Listed spas; or
    b. Pools or spas deriving at least 60 percent of the annual heating energy from site solar energy or recovered energy.

If a pool or spa does not currently use solar heating collectors for heating of the water, piping must be installed to accommodate any future installation. Contractors can choose 3 options to allow for the future addition of solar heating equipment:

1. Leave at least 36 inches of pipe between the filter and heater to allow for the future addition of solar heating equipment.
2. Plumb separate suction and return lines to the pool dedicated to future solar heating.
3. Install built-up or built-in connections for future piping to solar water heating. An example of a built-in connection could be a capped off tee fitting between the filter and heater.

Pool and spa heating systems with gas or electric heaters for outdoor use must use a pool cover. The pool cover must be fitted and installed during the final inspection.

All pool systems must be installed with the following:

1. Directional inlets must be provided for all pools that adequately mix the pool water.
2. A time switch or similar control mechanism shall be provided for pools to control the operation of the circulation control system, to allow the pump to be set or programmed to run in the off-peak demand period, and for the minimum time necessary to maintain the water in the condition required by applicable public health standards.

§110.5

Pool and spa heaters are not allowed to have pilot lights.

4.8 Performance Approach

Under the performance approach, the energy use of the building is modeled using a compliance software program approved by the California Energy Commission. This section presents some basic details on the modeling of building mechanical systems. Program users and those checking for enforcement should consult the most current version of the user's manuals and associated compliance supplements for specific instructions on the operation of the program. All compliance software programs, however, are required to have the same basic modeling capabilities.

More information on how to model the mechanical systems and components are included in Chapter 9, Performance Approach, and in the program vendor's compliance supplement.

The compliance rules used by the computer methods in generating the energy budget and compliance credits are detailed in the Nonresidential Alternative Calculation Methods (ACM) Approval Manual and are based on features required for prescriptive compliance.

There are minimum modeling capabilities required for programs that are used for the performance approach. All certified programs are tested for conformance with the requirements of the Nonresidential ACM. The designer has to use an approved program to show compliance.

Compliance is shown by running two models: a base case budget building that nominally just meets the mandatory and prescriptive requirements and a proposed building that represents the actual building's proposed envelope, lighting and mechanical systems. To create a level playing field the basecase and proposed designs are compared using the same assumptions of occupancy, proscribed climatic conditions and operating schedules. The results are compared using standardized time of use rates, or Time Dependent Valuations (TDV) of energy cost.

The proposed building complies if its annual TDV is less than or equal to that of the budget building. Reference Appendix JA3 describes the derivation of the TDV energy multipliers.

It is important to note that compliance in the Performance Approach is across all building systems. The design team can use more glass than with the prescriptive approach and comply by making a more efficient HVAC system. Energy can be traded off between prescriptive requirements in Envelope, HVAC, Indoor Lighting and Covered Processes.

The ACM defines the modeling rules for developing the base-case model of the building and mechanical systems. The base-case HVAC system(s) are based on the proposed HVAC system(s) according to the following specific characteristics:

- Occupancy type.
- Floor area of building.
- Number of floors, and zoning.

The following are some examples of how to get credit in the Performance Approach from HVAC systems:

- Use of high efficiency equipment that exceeds the minimum requirements of §110.1 and §110.2.
- Application of economizers where they are not required.
- Oversizing ducts and pipes to reduce fan and pump energy.
- Use of heat recovery for space or water heating.
- Use of thermal energy storage systems or building mass to move cooling off peak.
- Reduce reheating and recooling.
- Use of thermally driven cooling equipment, such as absorption chillers.

4.9 Additions and Alterations

4.9.1 Overview

This section addresses how the Energy Standards apply to mechanical systems for additions and alterations to existing buildings.

Application of the Energy Standards to existing buildings is often more difficult than for new buildings because of the wide variety of conditions that can be experienced in the field. In understanding the requirements, two general principles apply:

1. Existing systems or equipment are not required to meet the Energy Standards.
2. New systems and equipment are required to meet both the mandatory measures and the prescriptive requirements or the performance requirements as modeled in conjunction with the envelope and lighting design.

When heating, cooling or service water heating are provided for an alteration or addition by expanding an existing system, in general, that existing system need not comply with the mandatory measures or prescriptive requirements. However, any altered component must meet all applicable mandatory measures and prescriptive.

4.9.1.1 **Relocation of Equipment**

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 mandatory measures nor with the prescriptive or performance compliance requirements.

Performance approach may also be used to demonstrate compliance for alterations. Refer to Chapter 11, Performance Approach, for more details.

4.9.2 Mandatory Measures – Additions and Alterations

New mechanical equipment or systems in additions and/or alterations must comply with the mandatory measures as listed below. Additional information on these requirements is provided in earlier sections of this Chapter.

Table 4-23: Requirements for Additions and Alterations

Mandatory Measure	Application to Additions and Alterations
§110.1 – Mandatory Requirements for Appliances (see Section 4.2)	The California Appliance Efficiency Regulations apply to small to medium sized heating equipment, cooling equipment and water heaters. These requirements are enforced for all equipment sold in California and therefore apply to all equipment used in additions or alterations.
§110.2 – Mandatory Requirements for Space-Conditioning Equipment (see Section 4.2)	This section sets minimum efficiency requirements for equipment not covered by §110.1. Any equipment used in additions or alterations must meet these efficiency requirements.
§110.3 – Mandatory Requirements for Service Water-Heating Systems and Equipment (see Section 4.2)	This section sets minimum efficiency and control requirements for water heating equipment. It also sets requirements for recirculating hot water distribution systems. All new equipment installed in additions and/or alterations shall meet the requirements. The recirculation loop requirements of §110.3(c)5 apply when water heating equipment and/or plumbing is changed.
§110.4 – Mandatory Requirements for Pool and Spa Heating Systems and Equipment (see Sections 4.2 and 4.7).	The pool requirements of §110.4 do not apply for maintenance or repairs of existing pool heating or filtration systems.
§110.5 – Natural Gas Central Furnaces, Cooking Equipment, and Pool and Spa Heaters: Pilot Lights Prohibited (see Section 4.2)	Any new gas appliances installed in additions or alterations shall not have a standing pilot light, unless one of the exceptions in §110.5 is satisfied.
§120.1 – Requirements for Ventilation (see Section 4.3)	Systems that are altered or new systems serving an addition shall meet the outside air ventilation and control requirements, as applicable. When existing systems are extending to serve additions or when occupancy changes in an existing building (such as the conversion of office space to a large conference room), the outside air settings at the existing air handler may need to be modified and in some cases, new controls may be necessary.

§120.2 – Required Controls for Space-Conditioning Systems (see Section 4.5)	§120.2(a) requires a thermostat for any new zones in additions or new zones created in an alteration. §120.2(b) requires that new thermostats required by §120.2(a) meet the minimum requirements. §120.2(c) applies to hotel/motel guest rooms only when the system level controls are replaced; replacement of individual thermostats are considered a repair. However, §120.2(c) applies to all new thermostats in high rise residential, including replacements. §120.2(d) requires that new heat pumps used in either alterations or additions have controls to limit the use of electric resistance heat, per §110.2(b). This applies to any new heat pump installed in conjunction with an addition and/or alteration. §120.2(e) requires that new systems in alterations and additions have scheduling and setback controls. §120.2(f) requires that outside air dampers automatically close when the fan is not operating or during unoccupied periods, and remain closed during setback heating and cooling. This applies when a new system or air handling unit is replaced in conjunction with an addition or alteration. §120.2(g) requires that areas served by large systems be divided into isolation areas so that heating, cooling and/or the supply of air can be provided to just the isolation areas that need it and other isolation areas can be shut off. This applies to additions larger than 25,000 ft² and to the replacement of existing systems when the total area served is greater than 25,000 ft². §120.2(h) requires that direct digital controls (DDC) that operate at the zone level be programmed to enable non-critical loads to be shed during electricity emergencies. This requirement applies to additions and/or alterations anytime DDC are installed that operate at the zone level. §120.2(i) requires a Fault Detection and Diagnostic System (FDD) for all new air-cooled packaged direct expansion units used in either additions or alterations equipped with an economizer and mechanical cooling capacity equal to or greater than 54,000 Btu/hr in accordance with §120.2(i)2. through §120.2(i)8. §120.2(j) requires direct digital controls (DDC) in new construction, additions or alterations for certain applications and qualifications. It also requires certain capabilitis for mandated DDC systems. §120.2(k) requires that optimum start/stop when DDC is to the zone level.
§120.3 – Requirements for Pipe Insulation (see Section 4.4)	The pipe insulation requirements apply to any new piping installed in additions or alterations.
§120.4 – Requirements for Air Distribution System Ducts and Plenums (see Section 4.4)	The duct insulation, construction and sealing requirements apply to any new ductwork installed in additions or alterations.
§120.5 – Required Nonresidential Mechanical System Acceptance (See Chapter 13)	Acceptance requirements are triggered for systems or equipment installed in additions and alterations they same way they are for new buildings or systems.

4.9.3 Requirements for Additions

4.9.3.1 **Prescriptive Approach**

All new additions must comply with the following prescriptive requirements:

- §140.4 – Prescriptive Requirements for Space Conditioning Systems
- §140.5 – Prescriptive Requirements for Service Water-Heating Systems

For more detailed information about the prescriptive requirements, refer to following sections of this chapter:

- Section 4.5.2 - HVAC Controls
- Section 4.6.2 - HVAC System Requirements

4.9.3.2 **Performance Approach**

The performance approach may also be used to demonstrate compliance for new additions. When using the performance approach for additions §141.0(a)2B defines the characteristics of the standard design building.

Refer to Chapter 11, Performance Approach, for more details.

4.9.3.3 **Acceptance Tests**

Acceptance tests must be conducted on the new equipment or systems when installed in new additions. For more detailed information, see Chapter 13.

4.9.4 Requirements for Alterations

4.9.4.1 **Prescriptive Requirements – New or Replacement Equipment**

New space conditioning systems or components other than space conditioning ducts must meet applicable prescriptive requirements of Sections 4.5.2 and 4.6.2 (§140.4).

Minor equipment maintenance such as replacement of filters or belts does not trigger the prescriptive requirements. Equipment replacement such as the installation of a new air handler or cooling tower would be subject to the prescriptive requirements. Another example is if an existing VAV system is expanded to serve additional zones, the new VAV boxes are subject to zone controls of Section 4.5. Details on prescriptive requirements may be found in other sections of this chapter.

Replacements of electric resistance space heaters for high rise residential apartments are also exempt from the prescriptive requirements. Replacements of electric heat or electric resistance space heaters are allowed where natural gas is not available.

For alterations there are special rules for:

1. New or Replacement Space Conditioning Systems or Components in §141.0(b)2C.
2. Altered Duct Sytems in §141.0(b)2D.
3. Altered Space –Conditioning Systems in §141.0(b)2E.
4. Service water heating has to meet all of §140.5 with the exception of the solar water heating requirements in §141.0(b)2L.

4.9.4.2 **Prescriptive Requirements – Air Distribution Ducts**

§141.0(b)2D

When new or replacement space-conditioning ducts are installed to serve an existing building, the new ducts shall meet the requirements of Section 4.4 (insulation levels, sealing materials and methods, etc.).

If the ducts are part of a single zone constant volume system serving less than 5,000 ft² and more than 25 percent of the ducts are outdoors or in unconditioned area including attic spaces and above insulated ceilings, then the duct system shall be sealed and tested for air leakage by the contractor. In most nonresidential buildings this requirement will not apply because the roof is insulated so that almost all of the duct length is running through directly or indirectly conditioned space.

If the ducts are in unconditioned space and have to be sealed, they must also be tested to leak no greater than 6 percent if the entire duct system is new or less than 15 percent if the duct system is added to a pre-existing duct system. The description of the test method can be found in Section 2.1.4.2 of Reference Nonresidential Appendix NA2. The air distribution acceptance test associated with this can be found in Reference Nonresidential Appendix NA7. This and all acceptance tests are described in Chapter 13 of this manual.

If the new ducts form an entirely new duct system directly connected to an existing or new air handler, the measured duct leakage shall be less than 6 percent of fan flow; or

If the new ducts are an extension of an existing duct system, the combined new and existing duct system shall meet one of the following requirements:

1. The measured duct leakage shall be less than 15 percent of fan flow; or
2. If it is not possible to meet the duct sealing requirements of §141.0(b)2Dii, all accessible leaks shall be sealed and verified through a visual inspection and smoke test performed by a certified HERS Rater utilizing the methods specified in Reference Nonresidential Appendix NA 2.1.4.2.2.

Exception: Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos.

Once the ducts have been sealed and tested to leak less than the above amounts, a HERS rater will be contacted by the contractor to validate the accuracy of the duct sealing measurement on a sample of the systems repaired as described in Reference Nonresidential Appendix NA1.

4.9.4.3 **Prescriptive Requirements – Space-Conditioning Systems Alterations**

§141.0(b)2E

Similar requirements apply to ducts upon replacement of small (serving less than 5,000 ft²) constant volume HVAC units or their components (including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, or cooling or heating coil). Again the duct sealing requirements are for those systems where over 25 percent of the duct area is outdoors or in unconditioned areas including attic spaces and above insulated ceilings.

One can avoid sealing the ducts by insulating the roof and sealing the attic vents as part of a larger remodel, thereby creating a conditioned space within which the ducts are located, and no longer meets the criteria of §140.4(l).

When a space conditioning system is altered by the installation or replacement of space conditioning 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 new or replaced space conditioning equipment, if the duct system meets the criteria of §140.4(l)1, 2, and 3, shall be sealed, as confirmed through field verification and diagnostic testing in accordance with procedures for duct sealing of existing duct systems as specified in the Reference Nonresidential Appendix NA1, to one of the requirements of §141.0(b)2D; and the system shall include a setback thermostat that meets requirements of Reference Joint Appendix JA5.

There are three exceptions to this requirement:

1. Buildings altered so that the duct system no longer meets the criteria of §140.4(l)1, 2, and 3.

   Ducts would no longer have to be sealed if the roof deck was insulated and attic ventilation openings sealed.

2. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in Reference Nonresidential Appendix NA2.
3. Existing duct systems constructed, insulated or sealed with asbestos.

For all altered unitary single zone, air conditioners, heat pumps, and furnaces where the existing thermostat does not comply with Reference Joint Appendix JA5, the existing thermostat must be replaced with a thermostat that complies with Reference Joint Appendix JA5. All newly installed space-conditioning systems requiring a thermostat shall be equipped with a thermostat that complies with Reference Joint Appendix JA5. A JA5 compliant is also known as the Occupant Controlled Smart Thermostat (OSCT), which is capable of responding to demand response signals in the event of grid congestion and shortages during high electrical demand periods.

4.9.4.4 **Performance Approach**

When using the performance approach for alterations, see §141.0(b)3.

4.9.4.5 **Acceptance Tests**

Acceptance tests must be conducted on the new equipment or systems when installed in new additions. For more detailed information, see Chapter 13.

Example 4-52

Question

A maintenance contractor comes twice a year to change the filters and check out the rooftop packaged equipment that serves our office. Do the Energy Standards apply to this type of work?

Answer

In general, the Energy Standards do not apply to general maintenance such as replacing filters, belts or other components; however if the rooftop unit wears out and needs to be replaced, then the new unit would have to meet the equipment efficiency requirements of §110.2 as well as the mandatory requirements of §120.1-§120.4 and the prescriptive requirements of §140.4.

Example 4-53

Question

Our building is being renovated and the old heating system is being entirely removed and replaced with a new system that provides both heating and cooling. How do the Energy Standards apply?

Answer

All of the requirements of the Energy Standards apply in the same way they would if the system were in a new building.

Example 4-54

Question

A 10,000 ft² addition is being added to a 25,000 ft² building. The addition has its own rooftop HVAC system. The system serving the existing building is not being modified. How do the Energy Standards apply?

Answer

The addition is treated as a separate building and all the requirements of the Energy Standards apply to the addition. None of the requirements apply to the existing system or existing building since it is not being modified.

Example 4-55

Question

A 3,000 ft² addition is being added to a 50,000 ft² office. The existing packaged variable air volume (PVAV) system has unused capacity and will be used to serve the addition as well as the existing building. This system has direct digital controls at the zone level and an air side economizer.

Ductwork will be extended from an existing trunk line and two additional VAV boxes will be installed with hot water reheat. Piping for reheat will be extended from existing branch lines. How do the Energy Standards apply?

Answer

The general rule is that the Energy Standards apply to new construction and not to existing systems that are not being modified. In this case, the Energy Standards would not apply to the existing PVAV. However, the ductwork serving the addition would have to be sealed and insulated according to the requirements of §120.4, the hot water piping would have to be insulated according to the requirements of §120.3, The new thermostats would have to meet the requirements of §120.2 (a), (b), and (h), ventilation would have to be provided per §120.1, fractional fan motors in the new space would have to comply with §140.4(c)4, and the new VAV boxes would have to meet the requirements of 140.4(d).

Example 4-56

Question

In the previous example (3,000 ft² addition is added to a 50,000 ft² office), how do the outside air ventilation requirements of §120.1 apply?

Answer

The outside air ventilation rates specified in §120.1 apply at the air handler. When existing air handlers are extended to serve additional space, it is necessary to reconfigure the air handler to assure that the outside air requirements of §120.1 are satisfied for all the spaces served. In addition, the acceptance requirements for outside air ventilation are also triggered (see Chapter 12). It would be necessary to evaluate the occupancies both in the addition and the existing building to determine the minimum outside air needed to meet the requirements of §120.1. The existing air handler would have to be controlled to assure that the minimum outside air is delivered to the spaces served by the air handler for all positions of the VAV boxes. (See Section 4.3 for details on how this is achieved. Additional controls may need to be installed at the air handler to meet this requirement.)

Example 4-57

Question

In the previous example, the 3,000 ft² addition contains a large 400 ft² conference room. What additional requirements are triggered in this instance?

Answer

In this case, the demand control requirements of §140.4(c) would apply to the conference room, since it has an occupant density greater than 25 persons per 1,000 ft² and the PVAV system serving the building has an air side economizer and direct digital controls (DDC) at the zone level. If the existing system did not have an outside air economizer or if it did not have DDC controls at the zone level, then the demand control requirements would not apply. A separate sensor would need to be provided in the conference room to meet this requirement. The programming on the OSA damper would have to be modified to increase OSA if the zone ventilation wasn't satisfied.

Example 4-58

Question

An existing building has floor-by-floor VAV systems with no air side economizers. The VAV boxes also have electric reheat. Outside air is ducted to the air handlers on each floor which is adequate to meet the ventilation requirements of §120.1, but not large enough to bring in 100 percent outside air which would be needed for economizer operation. A tenant space encompassing the whole floor is being renovated and new ductwork and new VAV boxes are being installed. Does the economizer requirement of §140.4(e) apply? Does the restriction on electric resistance heat of §140.4(g) apply?

Answer

Since the air handler is not being replaced, the economizer requirement of §140.4(e) does not apply. If in the future the air handler were to be replaced, the economizer requirement would need to be satisfied; however for systems such as this a water side economizer is often installed instead of an air side economizer. The electric resistance restriction of §140.4(g) does however apply, unless the *Exception* 2 to §149(a) applies. This exception permits electric resistance to be used for the additional VAV boxes as long as the total capacity of the electric resistance system does not increase by more than 150 percent.

Example 4-59

Question

In the previous example, the building owner has decided to replace the air handler on the floor where the tenant space is being renovated because the new tenant has electronic equipment that creates more heat than can be removed by the existing system. In this case, does the economizer requirement of §140.4(e) apply?

Answer

In this case, because the air handler is being replaced, the economizer requirement does apply. The designer would have a choice of using an air-side economizer or a water-side economizer. The air side economizer option would likely require additional or new ductwork to bring in the necessary volume of outside air. The feasibility of a water economizer will depend on the configuration of the building. Often a cooling tower is on the roof and chillers are in the basement with chilled water and condenser water lines running in a common shaft. In this case, it may be possible to tap into the condenser water lines and install a water economizer, however, pressure controls would need to be installed at the take offs at each floor and at the chiller.

Example 4-60

Question

400 tons of capacity is being added to an existing 800 ton chilled water plant. The existing plant is air cooled (two 400 ton air cooled chillers). Can the new chillers also be air cooled?

Answer

No. The requirements of §140.4(j) apply in this case and a maximum of 300 tons of air-cooled chillers has been reached (and exceeded) at this plant. The remainder has to be water cooled. They would not have to retrofit the plant to replace either of the existing air-cooled chillers with water cooled. If one of the existing air-cooled chillers failed in the future they would have to replace it with a water-cooled chiller. If both air-cooled chillers failed they could only provide 300 tons of air cooled capacity.

4.10 Glossary/Reference

Terms used in this chapter are defined in Reference Joint Appendix JA1. Definitions that appear below are either not included within Reference Joint Appendix JA1 or expand on the definitions.

4.10.1 Definitions of Efficiency

§110.1 and §110.2 mandate minimum efficiency requirements that regulated appliances and other equipment must meet. The following describes the various measurements of efficiency used in the Energy Standards.

The purpose of space-conditioning and water-heating equipment is to convert energy from one form to another, and to regulate the flow of that energy. Efficiency is a measure of how effectively the energy is converted or regulated. It is expressed as the ratio:

Equation 4-9

$$Efficiency = \frac{Output}{Input}$$

The units of measure in which the input and output energy are expressed may be either the same or different, and vary according to the type of equipment. The Energy Standards use several different measures of efficiency.

Combustion Efficiency is defined in the Appliance Efficiency Regulations as follows:

Combustion efficiency of a space heater means a measure of the percentage of heat from the combustion of gas or oil that is transferred to the space being heated or lost as jacket loss, as determined using the applicable test method in Section 1604(e).

Boiler means a space heater that is a self-contained appliance for supplying steam or hot water primarily intended for space-heating. Boiler does not include hot water supply boilers.

Where boilers used for space heating are considered to be a form of space heater.

Thermal efficiency is used as the efficiency measurement for gas and oil boilers with rated input greater than or equal to 300,000 Btu/hr. It is a measure of the percent of energy transfer from the fuel to the heat exchanger (HX). Input and output energy are expressed in the same units so that the result has non-dimensional units:

Equation 4-10

$$\%\ \text{Combustion Eff} = \frac{(\text{Energy to HX}) \text{ x } 100}{\text{Total Fuel Energy Input}}$$

Note: Combustion efficiency does not include losses from the boiler jacket. It is strictly a measure of the energy transferred from the products of combustion.

Fan Power Index is the power consumption of the fan system per unit of air moved per minute (W/cfm) at design conditions.

Thermal Efficiency is defined in the Appliance Efficiency Regulations as a measure of the percentage of heat from the combustion of gas, which is transferred to the space or water being heated as measured under test conditions specified. The definitions from the Appliance Efficiency Regulations are:

1. Thermal Efficiency of a space heater means a measure of the percentage of heat from the combustion of gas or oil that is transferred to the space being heated, or in the case of a boiler, to the hot water or steam, as determined using the applicable test methods in Section 1604(e).
2. Thermal Efficiency of a water heater means a measure of the percentage of heat from the combustion of gas or oil that is transferred to the water, as determined using the applicable test method in Section 1604(f).
3. Thermal Efficiency of a pool heater means a measure of the percentage of heat from the input that is transferred to the water, as determined using the applicable test method in Section 1604(g).

Equation 4-11

$$\%\ \textit{Thermal Efficiency} = \frac{\textit{(Energy Transferred to Medium)}}{\textit{(Total Fuel Input)}}$$

4.10.2 Definitions of Spaces and Systems

The concepts of spaces, zones, and space-conditioning systems are discussed in this subsection.

Fan System is a fan or collection of fans that are used in the scope of the Prescriptive requirement for fan-power limitations §140.4(c). §140.4(c) defines fan-systems as all fans in the system that are required to operate at design conditions in order to supply air from the heating or cooling source to the conditioned space, and to return it back to the source or to exhaust it to the outdoors. For cooling systems this includes supply fans, return fans, relief fans, fan coils, series-style fan powered boxes, parallel-style fan powered boxes and exhaust fans. For systems without cooling this includes supply fans, return fans, relief fans, fan coils, series-style fan powered boxes, parallel-style fan powered boxes and exhaust fans. Parallel-style fan-powered boxes are often not included in a terminal unit where there is no need for heating as the fans are only needed for heating.

Space is not formally defined in the Energy Standards, but is considered to be an area that is physically separated from other areas by walls or other barriers. From a mechanical perspective, the barriers act to inhibit the free exchange of air with other spaces. The term “space” may be used interchangeably with “room.”

Space Conditioning zone is a space or group of spaces within a building with sufficiently similar comfort conditioning requirements so that comfort conditions, as specified in

§140.4(b)3, as applicable, can be maintained throughout the zone by a single controlling device. It is the designer's responsibility to determine the zoning; in most cases each building exposure will consist of at least one zone. Interior spaces that are not affected by outside weather conditions usually can be treated as a single zone.

A building will generally have more than one zone. For example, a facility having 10 spaces with similar conditioning that are heated and cooled by a single space-conditioning unit using one thermostat is one zone. However, if a second thermostat and control damper, or an additional mechanical system, is added to separately control the temperature within any of the 10 spaces, then the building has two zones.

Space-Conditioning System is used to define the scope of the requirements of the Energy Standards. It is a catch-all term for mechanical equipment and distribution systems that provide either collectively or individually- heating, ventilating, or cooling within or associated with conditioned spaces in a building. HVAC equipment is considered part of a space-conditioning system if it does not exclusively serve a process within the building. Space conditioning systems include general and toilet exhaust systems.

Space-conditioning systems may encompass a single HVAC unit and distribution system (such as a package HVAC unit) or include equipment that services multiple HVAC units (such as a central outdoor air supply system, chilled water plant equipment or central hot water system).

4.10.3 Types of Air

Exhaust Air is air being removed from any space or piece of equipment and conveyed directly to the atmosphere by means of openings or ducts. The exhaust may serve specific areas, such as toilet rooms, or may be for a general building relief, such as an economizer.

Make-up Air is air provided to replace air being exhausted.

Mixed Air is a combination of supply air from multiple air streams. The term mixed air is used in the Energy Standards in an exception to the prescriptive requirement for space conditioning zone controls §140.4(d). In this manual the term mixed air is also used to describe a combination of outdoor and return air in the mixing plenum of an air handling unit.

Outdoor Air is air taken from outdoors and not previously circulated in the building. For the purposes of ventilation, outdoor air is used to flush out pollutants produced by the building materials, occupants and processes. To ensure that all spaces are adequately ventilated with outdoor air, the Energy Standards require that each space be adequately ventilated (See Section 4.3).

Return Air is air from the conditioned area that is returned to the conditioning equipment either for reconditioning or exhaust. The air may return to the system through a series of ducts, or through plenums and airshafts.

Supply Air is air being conveyed to a conditioned area through ducts or plenums from a space-conditioning system. Depending on space requirements, the supply may be heated, cooled, or neutral.

Transfer Air is air that is transferred directly from either one space to another or from a return plenum to a space. Transfer air is a way of meeting the ventilation requirements at the space level and is an acceptable method of ventilation per §120.1. It works by transferring air with a low level of pollutants from an over ventilated space) to a space with a higher level of pollutants (See Section 4.3).

4.10.4 Air Delivery Systems

Space-conditioning systems can be grouped according to how the airflow is regulated as follows:

Constant Volume System is a space-conditioning system that delivers a fixed amount of air to each space. The volume of air is set during the system commissioning.

Variable Air Volume (VAV) System is a space conditioning system that maintains comfort levels by varying the volume of conditioned air to the zones served. This system delivers conditioned air to one or more zones. There are two styles of VAV systems, single-duct VAV where mechanically cooled air is typically supplied and reheated through a duct mounted coil, and dual-duct VAV systems where heated and cooled streams of air are blended at the zone level. In single-duct VAV systems the duct serving each zone is provided with a motorized damper that is modulated by a signal from the zone thermostat. The thermostat also controls the reheat coil. In dual-duct VAV systems the ducts serving each zone are provided with motorized dampers that blend the supply air based on a signal from the zone thermostat.

Pressure Dependent VAV Box has an air damper whose position is controlled directly by the zone thermostat. The actual airflow at any given damper position is a function of the air static pressure within the duct. Because airflow is not measured, this type of box cannot precisely control the airflow at any given moment: a pressure dependent box will vary in output as other boxes on the system modulate to control their zones.

Pressure Independent VAV Box has an air damper whose position is controlled on the basis of measured airflow. The setpoint of the airflow controller is, in turn, reset by a zone thermostat. A maximum and minimum airflow is set in the controller, and the box modulates between the two according to room temperature.

4.10.5 Return Plenums

Return Air Plenum is an plenum is an air compartment or chamber including uninhabited crawl spaces, areas above a ceiling or below a floor, including air spaces below raised floors of computer/data processing centers, or attic spaces, to which one or more ducts are connected and which forms part of either the supply air, return air or exhaust air system, other than the occupied space being conditioned. The return air temperature is usually within a few degrees of space temperature.

4.10.6 Zone Reheat, Recool and Air Mixing

When a space-conditioning system supplies air to one or more zones, different zones may be at different temperatures because of varying loads. Temperature regulation is normally accomplished by varying the conditioned air supply (variable volume), by varying the temperature of the air delivered, or by a combination of supply and temperature control. With multiple zone systems, the ventilation requirements or damper control limitations may cause the cold air supply to be higher than the zone load, this air is tempered through reheat or mixing with warmer supply air to satisfy the actual zone load. §140.4(c) limits the amount of energy used to simultaneously heat and cool the same zone as a basis of zone temperature control.

Zone Reheat is the heating of air that has been previously cooled by cooling equipment or systems or an economizer. A heating device, usually a hot water coil, is placed in the zone supply duct and is controlled via a zone thermostat. Electric reheat is sometimes used, but is severely restricted by the Energy Standards.

Zone Recool is the cooling of air that has been previously heated by space conditioning equipment or systems serving the same building. A chilled water or refrigerant coil is usually placed in the zone supply duct and is controlled via a zone thermostat. Re-cooling is less common than reheating.

Zone Air Mixing occurs when more than one stream of conditioned air is combined to serve a zone. This can occur at the HVAC system (e.g. multizone), in the ductwork (e.g. dual-duct system) or at the zone level (such as a zone served by a central cooling system and baseboard heating). In some multizone and dual duct systems an unconditioned supply is used to temper either the heating or cooling air through mixing. §140.4(c) only applies to systems that mix heated and cooled air.

4.10.7 Economizers

4.10.7.1 Air Economizers

An air economizer is a ducting arrangement and automatic control system that allows a cooling supply fan system to supply outside air to reduce or eliminate the need for mechanical cooling.

When the compliance path chosen for meeting the Energy Standards requires an economizer, the economizer must be integrated into the system so that it is capable of satisfying part of the cooling load while the rest of the load is satisfied by the refrigeration equipment. The Energy Standards also require that all new economizers meet the Acceptance Requirements for Code Compliance before a final occupancy permit may be granted. The operation of an integrated air economizer is diagrammed in Figure 4-32.

When outdoor air is sufficiently cold, the economizer satisfies all cooling demands on its own. As the outdoor temperature (or enthalpy) rises, or as system cooling load increases, a point may be reached where the economizer is no longer able to satisfy the entire cooling load. At this point the economizer is supplemented by mechanical refrigeration, and both operate concurrently. Once the outside drybulb temperature (for temperature controlled economizer) or enthalpy (for enthalpy economizers) exceeds that of the return air or a predetermined high limit, the outside air intake is reduced to the minimum required, and cooling is satisfied by mechanical refrigeration only.

Nonintegrated economizers cannot be used to meet the economizer requirements of the prescriptive compliance approach. In nonintegrated economizer systems, the economizer may be interlocked with the refrigeration system to prevent both from operating simultaneously. The operation of a nonintegrated air economizer is diagrammed in Figure 4-33. Nonintegrated economizers can only be used if they comply through the performance approach.

Figure 4-32: Integrated Air Economizer

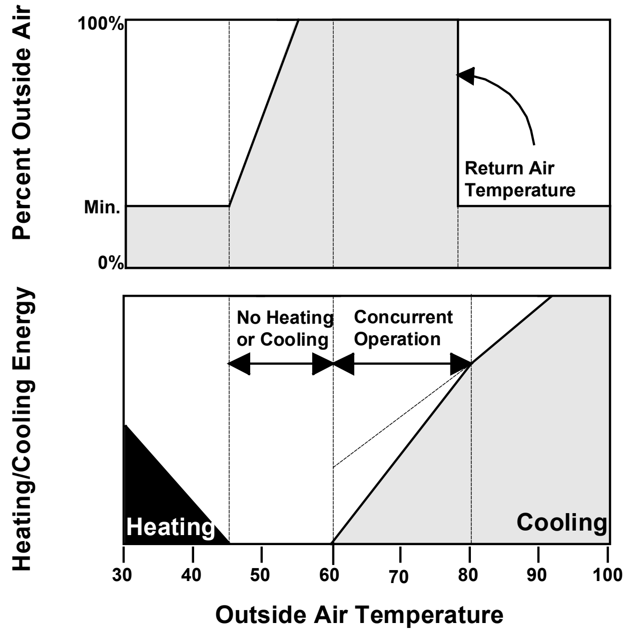
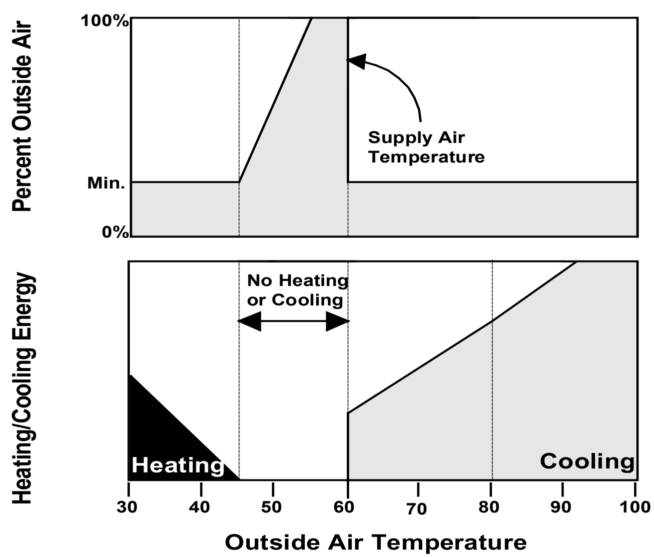


Figure 4-33: Nonintegrated Air Economizer



4.10.7.2 **Water Economizers**

A water economizer is a system by which the supply air of a cooling system is cooled directly or indirectly by evaporation of water, or other appropriate fluid, in order to reduce or eliminate the need for mechanical cooling.

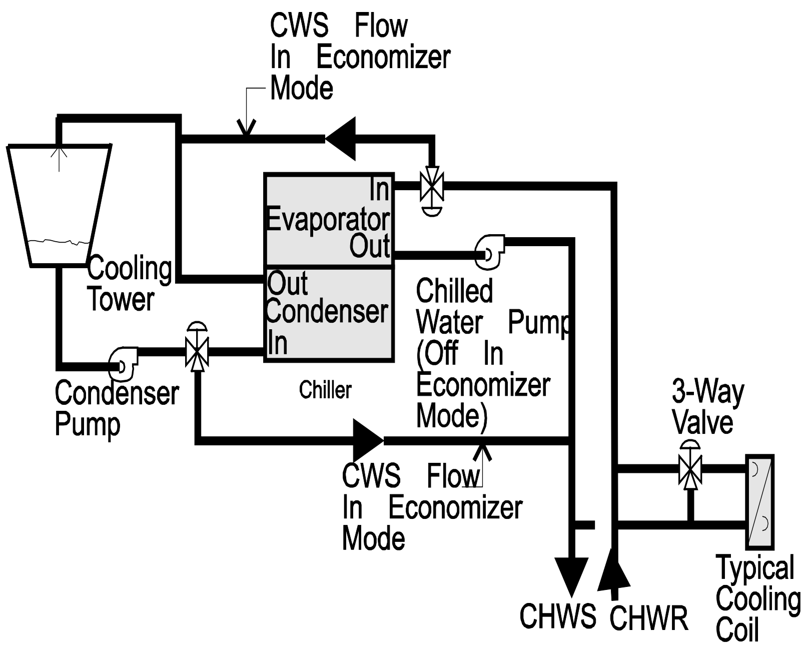
As with an air economizer, a water economizer must be integrated into the system so that the economizer can supply a portion of the cooling concurrently with the refrigeration system.

There are three common types of water-side economizers:

1. **Strainer-cycle or chiller-bypass water economizer**. This system, depicted in Figure 4-34 below, does *not* meet the prescriptive requirement as it cannot operate in parallel with the chiller. This system is applied to equipment with chilled water coils.
2. **Water-precooling economizer**. This system depicted in Figure 4-35 and Figure 4-36 below meets the prescriptive requirement if properly sized. This system is applied to equipment with chilled water coils.
3. **Air-precooling water economizer**. This system depicted in Figure 4-37 below *also meets* the prescriptive requirement if properly sized. The air-precooling water economizer is appropriate for water-source heat pumps and other water-cooled HVAC units.

To comply with the prescriptive requirements, the cooling tower serving a water-side economizer must be sized for 100 percent of the anticipated cooling load at the off-design outdoor-air condition of 50°F dry bulb/45°F wet bulb. This requires rerunning the cooling loads at this revised design condition and checking the selected tower to ensure that it has adequate capacity.

Figure 4-34: "Strainer-Cycle" Water Economizer



This system does not meet the prescriptive requirement as it cannot operate in parallel with the chiller

Figure 4-35: Water-Precooling Water Economizer with Three-Way Valves

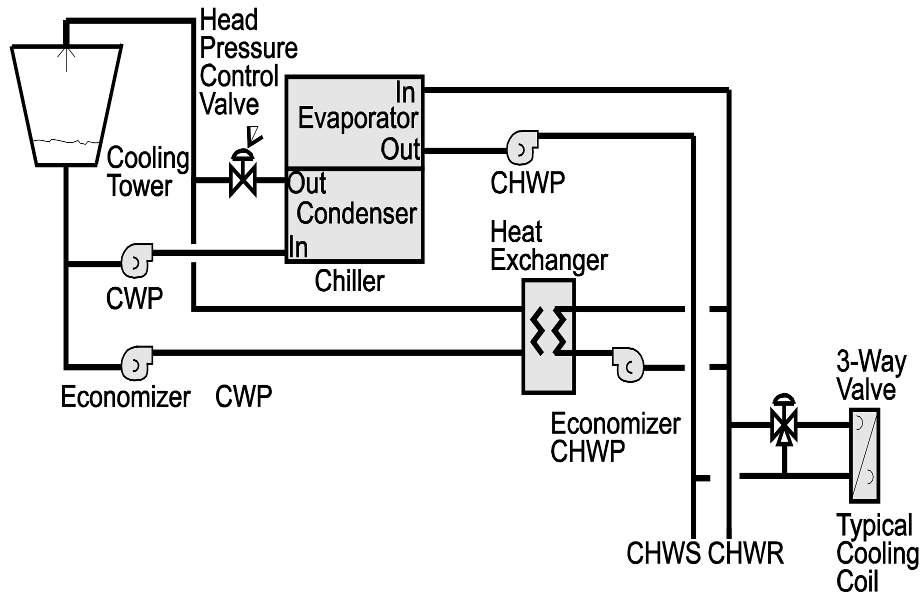


Figure 4-36: Water-Precooling Water Economizer with Two-Way Valves

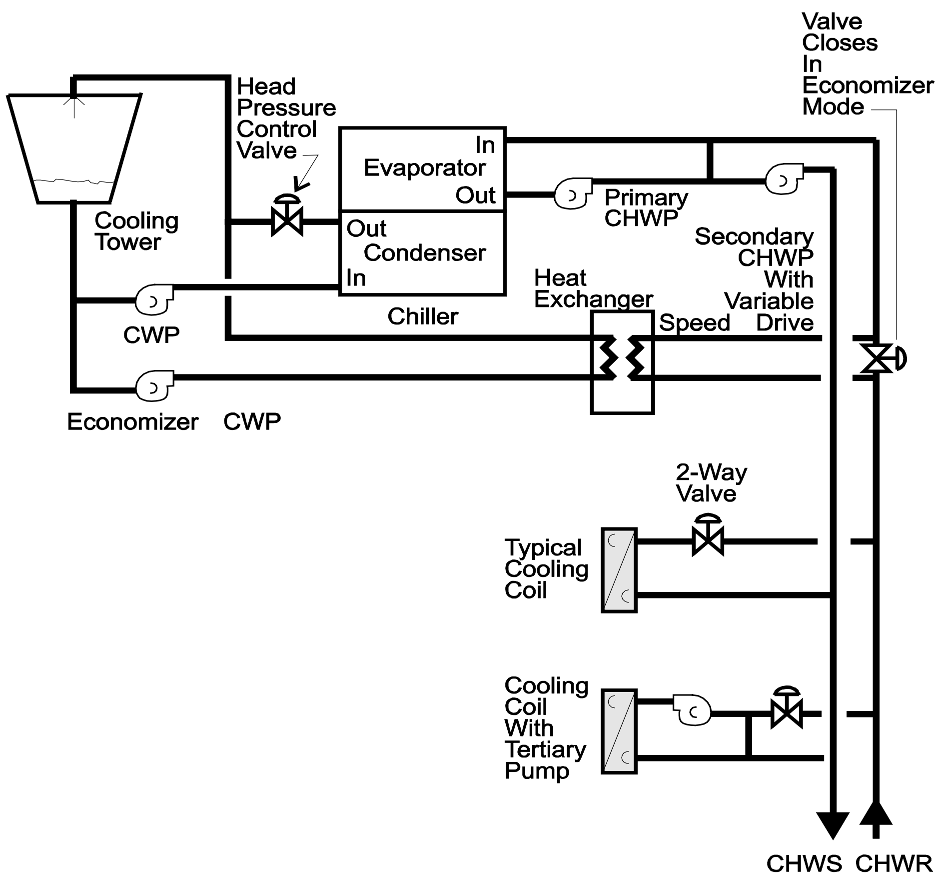
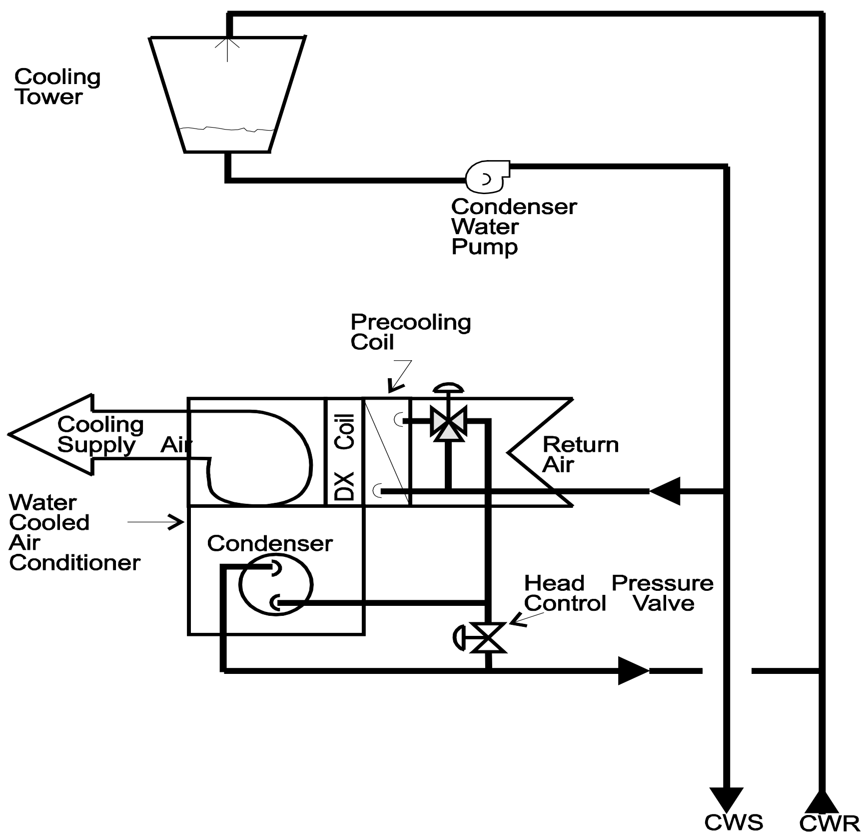


Figure 4-37: Air-Precooling Water Economizer



4.10.8 Unusual Sources of Contaminants

§120.1 address ventilation requirements for buildings and uses the term of “unusual sources of contamination.” In this context, such contaminants are considered to be chemicals, materials, processes or equipment that produce pollutants which are considered harmful to humans, and are not typically found in most building spaces. Examples may include some cleaning products, blueprint machines, heavy concentrations of cigarette smoke and chemicals used in various processes.

The designation of such spaces is left to the designer’s discretion, and may include considerations of toxicity, concentration and duration of exposure. For example, while photocopiers and laser printers are known to emit ozone, scattered throughout a large space it may not be of concern. A heavy concentration of such machines in a small space may merit special treatment (See Section 4.3).

4.10.9 Demand Controlled Ventilation

Demand controlled ventilation is required for use on systems that have an outdoor air economizer, and serve a space with a design occupant density, or maximum occupant load factor for egress purposes in the CBC, greater than or equal to 25 people per 1000 ft^2 (40 ft^2/ person) §120.1(c)3. Demand controlled ventilation is also allowed as an exception in the ventilation requirements for intermittently occupied systems §120.1(c)1, §120.1(c)3 and §120.1(c)4. It is a concept in which the amount of outdoor air used to purge one or more offending pollutants from a building is a function of the measured level of the pollutant(s).

§120.1 allows for demand controlled ventilation devices that employ a carbon dioxide (CO_2) sensor. Carbon dioxide sensors measure the level of carbon dioxide, which is used as a proxy for the amount of pollutant dilution in densely occupied spaces. CO_2 sensors have been on the market for many years and are available with integrated self-calibration devices that maintain a maximum guaranteed signal drift over a 5-year period. ASHRAE Standard 62 provides some guidelines on the application of demand controlled ventilation.

Demand controlled ventilation is available at either the system level (used to reset the minimum position on the outside air damper) and at the zone level (used to reset the minimum airflow to the zone). The zone level devices are sometimes integrated into the zone thermostat.

Occupant sensor ventilation control devises are required in multipurpose rooms less than 1000 ft^2, classrooms greater than 750 ft^2 and conference, convention, auditorium, and meeting center rooms greater than 750 ft^2 that do not generate dust, fumes, vapors, or gasses §120.1(c)5 and §120.2(e)3. Occupant sensor control devises are used to setup the operating cooling temperature, setback the operating heating temperature, and set minimum ventilation rate levels during unoccupied periods. Spaces with an area of less than 1,500 ft^2 are exempt from the demand control ventilation requirements specified in §120.1(c)3 if employing occupant sensor ventilation control devices in accordance with §120.1(c)5

4.10.10 Intermittently Occupied Spaces

The demand controlled ventilation devices discussed here are allowed and/or required only in spaces that are intermittently occupied. An intermittently occupied space is considered to be an area that is infrequently or irregularly occupied by people. Examples include auction rooms, movie theaters, auditoriums, gaming rooms, bars, restaurants, conference rooms and other assembly areas. Because the Energy Standards requires base ventilation requirement in office spaces that are very close to the actual required ventilation rate at 15 cfm per person, these controls may not save significant amounts of energy for these low-density applications. However, even in office applications, some building owners may install CO_2 sensors as a way to monitor ventilation conditions and alert to possible malfunctions in building air delivery systems.

4.11 Mechanical Plan Check Documents

At the time a building permit application is submitted to the enforcement agency, the applicant also submits plans and energy compliance documentation. This section describes the documents and recommended procedures documenting compliance with the mechanical requirements of the Energy Standards. It does not describe the details of the requirements; these are presented in Section 4.2. The following discussion is addressed to the designer preparing construction documents and compliance documentation, and to the enforcement agency plan checkers who are examining those documents for compliance with the Energy Standards.

4.11.1 Field Inspection Checklist

New for the compliance documents is the Field Inspection Energy Checklist. Prescriptively the Documentation Author is responsible for filling out the Field Inspection Energy Checklist. For the Performance Approach the fields will be automatically filled. A copy shall be made available to the Field Inspector during different stage inspection.

The Field Inspection Energy Checklist is designed to help Field Inspectors look at specifics features that are critical to envelope compliance. These features should match the building plans as indicated on the Mechanical Field Inspection Energy Checklist or NRCC-MCH-01-E. The Field Inspector must verify after the installation of each measure (e.g. HVAC Systems). The Field Inspector in addition must collect a signed MECH-INST (Installation Certificate) from the installer.

In the case of the Field Inspection Energy Checklist does not match exactly the building plans or the MECH-INST document, the field inspector must verify the features are meeting the minimum efficiency or better and if so no further compliance is required from the Architect or responsible party. In the case the features do not meet the efficiencies (worse) the field inspector shall require recompliance with the actual installed features.

4.11.1.1 **HVAC SYSTEM Details**

The Field Inspector need check the Pass or Fail check boxes only after the measures have been verified. If the Special Feature is checked, the enforcement agency should pay special attention to the items specified in the checklist. The local enforcement agency determines the adequacy of the justification, and may reject a building or design that otherwise complies based on the adequacy of the special justification and documentation. See MECH-2C Pages 1-2-3 of 3.

4.11.1.2 **Special Features Inspection Checklist**

The local enforcement agency should pay special attention to the items specified in this checklist. These items require special written justification and documentation, and special verification. The local enforcement agency determines the adequacy of the justification, and may reject a building or design that otherwise complies based on the adequacy of the special justification and documentation submitted. See MECH-1C Pages 2-3 of 3.

4.11.1.3 **Discrepancies**

If any of the Fail boxes are checked off, the field inspector shall indicate appropriate action of correction(s). See Field Inspection Energy Checklist on Page 2 of MECH-1C.

The use of each document is briefly described. The information and format of these may be included in the equipment schedule:

NRCC-MCH-01-E: Certificate of Compliance

Required for every job, and it is required to part on the plans.

NRCC-MCH-02-E: Air, Water Side, and Service Hot Water & Pool System Requirements

Summarizes the major components of the heating and cooling systems, and service hot water and pool systems, and documents the location on the plans and in the specifications where the details about the requirements appear.

NRCC-MCH-03-E: Mechanical Ventilation and Reheat

Documents the calculations used as the basis for the outdoor air ventilation rates. For VAV systems, it is also used to show compliance with the reduced airflow rates necessary before reheating, re-cooling or mixing of conditioned airstreams.

NRCC-MCH-07-E: Fan Power Consumption

This document is used, following the prescriptive approach, to calculate total system fan power consumption for fan systems exceeding 25 brake horsepower. The “total system” includes supply, exhaust and return fans used for space conditioning.

NRCC-PLB-01-E: Certificate of Compliance – Water Heating System General Information

Required for every job and required to part on the plans.

NRCI-PLB-01-E: Water Heating System

This installation document is used for all hot water system

NRCI-PLB-02-E: High Rise Residential, Hotel/Motel Single Dwelling Unit Hot Water Systems Distribution

Used when individual water heating system is installed in each dwelling units in High Rise Residential, Hotel/Motel

NRCI-PLB-03-E: High Rise Residential, Hotel/Motel Central Hot Water Systems Distribution

This installation document is used when central water heating system is installed that service multiple dwelling units in High Rise Residential, Hotel/Motel

NRCI-PLB-04-E: Nonresidential Single Dwelling Unit Hot Water Systems Distribution

Used when individual water heating system is installed in each dwelling units in High Rise Residential, Hotel/Motel

NRCI-PLB-05-E: Nonresidential Central Hot Water Systems Distribution Water Heating System

This installation document is used when central water heating system is installed that service multiple dwelling units in High Rise Residential, Hotel/Motel

4.11.2 Mechanical Inspection

The mechanical building inspection process for energy compliance is carried out along with the other building inspections performed by the enforcement agency. The inspector relies upon the plans and upon the NRCC-MCH-01-E Certificate of Compliance document printed on the plans.

4.11.3 Acceptance Requirements

Acceptance requirements can effectively improve code compliance and help determine whether mechanical equipment meets operational goals and whether it should be adjusted to increase efficiency and effectiveness.

Acceptance tests are described in detail in Chapter 13.

4.11.3.1 **Process**

The process for meeting the acceptance requirements includes:

1. Document plans showing thermostat and sensor locations, control devices, control sequences and notes,
2. Review the installation, perform acceptance tests and document results, and
3. Document the operating and maintenance information, complete installation certificate and indicate test results on the Certificate of Acceptance, and submit the Certificate to the enforcement agency prior to receiving a final occupancy permit.

4.11.3.2 **Administration**

The administrative requirements contained in the Energy Standards require the mechanical plans and specifications to contain:

Requirements for acceptance testing for mechanical systems and equipment shown in the table below:

Table 4-24: Mechanical Acceptance Tests

Variable Air Volume Systems
Constant Volume Systems
Package Systems
Air Distribution Systems
Economizers
Demand Control Ventilation Systems
Ventilation Systems
Variable Frequency Drive Fan Systems
Hydronic Control Systems
Hydronic Pump Isolation Controls and Devices
Supply Water Reset Controls
Water Loop Heat Pump Control
Variable Frequency Drive Pump Systems

1. Within 90 days of receiving a final occupancy permit, record drawings be provided to the building owners.
2. Operating and maintenance information be provided to the building owner.
3. For the issuance of installation certificates for mechanical equipment.

For example, the plans and specifications would require an economizer. A construction inspection would verify the economizer is installed and properly wired. Acceptance tests would verify economizer operation and that the relief air system is properly functioning. Owners' manuals and maintenance information would be prepared for delivery to the building owner. Finally, record drawing information, including economizer controller set points, must be submitted to the building owner within 90 days of the issuance of a final occupancy permit.

4.11.3.3 Plan Review

Although acceptance testing does not require that the construction team perform any plan review, they should review the construction drawings and specifications to understand the scope of the acceptance tests and raise critical issues that might affect the success of the acceptance tests prior to starting construction. Any construction issues associated with the mechanical system should be forwarded to the design team so that necessary modifications can be made prior to equipment procurement and installation.

4.11.3.4 Testing

The construction inspection is the first step in performing the acceptance tests. In general, this inspection should identify:

1. Mechanical equipment and devices are properly located, identified, calibrated and set points and schedules established.
2. Documentation is available to identify settings and programs for each device, and
3. For air distribution systems, this may include select tests to verify acceptable leakage rates while access is available.

Testing is to be performed on the following devices:

- Variable air volume systems
- Constant volume systems
- Package systems
- Air distribution systems
- Economizers
- Demand control ventilation systems
- Variable frequency drive fan systems
- Hydronic control systems
- Hydronic pump isolation controls and devices
- Supply water reset controls
- Water loop heat pump control
- Variable frequency drive pump systems
- System programming
- Time clocks

Chapter 13 contains information on how to complete the acceptance documents. Example test procedures are also available in Chapter 13.

4.11.3.5 Roles and Responsibilities

The installing contractor, engineer of record or owners agent shall be responsible for documenting the results of the acceptance test requirement procedures including paper and electronic copies of all measurement and monitoring results. They shall be responsible for performing data analysis, calculation of performance indices and crosschecking results with the requirements of the Energy Standards. They shall be responsible for issuing a Certificate of Acceptance. Enforcement agencies shall not release a final Certificate of

Occupancy until a Certificate of Acceptance is submitted that demonstrates that the specified systems and equipment have been shown to be performing in accordance with the Energy Standards. The installing contractor, engineer of record or owners agent upon completion of undertaking all required acceptance requirement procedures shall record their State of California Contractor’s License number or their State of California Professional Registration License Number on each Certificate of Acceptance that they issue.

4.11.3.6 **Contract Changes**

The acceptance testing process may require the design team to be involved in project construction inspection and testing. Although acceptance test procedures do not require that a contractor be involved with a constructability review during design-phase, this task may be included on individual projects per the owner’s request. Therefore, design professionals and contractors should review the contract provided by the owner to make sure it covers the scope of the acceptance testing procedures as well as any additional tasks.

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INSTALLER and INSPECTOR QUICK-REFERENCE:
2022 NRCA-MCH-06-A
Demand Control Ventilation (DCV) Systems

Purpose and Scope of the Test
The purpose of the test is to verify that systems required to employ demand-controlled ventilation as required by the Energy Code can vary outside ventilation flow rates based on maintaining interior carbon dioxide (CO_2) concentration setpoints. Demand controlled ventilation refers to an HVAC system's ability to reduce outdoor air ventilation flow below design values when the space served is at less than design occupancy. CO_2 is a good indicator of occupancy load and is the basis used for modulating ventilation flow rates.
Test trigger
Newly Constructed and Additions/Alterations: All new DCV controls installed on new or existing HVAC systems must be tested. DCV systems are required on all spaces with a design occupancy of 40 square feet/person or less and includes at least one of the following: • Air economizer. • Modulating outside air control. • Design outdoor airflow rate > 3,000 cfm. Exceptions: • The space exhaust is greater than the ventilation rate – 0.2 cfm/ft². • Spaces that have processes or operations that generate dusts, fumes, vapors, or gases and do not have local exhaust. • Spaces with an area less than 150 ft² or design occupancy < 10 people.
Relevant Energy Code References and Required Compliance Documents
Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards (Energy Code) sections 120.1, 120.1(d)3, 120.1(d)4, 160.3(d)1E, 160.2(c)5C, 160.2(c)5D; NA7.5.5; NRCC-MCH-E.
Who Can Perform the Test
This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-06-A.
Required Tools
To perform the test, it may be necessary to vary and possibly measure (if calibration is necessary) ambient CO_2 levels. The instrumentation needed to perform the test may include, but is not limited to: • Hand-held reference CO_2 probe calibrated to ±10 ppm. • Manufacturer's calibration kit. • Calibrated CO_2/air mixtures.

INSTALLER and INSPECTOR QUICK-REFERENCE: 2022 NRCA-MCH-06-A Demand Control Ventilation (DCV) Systems
Estimated Time to Complete Test
Construction Inspection: 0.5 to 1 hours (depending on CO_2 sensor calibration) Functional testing: 1 to 2 hours (depending on how ambient CO_2 concentration levels are manipulated, system response time to variations in CO_2).
Potential Issues and Cautions
Lock out the economizer control during the test. Outdoor air damper may not modulate correctly if the economizer control strategy is controlling damper operation. Overall test time may be reduced (especially for rooftop HVAC units) if two people perform the test - one to vary the CO_2 concentration while someone else verifies operation of the outdoor air dampers. During the testing of the DCV controls, the outside damper will modulate open. Care should be taken to prevent freezing of coils if testing with cold temperatures outside.
Inspection Enforcement
Interior CO_2 concentration setpoint is ≤ 600 ppm plus outdoor air CO_2 value if outside concentration is measured dynamically. Otherwise, setpoint is ≤ 1000 ppm. Outdoor air CO_2 concentration can be determined by three methods: 1. Assume a value of 400 ppm without any direct measurement. 2. Measure outside concentration dynamically to continually adjust interior concentration setpoint. 3. Measure outside concentration one time during system checkout and use this value continually to determine inside concentration setpoint.
Acceptance Criteria
• Each CO_2 sensor is factory calibrated (with calibration certificate) or field calibrated. • Each CO_2 sensor is wired correctly to the controls to ensure proper control of the outdoor air damper. • Each CO_2 sensor is located correctly within the space 3 to 6 feet above the floor. • Interior CO_2 concentration setpoint is ≤ 600 ppm plus outdoor air CO_2 value if dynamically measured or ≤1000 ppm if no outside air (OSA) sensor is provided. • A minimum OSA setting is provided whenever the system is in Occupied mode regardless of space CO_2 readings. • A maximum OSA damper position for DCV control can be established, regardless of space CO_2 readings.

INSTALLER and INSPECTOR QUICK-REFERENCE: 2022 NRCA-MCH-06-A Demand Control Ventilation (DCV) Systems
Acceptance Criteria (cont.)
• The outdoor air damper modulates open when the CO_2 concentration within the space exceeds setpoint. • The outdoor air damper modulates closed (toward minimum position) when the CO_2 concentration within the space is below setpoint.

1992 WL 278962 (Cal.Energy.Res.Cons.Dev.Com.)

Energy Resources Conservation and Development Commission

State of California

Division of Water Rights

THE 1992 EFFICIENCY STANDARDS FOR NEW RESIDENTIAL AND NON- RESIDENTIAL BUILDINGS

ORDER No. 92-0701-01

July 1, 1992

ORDER APPROVING REVISED DEFAULT TABLE FOR RESIDENTIAL MANUFACTURED FENESTRATION PRODUCTS

*1 On May 15, 1991, the Commission adopted revised energy efficiency standards for new low-rise residential buildings, additions, and alterations. These standards were approved on October 15, 1991, by the California Building Standards Commission. [1] Except for certain provisions relating to dual-pane, aluminum-frame windows, the new standards go into effect on a voluntary basis on July 1, 1992, and on a mandatory basis on January 1, 1993. [2]

Section 116 (a) 2 of the new standards requires that every manufactured fenestration product, including windows, glass doors, and skylights, carry a label that indicates its thermal conductivity in terms of a U-value. The section also requires that the U-value of each product be determined in accordance with the testing and rating procedures of the National Fenestration Rating Council (NFRC) or in accordance with “a default table method approved by the Commission.” Pursuant to this provision of section 116 (a) 2, the Commission on December 18, 1991, approved tables of default U-values for use in conjunction with the 1992 standards. [3] The purpose of today's ORDER is to revise certain portions of the table of default U-values for manufactured fenestration products that are used in residential construction.

Reasons for Considering Revisions to the Current Default Tables

The original default tables were recommended by an advisory group composed of fenestration industry members and a member of the CEC Staff. The Commission approved the default tables based on their recommendation. Subsequently, the Commission received public comment from representatives of aluminum fenestration products claiming that the approved default U-values gave too much credit for vinyl-frame product performance and too little credit for aluminum-frame product performance. These parties also asked that the Commission expand the default tables to include values for metal-frame products with thermal break designs. Similar comments were repeated at a public meeting involving the fenestration industry which the Commission held on April 24, 1992. Following that meeting, the presiding member for the Efficiency Standards Committee agreed to reconvene and expand the default techical advisory group to consider potential revisions to the default table, including adding default values for thermal-break products.

The expanded Advisory Group was organized onJune 3 and met on June 17 to consider information presented by the California Association of Window Manufacturers (CAWM) and other parties. The CAWM information consisted of a data base of over 100 fenestration products and their calculated U-values, based on using computer simulations. Two other parties also supplied calculated U-values, using the same computer simulations for another 100 or so products. With this expanded data base, the Advisory Group reviewed the range of calculated values and compared them with the current values, making recommendations for changes in several categories, grouping some categories, and retaining the current values in others. These recommendations were then presented to the Commission for its approval at the Commission's business meeting of July 1, 1992.

***2** In both the current default table and the proposed revision, the advisory groups derived U-values using computer simulations. The computer program used for the original table is WINDOW 3.1. The data base considered on June 17 by the Advisory Group used this same program, as well as FRAME 2.2, a program expressly designed to more accurately reflect the effects of a product's framing design and materials. For this reason, the Advisory Group regarded the use of both programs as an improvement over reliance on WINDOW 3.1 alone.

Advisory Group Recommendations

The Advisory Group recommended Commission approval of the following revisions to the current default U-value table for manufactured fenestration products installed in residential construction:

1. Revising certain U-values, to reflect the simulation results made available to and considered by the Group, and retaining other values from the original table, as shown on the attachment.

2. Combining all three categories of operable windows into a single category, to simplify the table and its use.

3. Combining both categories of skylights (operable and fixed) into a single skylight category.

4. Adding values for thermal-break products, along with a description of what constitutes a thermal-break product that would be entitled to use the values.

Commission Discussion

The Commission has considered the Advisory Group's recommendations, the record of the Group's deliberations, and comments from interested parties. We have determined that the Advisory Group's recommendations are reasonable and consistent with the underlying standard, section 116. We agree that the use of both computer programs to develop an expanded data base from which to derive U-values is an improvement. Using both programs also helps ensure consistency within the standards: Section 116 of the adopted standards specifies use of a U-value rating method developed by the National Fenestration Rating Council; this method also relies on both programs to determine U-values. Thus, default tables derived from use of the same two programs specified by the NFRC rating method should produce consistent ratings. We note that this method validated most of the U-values in the current default tables, while providing a basis for changes in other values.

We believe that consolidating the three categories of operable windows will make the table easier to use and simplify compliance and enforcement with the standards. According to one comment, this simplification obviates the need for the Commission to consider further aggregations of U-values into a “whole-house” U-value, a proposal which the Commission was prepared to investigate. Although a combined category sacrifices some accuracy by assigning the same value to three different product types, the proposed combination of categories sets the U-value based on simulation results for the most commonly-used type of operable window, thus minimizing any inaccuracy or potential for adverse energy effects.

***3** Finally, we concur that the default table should recognize the benefits of thermal-break designs and assign appropriate U-value credit, as recommended by the Advisory Group. In conjunction with the description of thermal-break designs, this credit will encourage aluminum-frame manufacturers to produce and market thermally-improved fenestration products.

Other Factors that Affect Thermal Performance

The default table U-values reflect the thermal conductivity of windows when newly manufactured. Thermal performance is affected by other factors as well, such as air infiltration, solar gain and visual transmittance. Life-cycle thermal performance will also depend on the durability of the window and its ability to resist structural deterioration that would increase air infiltration. While the building efficiency standards require windows to meet the ASTM E 283-89 test for air infiltration, that test does not consider structural integrity and deterioration over time. NFRC intends to examine durability, solar gain, and air infiltration and their effect on long-term thermal performance, but results of that effort will not be available until after the effective date of these standards.

Due to questions regarding the life-cycle thermal performance and structural integrity of windows, the Commission intends to re-examine such related factors between now and October 31, 1992 in order to evaluate the ability of window frame materials to maintain their durability and structural integrity. If it is found that certain windows are vulnerable to significant increases in air infiltration or loss of thermal performance due to reduced structural integrity or deterioration, as compared to other windows, then the Commission will make adjustments to the appropriate default table U-values or other factors to account for these related life-cycle thermal performance differences. The Commmission shall consider information relative to air infiltration and durability and the effects on window frame material type from temperature change and weather conditions. Such adjustments would remain in effect until the NFRC or other recognized testing agency concludes durability, solar gain, and air infiltration investigations, at which time the Commission would incorporate appropriate conclusions into the default tables or into other provisions affecting fenestration products. [4]

ORDER:

1. The Commission hereby approves the revisions, as shown in the attachment, to the U-value default table for manufactured fenestration products for residential construction. As permitted by section 116(a)2 of the Standards (Title 24, Cal. Code of Regs., **Part 6**) product manufacturers, builders, and building officials may use the U-values in these tables for compliance with the **1992** standards as of July 1, **1992**.

2. The Commission Staff shall include the approved U- values in the appropriate manual(s) for the low-rise residential standards.

CHARLES R. IMBRECHT
Chairman
***4** RICHARD A. BILAS
Commissioner
BARBARA CROWLEY
Vice Chair
SALLY RAKOW
Commissioner
ART S. KEVORKIAN, P.E.
Commissioner

DEFAULT TABLE

Table G-4: Manufactured Fenestration Product Default U- Values

	Framing Materials				
			Thermal [5]		
	Any Metal		**Break**	**Non-Metal [6, 7]**	
	Single	**Double**	**Double**	**Single**	**Double**
Operable Windows	1.28	0.87	0.71	0.92	0.60
Fixed Windows	1.19	0.72	0.60	1.04	0.57
Patio Door	1.25	0.77	0.68	0.99	0.55
Skylights	1.26	0.80	0.70	0.91	0.55

Greenhouse Windows	2.26	1.40	1.12	1.94	1.06

For all dual-glazed fenestration products:

Subtract 0.05 for spacers of 7/16“or wider.

Subtract 0.05 for low-e glazing.

Add 0.05 for products with between the panes dividers, if the spacer is less than 7/16” wide.

Add 0.05 to the U-value of any product with true divided lites [through the pane(s) dividers].

Footnotes

5 The minimum design characteristics to qualify as Thermal-Break Product are:

a The material used as the thermal-break must have a thermal conductivity of not more than 3.6 BTU-in/hr/ft2/F ^{O} , and;

b Thermal-break must produce a gap of not less than 0.210”, and;

c All metal members of the product exposed to interior and exterior air must incorporate a thermal-break meeting the criteria in (a) and (b) above.

In addition, the product must be clearly labeled by the manufacturer that it qualifies as a thermally broken product in accordance with CEC requirements.

6 Non-metal products can include metal fasteners, hardware and door thresholds.

7 Add 0.04 to the listed U-value for any products that have metal cladding in any configuration.

1 Current Commission standards are codified in Part 2, Chapter 2-53 of Title 24, California Code of Regulations. Beginning July 1, **1992**, these standards will appear in **Part 6** of the same code. This document is titled “California Energy Code”.

2 See AMENDMENT TO ORDERS OF DECEMBER 18, 1991, CERTIFYING MANUALS AND SETTING EFFECTIVE DATE OF BUILDING STANDARDS, dated April 29, 1992.

3 See ORDER APPROVING DEFAULT TABLES FOR FENESTRATION PRODUCTS, dated December 18, 1991.

4 If any adjustments to account for these related factors require changes in the adopted standards, the Commission shall make such changes pursuant to the Administrative Procedures Act.

Note: Factors other than thermal conductivity (U-value), such as air infiltration, solar gain, and visual transmittance, affect thermal performance. These factors can change over time due to product deterioration, but this fact is not reflected in current rating procedures. The Commission will examine product durability and these factors until October 31, 1992, to determine whether to adjust performance calculations to account for thermal performance over a product's life. Such adjustments would be used until the results of NFRC or other studies on durability become available.

1992 WL 278962 (Cal.Energy.Res.Cons.Dev.Com.)

End of Document

Related documents

Selected topics Secondary Sources Briefs Trial Court Documents

Products Liability
Elements and Concepts
Risk-Benefit Analysis of Unreasonable Dangerousness of Product Design

Table of Contents

4 Building HVAC Requirements

4.1 Overview

4.1.1 Introduction and Organization

This chapter addresses the requirements for heating, ventilating, and air-conditioning (HVAC) systems for newly constructed single-family residential buildings include single family residences, duplexes, townhouses, and triplexes. The requirements are a source of information for the general public, mechanical system designers and installers, energy consultants, Home Energy Rating System (HERS) Raters, and enforcement agency personnel.

Each section in this chapter outlines the mandatory measures and, when applicable, the prescriptive and performance or compliance options as they pertain to residential HVAC systems. If the overall home design does not achieve the minimum prescriptive requirements, the designer can consider using the HVAC performance compliance option that allows for making up the deficiencies. See Chapter 1.6 of the Residential Compliance Manual for a more detailed discussion of the compliance process and options.

Each section of this chapter includes mandatory measures, prescriptive requirements, and performance or compliance options. The chapter is organized under the following sections:

1. **Section 4.2** – Heating Equipment.
2. **Section 4.3** – Cooling Equipment.
3. **Section 4.4** – Air Distribution System Ducts, Plenums, and Fans.
4. **Section 4.5** – Controls.
5. **Section 4.6** – Indoor Air Quality and Mechanical Ventilation.
6. **Section 4.7** – Alternative Systems.
7. **Section 4.8** – Refrigerant Charge.
8. **Section 4.9** – Compliance and Enforcement.

Chapter 9 of the Residential Compliance Manual covers the heating and cooling requirements for additions to existing dwellings and for alterations to existing heating and cooling systems.

Chapter 10 of the Residential Compliance Manual covers the electric ready requirements (new under the 2022 Energy Code) including electric readiness for gas and propane furnaces and domestic hot water heaters.

4.1.2 What's New for the 2022 Energy Code

The following is an overview of the new HVAC measures for the *2022 Building Energy Efficiency Standards* (Energy Code), including new compliance options that provide greater flexibility in complying with the Energy Code when using the performance method.

4.1.2.1 **Mandatory Features and Devices - §150.0**

1. Portions of duct systems located in conditioned space and entire duct systems located in conditioned space can be uninsulated if specific conditions are met, as explained in Section 4.4.1 (§150.0(m)1B).
2. Updated ventilation requirements based on applicable sections of 2019 ASHRAE 62.2 and added clarification language (§150.0(o)).
3. Updated local exhaust requirements for kitchen range hoods which includes capture efficiency ratings (§150.0(o)1G).
4. Filter racks or grilles must use a gasket or sealing to prevent air from bypassing the filter (§150.0(m)12Bv).

4.1.2.2 **Prescriptive and Performance Compliance Approaches – §150.1**

1. Space heating systems used in prescriptive compliance must be a heat pump for climate zones 3, 4, 13, and 14 (§150.1(c)6).
2. Variable Capacity Heat Pump Compliance Option that was approved in November 2019 is incorporated into the 2022 Energy Code (§150.1(b)3Bii).

4.1.3 California Appliance Standards and Equipment Certification

§110.0 and §110.1

Most heating and cooling equipment installed in new California homes is regulated by the National Appliance Efficiency Conservation Act (NAECA) and/or the California *Appliance Efficiency Regulations (Title 20)*. Both the federal and state appliance standards apply to the manufacturing and sale of new equipment, whether for newly constructed buildings, additions, or alterations (replacements, or repairs). The *Appliance Efficiency Regulations* are enforced at the point of sale (except central split-system air conditioners and central single package air conditioners, see Table 4-6), while the Energy Code explained in this compliance manual is enforced by local enforcement agencies.

The manufacturer must certify that the equipment complies with the current *Appliance Efficiency Regulations* at the time of manufacture. Appliances covered by the *Appliance Efficiency Regulations* include:

1. Room air conditioners

2. Room air-conditioning heat pumps
3. Central air conditioners with a cooling capacity of less than 135,000 British thermal units per hour (Btu/hr)
4. Central air conditioning heat pumps
5. Gas-fired central furnaces
6. Gas-fired boilers
7. Gas-fired furnaces
8. Gas-fired floor furnaces
9. Gas-fired room heaters
10. Gas-fired duct furnaces
11. Gas-fired unit heaters

The *Appliance Efficiency Regulations* do not require certification for:

1. Electric resistance space heaters.
2. Oil-fired wall furnaces, floor furnaces, and room heaters. (Some are voluntarily listed with certified gas-fired furnaces.)

Equipment that does not meet the federal appliance efficiency standards may not be sold in California. Any equipment covered by the *Appliance Efficiency Regulations* and sold in California must have the date of manufacture permanently displayed in an accessible place on that equipment. This date is frequently included as part of the serial number.

Generally, equipment manufactured before the effective date of a new standard may be sold and installed in California indefinitely as long as the performance approach demonstrates energy compliance of the building using the lower efficiency of the relevant appliances. An exception is central split-system air conditioners and central single package air conditioners *installed* in California. The U.S. Department of Energy (DOE) requires compliance with the minimum efficiencies specified in Table 4-6 at the time of installation.

The compliance and enforcement processes should ensure that all installed HVAC equipment regulated by the *Appliance Efficiency Regulations* is certified by the California Energy Commission.

4.1.3.1 **Plan Review (Compliance)**

During the plan review, the builder is responsible for demonstrating compliance with the *Appliance Efficiency Regulations* by providing the efficiency of the HVAC equipment that is to be installed. Typically, the builder does not identify the exact make or model at this point of the process. The plans examiner is responsible for verifying that the specified equipment efficiency complies with the *Appliance Efficiency Regulations.*

4.1.3.2 **Field Inspection (Enforcement)**

It is the field inspector's responsibility to visually verify that the product information on the installed HVAC equipment matches the efficiency approved by the plans examiner. To simplify the inspection, the field inspector may reference the CF2R-MCH-01-H submitted by the builder/installing contractor.

4.2 Heating Equipment

This section addresses the requirements for heating equipment, including furnaces, boilers, heat pumps, and electric resistance equipment.

4.2.1 Mandatory Measures for Heating Equipment

4.2.1.1 **Equipment Efficiency**

§110.1 and §110.2(a)

The efficiency of most heating equipment is regulated by the National Appliance Energy Conservation Act of 1987 (NAECA, the federal appliance standard) and the California Appliance Efficiency Regulations. These regulations are not contained in the Energy Code but are published separately. These regulations are referenced in §110.1. The *Appliance Efficiency Regulations* include definitions for all types of equipment and are regularly updated.

Note: The *Appliance Efficiency Regulations* that are in effect when the building permit is applied for will determine the minimum efficiency of the appliances identified in the compliance documentation.

The energy efficiency of other equipment is regulated by §110.2(a). Also, see the *Nonresidential Compliance Manual* for more information on larger equipment.

A. Gas and Oil-Fired Furnaces

The *Appliance Efficiency Regulations* require gas- and oil-fired central furnaces with outputs less than 225,000 Btu/h to be rated according to the associated annual fuel utilization efficiency (AFUE). Gas- and oil-fired central furnaces with outputs greater than or equal to 225,000 Btu/h are rated according to the respective thermal (or steady-state) efficiency. Refer to Table 4-1 for the applicable efficiency requirements.

Table 4-1: Minimum Efficiency for Gas- and Oil-Fired Central Furnaces

Appliance	Rated Input (Btu/h)	Minimum Efficiency (%) AFUE	Minimum Efficiency (%) Thermal Efficiency
Weatherized gas central furnaces with single phase electrical supply	< 225,000	81	NA
Non-weatherized gas central furnaces with single phase electrical supply	< 225,000	80	NA
Weatherized oil central furnaces with single phase electrical supply	< 225,000	78	NA
Non-weatherized oil central furnaces with single phase electrical supply	< 225,000	83	NA
Gas central furnaces	≥ 225,000	NA	81
Oil central furnaces	≥ 225,000	NA	82

Source: California Appliance Efficiency Regulations Title-20 - Table E-5 and E-6

Noncentral gas furnaces and space heaters manufactured on or after April 16, 2013, shall be certified to have AFUE values greater than or equal to those listed in Table 4-2.

Table 4-2: Minimum Heating Efficiency for Non-ducted, Noncentral, Gas-Fired Heating Equipment

Type	Capacity (Btu/h)	AFUE
Wall Furnace (fan type)	≤ 42,000	75%
Wall Furnace (fan type)	> 42,000	76%
Wall Furnace (gravity type)	≤ 27,000	65%
Wall Furnace (gravity type)	> 27,000 to ≤ 46,000	66%
Wall Furnace (gravity type)	> 46,000	67%
Floor Furnace	≤ 37,000	57%
Floor Furnace	> 37,000	58%
Room Heater	≤20,000	61%
Room Heater	> 20,000 to ≤ 27,000	66%
Room Heater	> 27,000 to ≤ 46,000	67%
Room Heater	> 46,000	68%

Source: California Appliance Efficiency Regulations Title 20 - Table E-2

B. Heat Pumps and Electric Heating

Heat pumps shall be certified to have a HSPF or coefficient of performance (COP) equal to or better than those listed in Table 4-3.

There are no minimum appliance efficiency standards for electric-resistance or electric-radiant heating systems.

C. Gas- and Oil-Fired Central Boilers and Electric Boilers

Gas- and oil-fired central boilers shall be certified to have and AFUE or *Combustion Efficiency* equal to or better than those listed in

Table 4-4.

Table 4-3: Minimum Heating Efficiency for Heat Pumps

Equipment Type	Reference	Configuration/Size	Minimum Heating Efficiency
Packaged terminal heat pumps (heating mode)	Table 110.2 E	Newly constructed or newly conditioned buildings or additions	3.7-(0.052 x Cap[1]/1000) = COP
Packaged terminal heat pumps (heating mode)	Table 110.2 E	Replacements	2.9-(0.026 x Cap[1]/1000) = COP
Single-phase air source heat pumps (NAECA)	Table C-3	< 65,000 Btu/h cooling	Packaged 8.0 HSPF Split 8.2 HSPF
Single-phase air source heat pumps (NAECA)	Table C-3	Space constrained < 65,000 Btu/h cooling capacity	7.4 HSPF
Single-phase air source heat pumps (NAECA)	Table C-3	Small duct, high velocity < 65,000 Btu/h cooling capacity	7.2 HSPF
Three-phase air source heat pumps	Table C-4	Split-system < 65,000 Btu/h	8.2 HSPF
Three-phase air source heat pumps	Table C-4	≥ 65,000 and <135,000	3.4 COP
Three-phase air source heat pumps	Table C-4	≥ 135,000 and <240,000	3.3[2] COP 3.4[3] COP

Equipment Type	Reference	Configuration/Size	Minimum Heating Efficiency
Three-phase air source heat pumps	Table C-4	≥ 240,000 and <760,000	3.2 COP
Water-source heat pumps	Table C-5	≥ 65,000 and < 135,000 Btu/h	4.3 COP
Water-source heat pumps	Table 110.2 B	≥ 135,000 Btu/h, < 240,000 Btu/h	2.9 COP
Single package vertical heat pumps	Table C-6	< 65,000 single-phase	3.0 COP
Single package vertical heat pumps	Table C65	< 65,000 3-Phase	3.3 COP
Single package vertical heat pumps	Table C-6	≥ 65,000 and < 135,000	3.0 COP
Single package vertical heat pumps	Table C-6	≥ 135,000 and < 240,000	3.0 COP

1. Cap = Cooling Capacity of the product in Btu/h. If the unit's capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.
2. Electric resistance heating or no heating
3. All other types of heating

Source: California Appliance Efficiency Regulation Title 20 and Energy Code Table C-3, C-4, C-5, C-6; Title 24 Table 110.2-B, 110.2-E

Table 4-4s: Minimum Efficiency for Gas- and Oil-Fired Central Boilers

Appliance	Rated Input (Btu/h)	Minimum Efficiency (%)	Efficiency Metric
Gas steam boilers with single-phase electrical supply	< 300,000	82 [1]	AFUE
Gas hot water boilers with single-phase electrical supply	< 300,000	84 [1,2]	AFUE
Oil steam boilers with single-phase electrical supply	< 300,000	85	AFUE
Oil hot water boilers with single-phase electrical supply	< 300,000	86 [2]	AFUE
Electric steam residential boilers	< 300,000	NA	NA
Electric hot water residential boilers	< 300,000	NA	NA
All other boilers with single-phase electrical supply	< 300,000	NA	NA

1 No constant burning pilot light design standard.

2 Automatic means for adjusting temperature design standard.

Source: California Appliance Efficiency Regulations Title 20 Table E-3

Table 4-5: Minimum Efficiency for Gas- and Oil-Fired Central Boilers

Appliance	Rated Input (Btu/h)	Minimum Thermal Efficiency (%)	Minimum Combustion Efficiency (%)
Steam boilers; gas-fired, except natural draft;	≥ 300,000	79	81
Steam boilers; gas-fired, natural draft	≥ 300,000	79	81
Steam boilers; oil-fired	≥ 300,000	81	82

Source: California Appliance Efficiency Regulations Title 20 Table E-4

4.2.1.2 **Heating System Controls**

§150.0(i), §110.2(b), Exceptions to §110.2(b), §110.2(c), Exception to §110.2(c)

Heating systems must be controlled by a central energy management control system (EMCS) or by a setback thermostat. The setback thermostat must be capable of allowing the occupant to program temperature set points for at least four periods within a 24-hour time span.

The exception to this is gravity gas wall heaters, floor heaters, room heaters, fireplaces, wood stoves, and noncentral electric heaters.

Any heat pump with supplementary electric resistance heating requires controls with two capabilities to limit the electric resistance heating. The first required capability is to set the cut-on and cut-off temperatures for the heat pump and supplementary electric resistance heating at different levels.

For example, if the heat pump begins heating when the inside temperature reaches 68°F, the electric resistance heating may be set to come on if the temperature goes below 65°F if the heat pump alone could not maintain the set point of 68°F. Also, there must be an "off" mode that automatically shuts off the electric resistance when the inside temperature reaches 68°F.

The second control capability must prevent the supplementary electric resistance heater from operating if the heat pump alone can meet the heating load, except during defrost. There is a limited exception to this second function for "smart thermostats" that provide intelligent recovery, staging, ramping, or another control mechanism that prevents the unnecessary operation of supplementary electric resistance heating when the heat pump alone can meet the heating load.

To meet the thermostat requirements, a thermostat for a heat pump must be a "smart thermostat" that minimizes the use of supplementary heating during startup and enables recovery from setbacks.

Note: Room air conditioner heat pumps are not required to comply with the thermostat requirements.

4.2.1.3 **Equipment Sizing**

§150.0(h)1 and 2

The Energy Code does not set limits on the sizing of heating equipment, but does require that heating loads be calculated for new heating systems. Oversized equipment typically operates less efficiently and can create comfort problems due to excessive cycling and improper airflow.

Acceptable load calculation procedures include methods described in the following publications:

1. *The ASHRAE Handbook – Equipment*
2. *The ASHRAE Handbook – Applications*
3. *The ASHRAE Handbook – Fundamentals*
4. *The SMACNA Residential Comfort System Installation Manual*
5. *ACCA Manual J*

The Energy Code requires that the outdoor design conditions for load calculations be selected from Reference Joint Appendix (JA) JA2 and that the indoor design temperature for heating load calculations be 68°F.

The outdoor design temperature must be no lower than the "heating winter median of extremes," as listed in JA2.

If the actual city location for a project is not included inJA2, or if the data given for a particular city do not match the conditions at the actual site as well as that given for another nearby city, consult the local building department for guidance.

The load calculations must be submitted with the compliance documentation when requested by the building department.

The load calculations may be prepared by 1) a mechanical engineer, 2) the mechanical contractor who is installing the equipment or 3) someone who is qualified to do so in the State of California according to Division 3 of the Business and Professions Code.

The Business and Professions Code does not prohibit an unlicensed person from preparing plans, drawings, or specifications for single-family dwelling units of wood-frame construction not more than two stories and basement in height, or for certain buildings containing no more than four dwelling units of wood-frame construction not more than two stories and basement in height.

4.2.1.4 **Standby Losses and Pilot Lights**

§110.5 and §110.2(d)

Fan-type central furnaces may not have a continuously burning pilot light. This requirement does not apply to wall furnaces, floor furnaces, or any gravity-type furnace. Household cooking appliances also must not have a continuously burning pilot light, except for those without an electrical supply voltage connection and in which each pilot consumes less than 150 Btu/h.

Larger gas-fired and oil-fired forced air furnaces with input ratings equal to or greater than 225,000 Btu/h (which is bigger than a typical residential furnace) must also have an intermittent ignition device (IID) and either power venting or a flue damper.

A vent damper is an acceptable alternative to a flue damper for furnaces where combustion air is drawn from the conditioned space. All furnaces with input ratings equal to or greater than 225,000 Btu/h, including electric furnaces, that are not within the conditioned space must have jacket losses not exceeding 0.75 percent of the input rating.

4.2.1.5 **Pipe Insulation**

§150.0(j)1, §150.0(j)2, §120.3

The piping for heat pumps and for steam and hydronic heating systems shall meet the insulation requirements provided below in Table 4-5a-f when the insulation is outside conditioned space, it requires protection from damage caused by environmental conditions. The insulation must be rated for outdoor use or covered with a material that can withstand outdoor conditions. Examples of these types of coverings are aluminum, sheet metal, painted canvas, plastic cover, or, if the insulation is cellular foam, a coating that is water-retardant and shields from solar radiation. Moreover, the insulation used for the refrigerant suction line of a heat pump must be Class I or Class II vapor retardant.

Table 4 5a: Space-Heating and Service Water-Heating Systems Pipe Insulation (thickness in inches)
(Steam, Steam Condensate, Refrigerant, Space Heating, Service Hot Water)

Fluid Oper. Temp. Range (°F)	Insulation Conduct. (Btu·in/ h·ft²°F)	Insulation Mean Rating Temp. (°F)	Pipe Dia. (in) < 1	Pipe Dia. (in) 1 to <1.5	Pipe Dia. (in) 1.5 to < 4	Pipe Dia. (in) 4 to < 8	Pipe Dia. (in) 8 ≤
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.32	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5

Source: Energy Code Table 120.3-A

Table 4 5b: Space-Heating and Service Water-Heating Systems Pipe Insulation (R-Value)
(Steam, Steam Condensate, Refrigerant, Space Heating, Service Hot Water)

Fluid Oper. Temp. Range (°F)	Insulation Conduct. (Btu·in/ h·ft²°F)	Insulation Mean Rating Temp. (°F)	Pipe Dia. (in) < 1	Pipe Dia. (in) 1 to <1.5	Pipe Dia. (in) 1.5 to < 4	Pipe Dia. (in) 4 to < 8	Pipe Dia. (in) 8 ≤
Above 350	0.32-0.34	250	R 37	R 41	R 37	R 27	R 23
251-350	0.29-0.32	200	R 24	R 34	R 35	R 26	R 22
201-250	0.27-0.30	150	R 21	R 20	R 17.5	R 17	R 14.5
141-200	0.25-0.29	125	R 11.5	R 11	R 14	R 11	R 10
105-140	0.22-0.28	100	R 7.7	R 12.5	R 11	R 9	R 8

Source: Energy Code Table 120.3-A

Table 4 5c: Residential Space-Cooling Systems Pipe Insulation (thickness in inches)
(Chilled Water, Refrigerant and Brine)

Fluid Oper. Temp. Range (°F)	Insulation Conduct. (Btu·in/ h·ft²°F)	Insulation Mean Rating Temp. (°F)	Pipe Dia. (in) < 1	Pipe Dia. (in) 1 to <1.5	Pipe Dia. (in) 1.5 to < 4	Pipe Dia. (in) 4 to < 8	Pipe Dia. (in) 8 ≤
40-60	0.21-0.27	75	0.75	0.75	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0	1.5	1.5	1.5	1.5

Source: Energy Code Table 120.3-A

Table 4 5d: Residential Space-Cooling Systems Pipe Insulation (R-Value) (Chilled Water, Refrigerant and Brine)

Fluid Oper. Temp. Range (°F)	Insulation Conduct. (Btu·in/ h·ft²°F)	Insulation Mean Rating Temp. (°F)	Pipe Dia. (in) < 1	Pipe Dia. (in) 1 to <1.5	Pipe Dia. (in) 1.5 to < 4	Pipe Dia. (in) 4 to < 8	Pipe Dia. (in) 8 ≤
40-60	0.21-0.27	75	R-6	R-5	R-7	R-6	R-5
Below 40	0.20-0.26	50	R-8.5	R-12	R-12	R-10	R-9

Source: Energy Code Table 120.3-A

Table 4 5e: Nonresidential Space-Cooling Systems Pipe Insulation (thickness in inches) (Chilled Water, Refrigerant and Brine)

Fluid Oper. Temp. Range (°F)	Insulation Conduct. (Btu·in/ h·ft²°F)	Insulation Mean Rating Temp. (°F)	Pipe Dia. (in) < 1	Pipe Dia. (in) 1 to <1.5	Pipe Dia. (in) 1.5 to < 4	Pipe Dia. (in) 4 to < 8	Pipe Dia. (in) 8 ≤
40-60	0.21-0.27	75	0.5	0.5	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0	1.5	1.5	1.5	1.5

Source: Energy Code Table 120.3-A

Table 4 5f: Nonresidential Space-Cooling Systems Pipe Insulation (R-Value) (Chilled Water, Refrigerant and Brine)

Fluid Oper. Temp. Range (°F)	Insulation Conduct. (Btu·in/ h·ft²°F)	Insulation Mean Rating Temp. (°F)	Pipe Dia. (in) < 1	Pipe Dia. (in) 1 to <1.5	Pipe Dia. (in) 1.5 to < 4	Pipe Dia. (in) 4 to < 8	Pipe Dia. (in) 8 ≤
40-60	0.21-0.27	75	R-3	R-3	R-7	R-6	R-5
Below 40	0.20-0.26	50	R-8.5	R-12	R-12	R-10	R-9

Source: Energy Code Table 120.3-A

4.2.2 Prescriptive Requirements for Heating Equipment

§150.1(c)6

Prescriptive component compliance requires the installation of a gas heating system or heat pump, depending on the climate zone, that meets minimum energy efficiency ratings (See Table 4-1 through Table 4-4).

The heating system type must be a heat pump in climate zones 3, 4, 13, and 14. There are no restrictions on the type of heat pump that can be installed if it meets the minimum efficiency rating requirements. For all other climate zones, the heating system can be either a heat pump or a gas heating system.

Supplemental heating systems are allowed prescriptively, and the designer may elect to provide supplemental heating to a space such as a bathroom. In this instance, the supplemental heating system must be installed in a space that is served directly or indirectly by the primary heating system and must have a thermal capacity of less than 2 kilowatts (kW) or 7,000 Btu/h while being controlled by a time-limiting device not exceeding 30 minutes.

Electric resistance and electric radiant heating installations are not allowed as the primary heating system when using the prescriptive compliance approach.

4.2.3 Performance Compliance Options for Heating Equipment

§150.1(b)3

Through the performance compliance approach there is one option for receiving compliance credit related to the heating system.

4.2.3.1 **High-Efficiency Heating**

Heating system efficiencies are explained in Section 4.2.1.1. The minimum efficiency is required to be met for prescriptive compliance or performance compliance. When the performance compliance approach is used, additional compliance credit may be available from higher efficiency heating equipment which can be used to offset less efficient building features.

When a heat pump is providing space heating, if the efficiency used for compliance is higher than the minimum required HSPF, the system efficiency must be verified by a HERS Rater. Moreover, because the capacity of the heat pump affects the amount of back-up electric resistance heating required to attain and maintain comfort conditions, if the capacity proposed for compliance is different than the default capacity used in the performance compliance software, the Air Conditioning, Heating, and Refrigeration Institute (AHRI) ratings for heating capacity of the installed heat pump must be verified by a HERS Rater to confirm the heating capacities at 47 degrees F and 17 degrees F are equal or greater than the heating capacities given on the certificate of compliance (CF1R). See RA3.4 for more information about this HERS verification

4.3 Cooling Equipment

This section addresses the requirements for space-cooling equipment.

4.3.1 Mandatory Measures for Cooling Equipment

4.3.1.1 **Equipment Efficiency**

§110.1 and §110.2(a)

The efficiency of most cooling equipment is regulated by NAECA (the federal appliance standard) and the California Appliance Efficiency Regulations. These regulations are not contained in the Energy Code but are referenced in §110.1. The energy efficiency of larger equipment is regulated by §110.2(a). See the *Nonresidential Compliance Manual* for information on larger equipment.

A. Central, Single-Phase Air Conditioners and Air Source Heat Pumps (Under 65,000 Btu/h)

The central, single-phase air conditioners and air source heat pumps that are most commonly installed in homes have a capacity less than 65,000 Btu/h. The *Appliance Efficiency Regulations* for this equipment require minimum seasonal energy efficiency ratios (SEER).

The SEER of all new central, single-phase air conditioners and air source heat pumps with output less than 65,000 Btu/h shall be certified to the Energy Commission to have values no less than the values listed in Table 4-6.

Table 4-6: Minimum Cooling Efficiencies for Central Air Conditioners and Heat Pumps
(Cooling Capacity Less Than 65,000 Btu/h)
(NR = No Requirement)

Appliance	Type	SEER	EER
Central Air Conditioners	Split-System <45,000 Btu/h	14.0	12.2
Central Air Conditioners	Split-System ≥45,000 Btu/h	14.0	11.7
Central Air Conditioners	Single-Package	14.0	11.0
Central Air Source Heat Pumps	Split-System	14.0	NR
Central Air Source Heat Pumps	Single-Package	14.0	NR
Space-Constrained Air Conditioner	Split-System	12.0	NR
Space-Constrained Air Conditioner	Single-Package	12.0	NR
Space-Constrained Heat Pump	Split-System	12.0	NR
Space-Constrained Heat Pump	Single-Package	12.0	NR
Small-Duct, High-Velocity Air Conditioner	All	12.0	NR
Small-Duct, High-Velocity Heat Pump	All	12.0	NR

Source: California Appliance Efficiency Regulations, Title 20, Table C-3 and Federal Appliance Standards (NAECA)

B. Other Air Conditioners and Heat Pumps

Appliance Efficiency Regulations

The current *Appliance Efficiency Regulations* for three-phase models, larger-capacity central air conditioners and heat pumps, and all room air conditioners and room air conditioner heat pumps shall be certified to the Energy Commission by the manufacturer to have values no less than the values listed in Table 4-7 and Table 4-8.

Table 4-7: Minimum Cooling Efficiency for Three-Phase Models and Larger Capacity Central Air Conditioners and Heat Pumps

Equipment Type	Size Category (Btu/h)	SEER or EER
Central Air-Conditioners	< 65,000 Split-System	13.0 SEER
Central Air-Conditioners	< 65,000 Single-Packaged	14.0 SEER
Central Air-Conditioners	≥65,000 but <135,000	11.2[1] EER 11.0[2] EER
Central Air-Conditioners	≥135,000 but <240,000	11.0[1] EER 10.8[2] EER
Central Air-Conditioners	≥240,000 but <760,000	10.0[1] EER 9.8[2] EER
Central Air-Source Heat Pumps	< 65,000 Split-System	14.0 SEER
Central Air-Source Heat Pumps	< 65,000 Single-Packaged	14.0 SEER
Central Air-Source Heat Pumps	≥ 65,000 but <135,000	11.0[1] EER 10.8[2] EER
Central Air-Source Heat Pumps	≥135,000 but <240,000	10.6[1] EER 10.4[2] EER
Central Air-Source Heat Pumps	≥240,000 but <760,000	9.5[1] EER 9.3[2] EER
Central Water-Source Heat Pumps	< 17,000	12.2 EER
Central Water-Source Heat Pumps	≥ 17,000 and < 65,000	13.0 EER

Equipment Type	Size Category (Btu/h)	SEER or EER
Central Water-Source Heat Pumps	≥ 65,000 and < 135,000	13.0 EER
Central Water-Source Heat Pumps	≥ 135,000 and < 240,000	12.5 EER
Central Water-Source Heat Pumps	≥ 240,000 and < 760,000	12.4 EER
Water-Cooled Air Conditioners	< 17,000	12.2 EER
Water-Cooled Air Conditioners	≥ 17,000 < 65,000	13.0 EER
Water-Cooled Air Conditioners	≥ 65,000 and < 135,000	12.1[3] EER
Water-Cooled Air Conditioners	≥ 135,000 and < 240,000	12.5[3] EER
Water-Cooled Air Conditioners	≥ 240,000 and < 760,000	12.4[3] EER

* Three-phase models only

1 Applies to equipment that has electric resistance heat or no heating.

2 Applies to equipment with all other heating-system types that are integrated into the unitary equipment.

3 Deduct 0.2 from the required EER for units with heating sections other than electric resistance heat.

Source: California Appliance Efficiency Regulations Table C-4, C-5

Table 4-8: Minimum Cooling Efficiency for Noncentral Space-Cooling Equipment

Equipment Type	Size Category (Input)	Minimum Efficiency
Room Air Conditioners, With Louvered Sides	< 6,000	11.0 EER
Room Air Conditioners, With Louvered Sides	≥ 6,000 and - 7,999	11.0 EER
Room Air Conditioners, With Louvered Sides	≥ 8,000 and -13,999	10.9EER
Room Air Conditioners, With Louvered Sides	≥ 14,000 and - 19,999	10.7 EER
Room Air Conditioners, With Louvered Sides	≥ 20,000 and 27,999	9.4 EER
Room Air Conditioners, With Louvered Sides	≥ 28,000	9.0 EER
Room Air Conditioners, Without Louvered Sides	< 6,000	10.0 EER
Room Air Conditioners, Without Louvered Sides	≥ 6,000 and - 7,999	10.0 EER
Room Air Conditioners, Without Louvered Sides	≥ 8,000 and - 10,999	9.6 EER
Room Air Conditioners, Without Louvered Sides	≥ 11,000 and - 13,999	9.5 EER
Room Air Conditioners, Without Louvered Sides	≥ 14,000 nd - 19,999	9.3 EER
Room Air Conditioners, Without Louvered Sides	≥ 20,000	9.4 EER
Room Air Conditioner Heat Pumps With Louvered Sides	< 20,000	9.8 EER
Room Air Conditioner Heat Pumps With Louvered Sides	≥ 20,000	9.3 EER

Equipment Type	Size Category (Input)	Minimum Efficiency
Room Air Conditioner Heat Pumps Without Louvered Sides	< 14,000	9.3 EER
Room Air Conditioner Heat Pumps Without Louvered Sides	≥ 14,000	8.7 EER
Casement-Only Room Air Conditioner	All Capacities	9.5 EER
Casement-Slider Room Air Conditioner	All Capacities	10.4 EER
Standard Sized PTAC (cooling mode)	All Capacities	14.0 - (0.300 x Cap/1000) = EER
Non-Standard Sized PTAC (cooling mode)	All Capacities	10.9 - (0.213 x Cap/1000) = EER
Standard Sized PTHP (cooling mode)	All Capacities	14.0 - (0.300 x Cap/1000) = EER
Non-Standard Sized PTHP (cooling mode)	All Capacities	10.8 - (0.213 x Cap/1000) = EER
SPVAC (cooling mode)	< 65,000	11.0 EER
SPVAC (cooling mode)	≥ 65,000 and < 135,000	10.0 EER
SPVAC (cooling mode)	≥ 135,000 and < 240,000	10.0 EER
SPVHP (cooling mode)	< 65,000 Btu/h	11.0 EER
SPVHP (cooling mode)	≥ 65,000 and < 135,000	10.0 EER
SPVHP (cooling mode)	≥ 135,000 and < 240,000	10.0 EER

Cap. = Cooling Capacity (Btu/h)

Note: Including room air conditioners and room air conditioner heat pumps, package terminal air conditioners (PTAC), package terminal heat pumps (PTHP), single-package vertical air conditioners (SPVAC), and heat pumps (SPVHP).

Source: California Appliance Efficiency Regulations Title 20, Table B-2, B-3, B-4; Energy Code Title 24, Table 110.2-E

4.3.1.2 **Insulation for Refrigerant Lines in Split-System Air Conditioners**

§150.0(j)2 and 3, §150.0(m)9

Two refrigerant lines connect the indoor and outdoor units of split-system air conditioners and heat pumps. These are the liquid line (the smaller diameter tube) and the suction line (the larger diameter tube).

If the liquid line remains at an elevated temperature relative to outdoor and indoor temperatures, it should not be insulated. In this situation, the heat loss is helpful.

The suction line carries refrigerant vapor that is cooler than ambient in the summer and (with heat pumps) warmer than ambient in the winter. This line must be insulated to the required thickness (in inches) as specified in Table 4-9.

Table 4 9a: Insulation Requirements for Split-System Refrigerant Piping Space heating and Service Water Heating Systems (Steam, Steam Condensate, Refrigerant, Space Heating, Service Hot Water)

Fluid Operating Temperature Range (°F)	Conductivity (Btu·in/h·ft2°F)	Mean Rating Temperature (°F)	Inches normal pipe diameter <1	Inches normal pipe diameter 1 to <1.5
105-140	0.22-0.28	100	1.0 inches[1]	1.5 inches[1]
105-140	0.22-0.28	100	R 7.7	R 12.5

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.

Source: Table 120.3-A of the Energy Code

Table 4 9b: Insulation Requirements for Split-System Refrigerant Piping Space-Cooling Systems (Chilled Water, Refrigerant and Brine)

Fluid Operating Temperature Range (°F)	Conductivity (Btu·in/h·ft^2°F)	Mean Rating Temperature (°F)	Inches normal pipe diameter <1	Inches normal pipe diameter 1 to <1.5
Residential 40-60	0.21-0.27	75	0.75 inches[1]	0.75 inches[1]
Residential 40-60	0.21-0.27	75	R-6	R-5

Fluid Operating Temperature Range (°F)	**Conductivity (Btu·in/h·ft²°F)**	**Mean Rating Temperature (°F)**	**Inches normal pipe diameter <1**	**Inches normal pipe diameter 1 to <1.5**
Nonresidential 40-60	0.21-0.27	75	0.50 inches[1]	0.50 inches[1]
Nonresidential 40-60	0.21-0.27	75	R-3	R-3
Below 40	0.20-0.26	50	1.0 inches[1]	1.5 Inches[1]
Below 40	0.20-0.26	50	R-8.5	R-14

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.

Source: Table 120.3-A of the Energy Code

Insulation used for refrigerant suction lines located outside a condition space, must include a Class I or Class II vapor retarder. The vapor retarder and insulation must be protected from physical damage, UV deterioration, and moisture with a covering that can be removed for equipment maintenance without destroying the insulation. Insulation is typically protected by aluminum, sheet metal jacket, painted canvas, or plastic cover. Adhesive tape should not be used as insulation protection because removal of the tape will damage the integrity of the original insulation during preventive maintenance.

Figure 4-1: Refrigerant Line Insulation

Source: Airex Manufacturing Inc.

4.3.1.3 Outdoor Condensing Units

§150.0(h)3

Any obstruction of the airflow through the outdoor unit of an air conditioner or heat pump lowers efficiency. Dryer vents are prime sources for substances that clog outdoor coils and sometimes discharge substances that can cause corrosion. Therefore, condensing units shall not be placed within 5 feet of a dryer vent. This requirement is applicable to new installations and to replacements. Regardless of location, condenser coils should be cleaned regularly in all homes. The manufacturer installation instructions may include requirements for minimum horizontal and vertical distance to surrounding objects that should be met if greater than the minimum distance required by the Energy Code.

Figure 4-2: Noncompliant Condensing Unit Clearance from Dryer Vents

Source: California Energy Commission

Liquid line filter driers are components of split system air-conditioners and split system heat pumps that are installed in the refrigerant line to remove moisture and particles, from the refrigerant stream. These contaminates may be introduced in the refrigerant as a result of improper flushing, evacuation, and charging procedures, causing the efficiency and capacity of the air conditioner to be impaired, or damaging components. If required by manufacturer’s instructions, liquid line filter dryers must be installed. Sometimes, liquid line filter dryers are preinstalled by manufacturers within condensing units, which makes it difficult for technicians to access. Because of this difficulty, manufacturers have begun changing this practice by installing liquid line filter dryers outside condensers, so that they can be easily serviced by technicians and more easily verified by HERS Raters.

The quality of the filter dryer installation impacts the effectiveness of the liquid line filter dryer, as some liquid line filter dryers can be installed without regard to the direction of refrigerant flow. Heat pumps, for example, allow refrigerant flow in both directions. However, in other air conditioners where refrigerant flow occurs in only one direction, correct orientation of the liquid line filter dryer is important.

4.3.1.4 **Equipment Sizing**

§150.0(h)

Similar to heating equipment, the Energy Code does not set limits on the size of cooling equipment, but does require that cooling loads be calculated for new cooling systems. Avoid oversizing the cooling components since oversizing may adversely affect the efficiency of the system. Ducts must be sized correctly, otherwise the system airflow rate may be restricted, adversely affecting the efficiency of the system and preventing the system from meeting the mandatory minimum airflow rate requirements.

The outdoor design conditions for load calculations must be selected from JA2, Table 2-3, using values no greater than the "1.0 percent cooling dry bulb" and "mean coincident wet bulb" values listed. The indoor design temperature for cooling load calculations must be 75°F. Acceptable load calculation procedures include methods described in:

1. *The ASHRAE Handbook – Equipment*
2. *The ASHRAE Handbook – Applications*
3. *The ASHRAE Handbook – Fundamentals*
4. The SMACNA Residential Comfort System Installation Manual.
5. *ACCA Manual J*

Cooling load calculations must be submitted with compliance documentation when requested by the building department. The load calculations may be prepared by 1) a mechanical engineer, 2) the mechanical contractor who is installing the equipment or 3) someone who is qualified to do so in the State of California according to Division 3 of the Business and Professions Code.

4.3.1.5 **Hole for Static Pressure Probe (HSPP) or Permanently Installed Static Pressure Probe (PSPP)**

§150.0(m)13

Space-conditioning systems that use forced air ducts to cool occupiable space shall have a hole for the placement of a static pressure probe (HSPP) or permanently installed static pressure probe (PSPP) installed downstream from the evaporator coil.

The HSPP or PSPP must be installed in the required location, in accordance with the specifications detailed in Reference Residential Appendix (RA) RA3.3. The HSPP or PSPP is required to promote system airflow measurement when using devices/procedures that depend on supply plenum pressure measurements. The

HSPP or PSPP allows HERS Raters to perform the required diagnostic airflow testing in a nonintrusive manner, by eliminating the necessity for the raters to drill holes in the supply plenum for placement of pressure measurement probes.

The size and placement of the HSPP/PSPP shall be in accordance with RA3.3.1.1 and shall be verified by a HERS Rater. In the event that the HSPP/PSPP cannot be installed as shown in Figure RA3.3-1 because of the configuration of the system or that the location is not accessible, an alternative location may be provided that can accurately measure the average static pressure in the supply plenum. If an alternative location cannot be provided, then the HSPP/PSPP is not required to be installed. The HERS Rater will verify this. Not installing an HSPP/PSPP will limit the airflow measurement method to either a powered flow hood or passive (traditional) flow hood.

When the mandatory measure for minimum system airflow rate is in effect (entirely new systems), there must be a hole in the supply plenum, provided by the installing contractor, for the placement of a static pressure probe (HSPP). Alternatively, a permanently installed static pressure probe (PSPP) must be installed in the same location.

This requirement also applies when the plenum pressure matching method or the flow grid method of airflow measurement is used by either the installer or the rater to verify airflow in an altered system. The HSPP/PSPP must be installed by the installer, not the rater.

See Air Distribution Ducts, Plenums, and Fans Section 4.4 for discussion regarding mandatory sizing/airflow requirements for ducted systems with cooling.

4.3.2 Prescriptive Requirements for Cooling Equipment

§150.1(c)7

Prescriptive compliance does not require that a cooling system be installed. However, if one is to be installed, the cooling equipment efficiency requirements are specified by the mandatory measures (See Section 4.3.1 above)

Prescriptive requirements for air-cooled air conditioners and air-source heat pumps installed in Climate Zones 2 and 8 through 15 necessitates the installation of a measurement access hole (MAH), refrigerant charge verification (RCV), and minimum system airflow verification. The minimum system airflow installation and RCV must be performed by the installer and/or HERS Rater. The MAH provides a nonintrusive means of measuring return air temperature, which is a parameter important to the RCV process. The alternative to RCV by a HERS Rater is the installation of a refrigerant fault indicator display. When installing a fault indicator display, the installer must still perform a RCV.

Note: The refrigerant charge verification is discussed below (4.3.2.3) and in greater detail later in Section 4.8.

4.3.2.1 **Measurement Access Hole (MAH)**

The MAH provides a nonintrusive means for refrigerant charge verification by HERS Raters and other third-party inspectors. They eliminate the need for raters/inspectors to drill holes into the installed air conditioning equipment enclosures for placement of the temperature sensors required by the refrigerant charge verification test procedures described in RA3.2.

Installation of MAH must be performed by the installer of the air conditioner or heat pump equipment according to the specifications given in RA3.2.

The MAH feature consists of one 5/8-inch (16 millimeters [mm]) diameter hole in the return plenum, upstream from the evaporator coil. (See Figure RA3.2-1)

4.3.2.2 **Minimum System Airflow**

Ducted forced air cooling systems must comply with the minimum system airflow rate of greater than or equal to 350 CFM per ton, or 250 CFM/ton for small duct, high velocity systems, when performing the refrigerant charge verification. The airflow is important when performing the refrigerant charge verification to validate the measured values for pressure and temperature. The correct airflow will also improve the performance of the air-conditioning equipment.

The airflow verification procedure is documented in RA3.3.

4.3.2.3 **Refrigerant Charge Verification (RCV)**

The prescriptive standards for Climate Zones 2 and 8-15 require that a HERS rater verify that ducted air-cooled air conditioners, ducted air-source heat pumps, small-duct high-velocity systems; and mini-split systems have the correct refrigerant charge. The RCV procedures are documented in RA1.2, RA2.4.4, and RA3.2.

Refrigerant charge refers to the actual amount of refrigerant present in the system. Excessive refrigerant charge (overcharge) reduces system efficiency and can lead to premature compressor failure. Insufficient refrigerant charge (undercharge) also reduces system efficiency and can cause compressors to overheat. Ensuring correct refrigerant charge can significantly improve the performance of air-conditioning equipment. *Refrigerants* are the working fluids in air-conditioning and heat-pump systems that absorb heat energy from one area (through the evaporator), transfer, and reject it to another (through the condenser).

4.3.2.4 **Fault Indicator Display**

The installation of a fault indicator display (FID) may be used as an alternative to the prescriptive requirement for HERS diagnostic testing of the refrigerant charge in air conditioners and heat pumps. The installation of an FID does not preclude the

HVAC installer from having to properly charge the system with refrigerant. The FID provides real-time information to the building occupant about the status of the system refrigerant charge, metering device, and system airflow. The FID will monitor and determine the operating performance of air conditioners and heat pumps and provide visual indication to the system owner or operator if the refrigerant charge, airflow, or metering device performance of the system does not conform to approved target parameters for minimally efficient operation. Thus, if the FID signals the owner/occupant that the system requires service or repair, the occupant can immediately call for a service technician to make the necessary adjustments or repairs. An FID can provide significant benefit to the owner/occupant by alerting the owner/occupant to the presence of inefficient operation that could result in excessive energy use/costs over an extended period. An FID can also indicate system performance faults that could result in system component damage or failure if not corrected, thus helping the owner/occupant avoid unnecessary repair costs.

Fault indicator display technologies are expected to be installed at the factory; otherwise, they may be installed in the field according to manufacturer's specifications. JA6 contains more information about FID technologies.

The presence of an FID on a system must be field-verified by a HERS Rater. See RA3.4.2 for the HERS verification procedure, which consists of a visual verification of the presence of the installed FID technology. The rater must inspect to see that the visual indication display component of the installed FID technology is mounted adjacent to the thermostat of the split system. When the outdoor temperature is greater than 55°F, the rater must also observe that the system reports no system faults when the system is operated continuously for at least 15 minutes when the indoor air temperature returning to the air conditioner is at or above 70°F. When the outdoor temperature is below 55°F, the rater must observe that the FID performs a self-diagnosis and indicates that the sensors and internal processes are operating properly.

4.3.3 Performance Compliance Options for Cooling Equipment

There are several options for receiving compliance credit related to the cooling system. These credits are available through the performance compliance method.

4.3.3.1 **High-Efficiency Air Conditioner**

Air conditioner efficiencies are determined according to federal test procedures. The efficiencies are reported in terms of seasonal energy efficiency ratio (SEER) and energy efficiency ratio (EER). Savings can be achieved by choosing an air conditioner that exceeds the minimum efficiency requirements.

The EER is the full-load efficiency at specific operating conditions. It is possible that two units with the same SEER can have different EERs. In cooling climate zones of

California, for two units with a given SEER, the unit with the higher EER is more effective in saving energy. Using the performance compliance method, credit is available for specifying an air conditioner with an EER greater than the minimum (Table 4-6). When credit is taken for a high EER and/or SEER, field verification by a HERS Rater is required. (See RA3.4.4).

4.3.3.2 **Air Handler Fan Efficacy and System Airflow**

It is mandatory that central forced-air systems operate at fan efficacy values less than or equal to

- 0.58 watts/CFM for air handlers that are not gas furnaces.
- 0.45 watts/CFM for gas furnaces.
- 0.62 watts/CFM for small-duct high-velocity system air handlers.

These central forced-air systems also must operate at airflow rates of at least 350 CFM per nominal cooling ton, or 250 CFM/ton for small-duct high-velocity systems. Performance compliance credits are available for demonstrating the installation of a high-efficiency system with a lower fan wattage and/or higher airflow than the mandatory requirements. Compliance with these credits can be achieved by installing a well-designed duct system and can be assisted by a high-efficiency fan. There are two possible performance compliance credits:

1. The performance compliance method allows the user’s proposed fan efficacy to be entered and credit earned if it is lower than the default mandatory values. To obtain this credit for a system with cooling, the system airflow must meet the mandatory requirement of at least 350 CFM/ton of nominal cooling capacity.
2. The performance compliance method allows the user’s proposed system airflow to be entered and credit earned if it is higher than the default of 350 CFM/ton of nominal cooling capacity. To obtain this credit, the fan efficacy must meet the mandatory requirements listed above.

4.3.3.3 **Whole-House Fan Ventilation Cooling**

A whole-house fan (WHF) is not a mandatory requirement. It is required in some climate zones when using prescriptive compliance. The three performance compliance options are the following:

1. No WHF is assumed in the performance compliance software (no ventilation cooling). This will be either energy-neutral, or there will be an energy penalty if the applicable climate zone assumes the effects of a WHF.
2. A default WHF means this proposed feature is equivalent to the standard feature used to establish the energy budget of the building (The performance of the fan

is derated to account for deficiencies from installing undersized or inefficiently designed WHF).

3. The HERS-verified WHF option allows for modeling the effects of the WHF without derating the system performance. The HERS-verified option also allows modeling a WHF with a higher airflow rate or lower fan efficacy than the default, which improves the compliance credit.

4.3.3.4 **Central Fan Ventilation Cooling**

Central fan ventilation cooling (CFVC) performs a function similar to a WHF using the central space-conditioning ducts to distribute outside air. When using the performance compliance approach, a CFVC system may be selected in the compliance software instead of a conventional whole-house fan. Three compliance options are:

1. No CFVC is assumed in the performance compliance software (no ventilation cooling). This will be either energy-neutral, or an energy penalty will be assessed if the applicable climate zone assumes the effects of a WHF.
2. A default CFVC system means the proposed system is equivalent in size and features to a derated WHF.
3. The HERS verified CFVC system option allows for the effects of the system without derating system performance. It also allows for modeling a system with greater capacity, a higher airflow rate or lower fan efficacy than default.

After installation, the contractor must test the actual fan power and airflow of the system using the procedure in RA3.3 and show that it is equal or better than what was proposed in the compliance software analysis.

Field verification by a HERS Rater is required. (See RA3.3.)

4.4 Air Distribution System Ducts, Plenums, Fans, and Filters

Air distribution system performance can have a big effect on overall HVAC system efficiency. Therefore, air distribution systems are required to meet several mandatory and prescriptive requirements as discussed below.

The 2022 Energy Code specifies mandatory requirements for air distribution ducts to be sealed and tested in all climate zones. There are also several compliance credits available related to duct system design.

Duct efficiency is affected by the following parameters:

1. Duct location (e.g., attic, crawlspace, basement, inside conditioned space, etc.).

2. Specific conditions in the unconditioned space, for example, presence of a radiant barrier.
3. Duct insulation characteristics.
4. Duct internal surface area.
5. Air leakage of the duct system.

In performance calculations, duct efficiency can be calculated in one of two ways:

1. Default input assumptions.
2. Diagnostic measurement values.

The computer program will use default assumptions for the proposed design when the user does not intend to make improvements in duct efficiency.

4.4.1 Mandatory Measures for Air Distribution System Ducts, Plenums, Fans, and Filters

4.4.1.1 **Minimum Insulation**

§150.0(m)1B

Space conditioning supply-air and return-air ducts and plenums are required to have a minimum duct insulation level of R-6, except for when the duct or plenum is located in conditioned space as described below. For duct systems located in both unconditioned and conditioned space, the portions of the duct system located in conditioned space are not required to be insulated if all of the following conditions are met and visually confirmed by the building inspector:

1. The non-insulated portion of the duct system is located below the ceiling that separates the occupiable space from the attic and is entirely inside the building's thermal envelope.
2. At all locations where the non-insulated portions of the duct system penetrate into unconditioned space, the penetration must be draft stopped in compliance with California Fire Code Sections 703.1 and 704.1. The penetration must also be air-sealed to the construction materials that are penetrated using materials compliant with California Mechanical Code Section E502.4.2 to prevent air infiltration into the building cavity. Any connections in the unconditioned space must be insulated to a minimum R-6.

CFC sections 703.1 and 704.1 require that materials and firestop systems used through penetrations in fire-resistance-rated construction, construction installed to resist the passage of smoke, and materials and systems used to protect joints and voids in the following locations must be maintained.

- Joints in or between fire-resistance-rated walls, floors or floor/ceiling assemblies and roof or roof/ceiling assemblies.
- Joints in smoke barriers.
- Voids at the intersection of a horizontal floor assembly and an exterior curtain wall.
- Voids at the intersection of a horizontal smoke barrier and an exterior curtain wall.
- Voids at the intersection of a nonfire-resistance-rated floor assembly and an exterior curtain wall.
- Voids at the intersection of a vertical fire barrier and an exterior curtain wall.
- Voids at the intersection of a vertical fire barrier and a nonfire-resistance-rated roof assembly.

The materials and systems must be securely attached to or bonded to the construction being penetrated or the adjacent construction, with no openings visible through or into the cavity of the construction.

CMC E502.4.2 requires that all joints, seams, and penetrations of duct systems must be made airtight by means of mastics, gasketing, or other means.

For duct systems located entirely in conditioned space, the ducts do not require insulation. To determine whether ducts are entirely in conditioned space as defined in §100.1, a rater must field verify by visual inspection and by using the protocols of RA 3.1.4.3.8.

RA 3.1.4.3.8 describes the duct leakage to outside test that determines whether the ducts are within the pressure boundary of the space being served by the duct system. Also, a basic visual inspection of the ducts is required to ensure that no portion of the duct system is obviously outside the apparent pressure/thermal boundary.

Leakage to "outside" means conditioned air leaking from the ducts to anywhere outside the pressure boundary of the dwelling unit conditioned space served by the duct system, which includes leakage to outside the building, and leakage to adjacent dwelling units.

Exception to §150.0(m)1: Ducts and fans integral to a wood heater or fireplace are exempt from §150.0(m)1.

§150.0(m)5

For determining the installed R-value of duct insulation based on thickness, when not an integral part of a manufacturer-labeled, insulated duct product such as vinyl flex duct, the following shall be used:

1. For duct wrap, the installed thickness of insulation must be assumed to be 75 percent of the nominal thickness due to compression.
2. For duct board, duct liner, and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.

4.4.1.2 **Connections and Closures**

§150.0(m)1 - §150.0(m)3

The Energy Code sets a number of mandatory measures related to duct connections and closures. These measures address the materials and methods used for duct sealing. The following is a summary. Refer to the sections of the sections listed above for details.

4.4.1.3 **Factory-Fabricated Duct Systems**

Factory-fabricated duct systems must comply with the following requirements:

1. All factory-fabricated duct systems must comply with UL 181 for ducts and closure systems, including collars, connections, and splices, and be labeled as complying with UL 181.
2. All pressure-sensitive tapes, heat-activated tapes, and mastics used in the manufacture of rigid fiberglass ducts must comply with UL 181 and UL 181A.
3. All pressure-sensitive tapes and mastics used with flexible ducts must comply with UL 181 and UL 181B.
4. Joints and seams of duct systems and related components cannot be sealed with cloth-backed rubber adhesive duct tapes unless such tape is used in combination with mastic and draw bands, or
5. It has on its backing the phrase "CEC approved," a drawing of a fitting to plenum joint in a red circle with a slash through it (the international symbol of prohibition), and a statement that it cannot be used to seal fittings to plenums and junction box joints.

4.4.1.4 **Field-Fabricated Duct Systems**

Field-fabricated duct systems must comply with the following requirements:

1. Factory-made rigid fiberglass and flexible ducts for field-fabricated duct systems must 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.
2. Mastic sealants and mesh:

a. Sealants must comply with the applicable requirements of UL 181, UL 181A, and/or UL 181B and be nontoxic and water-resistant.

b. Sealants for interior applications must be tested in accordance with ASTM C731 and D2202.

c. Sealants for exterior applications must be tested in accordance with ASTM C731, C732, and D 2202.

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

3. Pressure-sensitive tapes must comply with the applicable requirements of UL 181, UL 181A, and UL 181B.
4. Joints and seams of duct systems and their components must not be sealed with cloth-backed rubber adhesive duct tapes unless such tape is used in combination with mastic and draw bands, or
5. It has on its backing the phrase "CEC approved," a drawing of a fitting to plenum joint in a red circle with a slash through it (the international symbol of prohibition), and a statement that it cannot be used to seal fittings to plenums or junction box joints.

4.4.1.5 **Draw Bands Used With Flexible Duct**

1. Draw bands must be either stainless-steel worm-drive hose clamps or UV-resistant nylon duct ties.
2. Draw bands must have a minimum tensile strength rating of 150 pounds.
3. Draw bands must be tightened as recommended by the manufacturer with an adjustable tensioning tool.

4.4.1.6 **Aerosol-Sealant Closures**

1. Aerosol sealants shall meet the requirements of UL 723 and be applied according to manufacturer specifications.
2. Tapes or mastics used in combination with aerosol sealing shall meet the requirements of this section.

If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape must be used.

Building spaces such as cavities between walls, support platforms for air handlers, and plenums defined or constructed with materials other than sealed sheet metal, duct board, or flexible duct must not be used for conveying conditioned air, including return air and supply air. Using drywall materials as the interior surface of a return plenum is not allowed. Building cavities and support platforms may contain ducts. Ducts installed in cavities and support platforms must not be compressed to cause reductions in the cross-sectional area of the ducts. Although a HERS Rater may examine this as a part of his or her responsibilities when involved in a project, the enforcement of these minimum standards for ducts is the responsibility of the building official.

§150.0(m)2D, §150.0(m)3D

Duct systems may not use cloth-backed, rubber-adhesive duct tape (typical, "old fashioned," nonrated duct tape) unless it is installed in combination with mastic and draw bands. Mastic and draw bands alone are adequate for sealing most connections. Cloth–backed, rubber-adhesive duct tape may be used to hold the outer vapor barrier in place or for some purpose other than prevention of duct leakage. Cloth-backed rubber adhesive duct tape alone is not adequate to serve as an air-sealing method or as a mechanical connection.

The enforcement of these minimum standards is normally the responsibility of the building official; however, HERS Raters will also verify compliance with this requirement in conjunction with duct leakage verification.

4.4.1.7 **Product Markings**

§150.0(m)2A, §150.0(m)6

All factory-fabricated duct systems must meet UL 181 for ducts and closure systems and be labeled as complying with UL 181. Collars, connections, and splices are considered to be factory-fabricated duct systems and must meet the same requirement.

Insulated flexible duct products installed to meet this requirement must include labels, in maximum intervals of 3 ft, showing the R-value for the duct insulation (excluding air films, vapor barriers, or other duct components), based on the tests and thickness specified in §150.0(m)4 and §150.0(m)5C.

4.4.1.8 **Dampers to Prevent Air Leakage**

§150.0(m)7

Fan systems that exhaust air from the building to the outside must be provided with back draft or automatic dampers.

§150.0(m)8

Gravity ventilating systems must have an automatic or readily accessible, manually operated damper in all openings to the outside, except combustion inlet and outlet air openings and elevator shaft vents. This includes clothes dryer exhaust vents when installed in conditioned space.

4.4.1.9 Protection of Insulation

§150.0(m)9

Insulation must be protected from damage, including damage from sunlight, moisture, equipment maintenance, and wind, but not limited to the following:

1. Insulation exposed to weather must be suitable for outdoor service – for example, protected by aluminum, sheet metal, painted canvas, or plastic cover.
2. Cellular foam insulation shall be protected as above or painted with a coating that is water-retardant and shields from solar radiation that can degrade the material.

4.4.1.10 Ducts in Concrete Slab

Ducts in a concrete slab must have R-6 insulation, but other issues will come into play. If ducts are in the soil beneath the slab or embedded in the slab, the insulation material should be designed and rated for such installation. Insulation installed in below-grade applications should resist moisture penetration. (Closed-cell foam is one moisture-resistant product.) Common premanufactured duct systems are not suitable for below-grade installations. If concrete is to be poured directly over the ducts, then the duct construction and insulation system should be sturdy enough to resist the pressure and not collapse. Insulation should be of a type that will not compress, or it should be inside a rigid duct enclosure. The only time that common flex ducts are suitable in a below-grade application is when a channel is provided in the slab.

4.4.1.11 Porous Inner Core Flex Duct

§150.0(m)10

Over time, the outer vapor barrier of flex duct can degrade and be easily damaged. Therefore, porous inner core flex duct must have a non-porous layer or air barrier between the inner core and the outer vapor barrier.

4.4.1.12 Duct System Sealing and Leakage Testing

§150.0(m)11

Duct system sealing and leakage testing is mandatory in all climate zones. Duct systems in newly constructed single-family dwellings and, townhouses are required to comply with the requirements. For single-family dwellings and townhouses where the air-handling unit is installed and ducts are connected directly to the air handler, the total leakage of the duct system must be 5 percent or less of the nominal system air handler airflow. For single-family dwellings and townhouses inspected at the "rough-in" stage of construction, where the air-handling unit is not installed, the total leakage of the duct system shall not exceed 4 percent of the nominal systems air handler airflow.

The duct system leakage must be verified according to the applicable procedures outlined in RA3.1.4.

Alterations and additions to ducted systems in existing buildings in all climate zones are also required to comply with applicable maximum leakage criteria. Refer to Chapter 9 for more information on duct sealing and leakage testing for existing buildings.

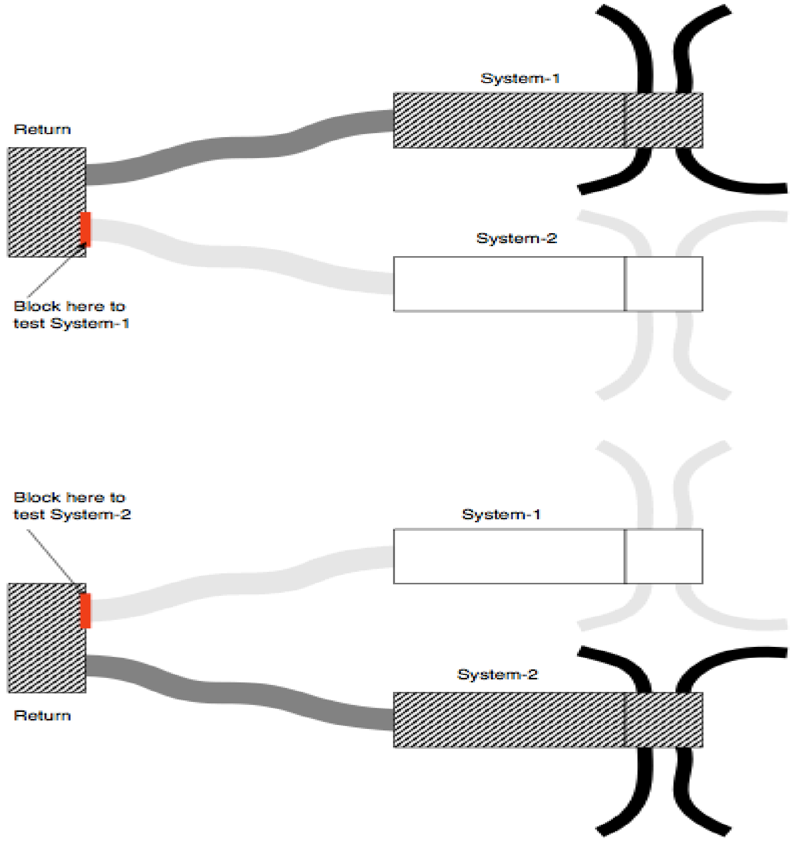
4.4.1.13 **Duct Leakage Testing for Multiple Duct Systems With Common Return Ducts**

If there are two or more duct systems in a building that are tied together at a common return duct, then each duct system should be tested separately, including the shared portion of the return duct system in each test. Under this scenario, the portions of the second duct system that is not being tested must be completely isolated from the portions of the ducts that are being tested, so the leakage from second duct system does not affect the leakage rate from the side that is being tested.

Figure 4-3 represents the systems that are attached to a shared return boot or remote return plenum. In this case, the point in the return system that needs to be blocked off is readily accessible through the return grille.

The "duct leakage averaging," where both systems are tested together as though it is one large system and divided by the combined tonnage to get the target leakage, may not be used as it allows a duct system with more the 5 percent leakage to pass if the leakage of the combined system is 5 percent or less.

Figure 4-3: Two Duct Systems with a Common Return Duct



Source: California Energy Commission

4.4.1.14 **Air Filtration**

§150.0(m)12

Air filtration is used in forced air systems to protect the equipment from dust accumulation that could reduce the capacity or efficiency of the system. Preventing dust buildup may also prevent the system from becoming a host to biological contaminants such as mold, especially if dust is deposited on cooling coils that become wet from water condensation during comfort cooling operation. Air filter efficiencies of Minimum Efficiency Reporting Value (MERV) 6 to MERV 8 are sufficient for protection from these large airborne dust particles. Air filter efficiencies of at least MERV 13 are needed to protect occupants from exposure to the smaller airborne particles that are known to adversely affect respiratory health. These smaller particles are often referred to as PM 2.5 which refers to particulate matter of 2.5 microns. PM2.5 is produced from combustion such as that resulting from cooking in the kitchen and from exhaust from motor vehicles that enters a dwelling through ventilation openings and infiltration.

4.4.1.14.1 **Air Filter Pressure Drop**

Energy Code Section 150.0(m)12Bii requires all systems to be designed to accommodate the clean-filter pressure drop imposed by the system air filter device(s). This applies to space-conditioning systems and to the ventilation system types described in Section 4.4.1.14.2 below. The design airflow rate, and maximum allowable clean-filter pressure drop at the design airflow rate applicable to each air filter device shall be determined and posted on a sticker or label by the installer inside the filter grille or near the filter rack, according to Section 4.4.1.14.5 below.

Designers of space-conditioning systems must determine the total of the system external static pressure losses from filters, coils, ducts, and grilles, such that the sum is not greater than the available static pressure of the air handling unit at the design airflow rate. Therefore, air filters should be sized to minimize static pressure drop across the filter during system operation.

The air filter pressure drop can be reduced by increasing the amount of air filter media surface area available to the system airflow. Increased media surface area can be accomplished by adjusting one, two, or all three of the following factors:

a. *The number of pleats of media per inch inside the air filter frame.* The number of pleats per inch inside the filter frame is determined by the manufacturer’s filter model design and is held constant for all filter sizes of the same manufacturer’s model. For example, all 3M Filtrete™ 1900 filters will have the same media type, the same MERV rating, and the same number of pleats of media per inch inside the filter frame regardless of whether the nominal filter size is 20” X 30” or 24” X 24”, and so forth. Generally, as the number of pleats per inch is increased, the pressure drop is reduced if all other factors remain constant. The pressure drop characteristics of air filters vary widely between air filter manufacturers and between air filter models, largely because of the number of pleats per inch in the manufacturer’s air filter model design. System designers and system owners cannot change the manufacturer's filter model characteristics, but they can select a superior air filter model from a manufacturer that provides greater airflow at a lower pressure drop by comparing the filter pressure drop performance shown on the air filter manufacturer's product label (see example label in Figure 4-5).

b. *The face area of the air filter and filter grille.* Face area is the nominal cross-sectional area of the air filter, perpendicular to the direction of the airflow through the filter. Face area is also the area of the filter grille opening in the ceiling or wall. The face area is determined by multiplying the length times width of the filter face (or filter grille opening). The nominal face area for a filter corresponds to the nominal face area of the filter grille in which the filter is installed. For example, a nominal 20” X 30” filter has a face area of 600 in^2 and would be installed in a nominal 20” X 30” filter grille. Generally, as the total system air filter face area increases, the pressure drop is reduced if all other factors remain constant. Total system air filter face area can be increased by specifying a larger area filter/grille, or by using multiple return filters/grilles and summing the face areas. The filter face area is specified by the system designer or installer.

c. *The depth of the filter and filter grille.* Air filter depth is the nominal filter dimension parallel to the direction of the airflow through the filter. Nominal filter depths readily available for purchase include one, two, four, and six inches. Generally, as the system air filter depth increases, the pressure drop is reduced if all other factors remain constant. For example, increasing filter depth from one inch to two inches nominally doubles the filter media surface area without increasing the filter face area. The filter depth is specified by the system designer or installer.

4.4.1.14.2 **Air Filter Particle Removal Efficiency Requirements – MERV 13**

An air filter with a particle removal efficiency equal to or greater than MERV 13, or a particle size efficiency rating equal to or greater than 50 percent in the 0.30-1.0 micrometer (μm) range, and equal to or greater than 85 percent in the 1.0-3.0 μm range is required for the following systems:

a. Mechanical space conditioning (heating or cooling) systems with a total of more than 10 feet of duct. The total is determined by summing the lengths of all the supply and return ducts for the forced-air system.

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

c. 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.

Evaporative coolers are exempt from the air filtration requirements

4.4.1.14.3 **Air Filter Requirements for Space-Conditioning Systems:**

Space-conditioning systems may use any of the three following compliance approaches:

a. Install a filter grille or accessible filter rack that accommodates a minimum 2-inch depth filter and install the appropriate filter.

b. Install a filter grille or accessible filter rack that accommodates a minimum 1” depth filter and install the appropriate filter. The filter/grille must be sized for a velocity of ≤ 150 ft per minute. The installed filter must be labeled to indicate the pressure drop across the filter at the design airflow rate for that return is ≤ 0.1 inch water column (w.c. [25 PA]).

Use the following method to calculate the 1" depth filter face area required. Divide the design airflow rate (ft^3/min) for the filter grille/rack by the maximum allowed face velocity 150 ft/min. This yields a value for the face area in ft^2. Since air filters are sold using nominal sizes in terms of inches, convert the face area to in^2 by multiplying the face area (ft^2) by a conversion factor of 144 in^2/ft^2. Summarizing:

$$\text{Filter Nominal Face Area (in2)} = \text{airflow (CFM)} \div 150 \times 144 \qquad \text{Equation 4.4-1}$$

c. Comply with Energy Code Tables 150.0-B and C (Table 4-10 and Table 4-11), which prescribe the minimum total system nominal filter face area and return duct size(s). The installed filter must be labeled to indicate the pressure drop across the filter at the design airflow rate for that return is ≤ 0.1 inch w.c. (25 PA). This option is an alternative to the Section 150.0(m)13 requirement for HERS-verified fan efficacy and airflow rate but requires instead a HERS verification of the return duct design.

4.4.1.14.4 Air Filter Requirements for Ventilation Systems

a. Filters with a depth of 1” or greater are allowed.

b. The design airflow rate, and maximum allowable clean-filter pressure drop at the design airflow rate applicable to each air filter device must be determined by the system designer or installer and that information must be posted on a sticker by the installer inside or near the filter grille/rack according to Section 4.4.1.14.5 below.

c. Ventilation systems must deliver the volume of air specified by §150.0(o) with filters in place.

4.4.1.14.5 Filter Access and Filter Grille Sticker – Design Airflow and Pressure Drop

All filters used in all system types must be accessible to facilitate replacement.

a. **Air filter grille sticker**. The design airflow rate and maximum allowable clean-filter pressure drop at the design airflow rate applicable to each air filter grille/rack must be determined by the designer/installer and posted on a sticker placed by the installer inside or near the filter grille/rack. The design airflow and initial resistance posted on this sticker should correspond to the conditions used in the system design calculations. This requirement applies to space conditioning systems and to the ventilation system types described in Section 4.4.1.14.2 above.

An example of an air filter grille sticker showing the design airflow and pressure drop for the filter grille/rack is shown in Figure 4-4.

b. **Air filter manufacturer label.** Space-conditioning system filters are required to be labeled by the manufacturer to indicate the pressure drop across the filter at several airflow rates. For the system to comply, and to ensure adequate airflow for efficient heating and cooling equipment operation, the manufacturer's air filter label (Figure 4-5) must display information that indicates the filter can meet the design airflow rate for that return grille/rack at a pressure drop ≤ the value shown on the installer's filter grille sticker (Figure 4-4). This requirement does not apply to the ventilation system types described in Section 4.4.1.14.2.

Figure 4-4: Example of Installer's Filter Grille Sticker

Air Filter Performance Requirement	Air Filter Performance Requirement	Maintenance Instructions
Airflow Rate (CFM) Must be greater than or equal to the value shown	**Initial Resistance (IWC)** Must be less than or equal to the value shown	Use only replacement filters that are rated to simultaneously meet both of the performance requirements specified on this sticker:
750	0.1	Left blank

Source: California Energy Commission

Figure 4-5: Example Manufacturer's Filter Label

MERV	(µm)	0.30-1.0	1.0-3.0	3.0-10	Airflow Rate (CFM)	615	925	1230	1540	2085*	*Max Rated Airflow
13	PSE (%)	62	87	95	Initial Resistance (IWC)	0.07	0.13	0.18	0.25	0.38	

Source: California Energy Commission

4.4.1.14.6 Air Filter Selection

For a filter to meet the system specifications for airflow and pressure drop, it must be rated by the manufacturer to provide more than the specified airflow at less than the specified pressure drop. It is unlikely that a filter will be available that is rated to have the exact airflow and pressure drop ratings specified, so filters should be selected that are rated to have less than the specified pressure drop at the specified airflow rate, otherwise select filters that are rated to have greater than the specified airflow rate at the specified pressure drop. See Figure 4-4 for an example of an installer's filter grille sticker that provides an air filter rating specification for minimum airflow of 750 CFM at maximum pressure drop 0.1 inch w.c.

Manufacturers of air filters may make supplementary product information available to consumers that will assist with selecting the proper replacement filters. This product information may provide more detailed information about the filter model airflow and pressure drop performance – details such as airflow and pressure drop values that are intermediate values that lie between the values shown on their product label. The information may be published in tables, graphs, or presented in software applications available on the internet or at the point of sale.

Figure 4-6 below shows a graphical representation of the initial resistance (pressure drop) and airflow rate ordered pairs given on the example air filter manufacturer's label shown in Figure 4-5 above. The graph in Figure 4-6 makes it possible to visually determine the airflow at 0.1 inch w.c. pressure drop for which the values are not shown on the manufacturer's filter label.

If there is no supplementary manufacturer information available, and it is necessary to determine the performance of a filter model at an airflow rate or pressure drop between two values shown on a manufacturer's label, linear interpolation may be used. Linear interpolation apps are readily available on the internet, and formulas for linear interpolation are shown below.

The linear interpolation method may be used to determine an unknown pressure drop corresponding to a known airflow rate by use of Equation 4-1a, or it may also be used to determine an unknown airflow rate corresponding to a known pressure drop by use of Equation 4-1b.

$$\mathbf{p} = \mathbf{p1} + [(\mathbf{f} - \mathbf{f1}) \div (\mathbf{f2} - \mathbf{f1})] \,\mathbf{x}\, (\mathbf{p2} - \mathbf{p1}) \qquad \text{Equation 4-1a}$$

where:

f = a known flow value between f_1 and f_2

p = the unknown pressure drop value corresponding to f.

p_1 and p_2 = known values that are less than and greater than p respectively.

f_1 and f_2 are the known values corresponding to p_1 and p_2.

$$\mathbf{f = f_1 + [(p - p_1) \div (p_2 - p_1)] \times (f_2 - f_1)} \qquad \text{Equation 4-1b}$$

where:

p = a known pressure drop value between p_1 and p_2

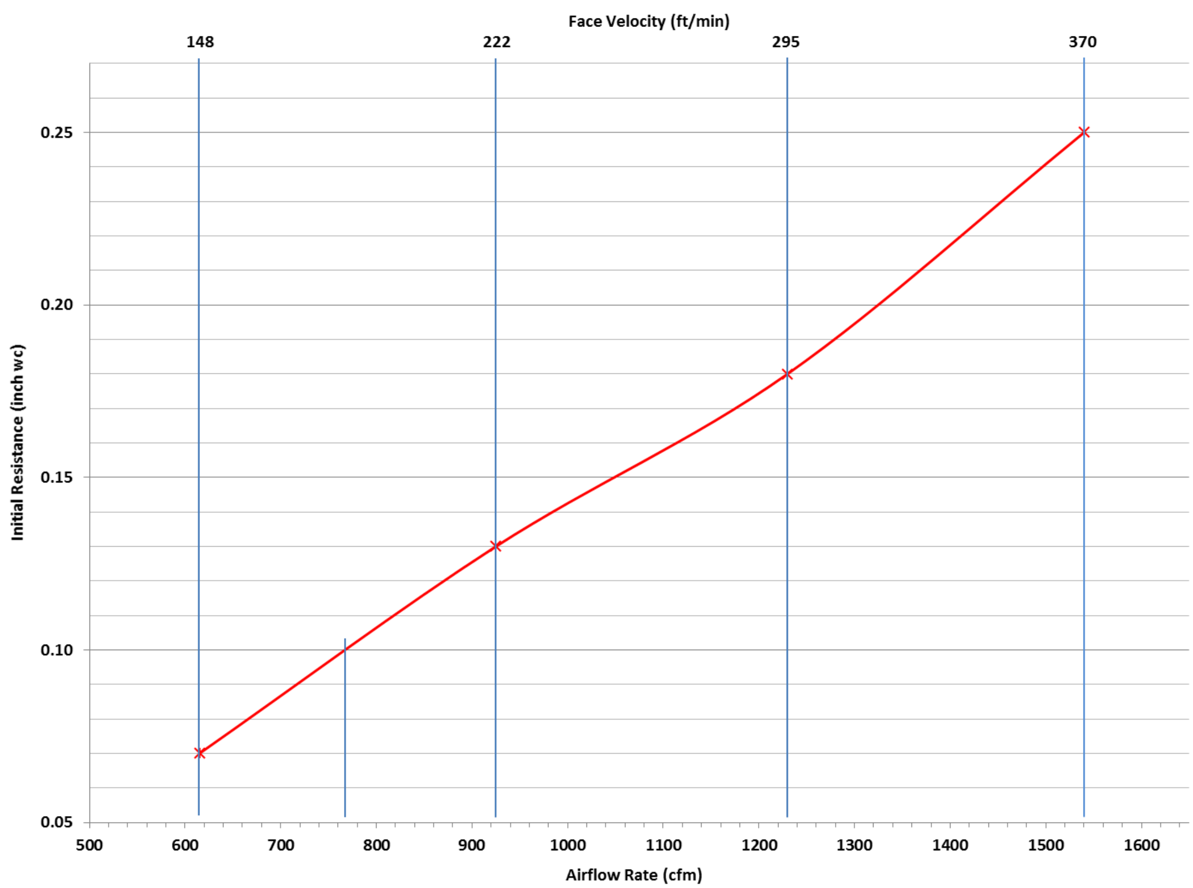
f = the unknown flow value corresponding to p.

f_1 and f_2 = known values that are less than and greater than f respectively.

p_1 and p_2 are the known values corresponding to f_1 and f_2.

See Example 4-1 for sample calculations that determine the rated airflow of the filter corresponding to a known pressure drop specification (0.1 inch w.c.).

Figure 4-6. Plot of Pressure drop vs. Airflow for a 20" X 30" X 1" Depth Air Filter From Manufacturer Label Information



Source: California Energy Commission

4.4.1.14.7 Preventing Bypass

Any gaps around an air filter allows air to bypass the filter. The Energy Code requires that filter racks and grilles use gaskets, sealing, or other means to close gaps around inserted filters and prevent air from bypassing the filter. Filter racks and grilles include any device that houses the air filter used to satisfy the air filtration requirements.

Example 4-1– Filter Selection Using Linear Interpolation

Question:

Does the air filter label in Figure 4-5 indicate the filter would meet the airflow (750 CFM) and pressure drop (0.1 inch w.c.) requirements shown on the installer filter grille sticker in Figure 4-4? How can I determine the filter's airflow rate at 0.1 inch w.c. for the manufacturer's filter label shown in Figure 4-5?

Answer:

The filter must be rated to provide greater than 750 CFM at the specified 0.1 inch w.c. pressure drop, or equivalently: the filter must be rated to provide a pressure drop less than 0.1 inch w.c. at the specified 750 CFM.

Referring to Equation 4-1b, we calculate the unknown value "f" in CFM that corresponds to the known value "p" of 0.1 inch w.c.

Referring to Figure 4-5: p_1=0.07, p_2=0.13, f_1=615, f_2=925, and applying Equation 4-1b:

615 + [(0.1-0.07) ÷(0.13-0.07)] x (925-615) yields 770 CFM.

Therefore, since the filter is rated for greater than 750 CFM at 0.1 inch w.c., the filter complies.

Example 4-2– Filter Sizing

Question:

I am installing a 1,200 CFM furnace in a new house. It has a 20" x 20" x 1” inch filter rack furnished with a 1" depth filter installed in the unit. Is this filter in compliance?

Answer:

The nominal face area of the filter rack is 20" x 20" = 400 in^2, and since it is a 1” filter, the face area may not be less than 1,200 (CFM)/150 (ft/min) x144 (in^2 / ft^2) = 1,152 in^2. Therefore, this filter installation does not comply.

Example 4-3

Question:

For the same 1,200 CFM furnace, what other options do I have?

Answer:

Option 1: The filter will comply if it has a depth of 2 inches or more and is properly sized by the system designer such that the duct system as a whole will be capable of meeting the HERS verification for fan efficacy specified in Section 150.0(m)13.

Otherwise, the required total system filter face area of 1,152 in^2 must be met using multiple remote wall or ceiling filter grilles for which the sum of the face areas is equal to or greater than 1152 in^2, and the filters must be rated for pressure drop of 0.1 inch w.c. or less at the design airflow rates of each filter grille.

Option 2: Table 150.0-B may be used for compliance. If the air conditioner is rated at 3 tons and two return ducts sized at 16” and 14” or larger are provided, the total filter/grille nominal area may be reduced to 900 in^2, or 450 in^2 per filter grille. However, the filters still must have a pressure drop of 0.1 inch or less at 600 CFM (based on filter manufacturer label data).

For any filter, the pressure drop, efficiency, and length of time the filter can remain in operation without becoming fully loaded with dust, can all be improved by using filters that are deeper than 1". As the depth of the filter is increased, the pressure drop across the filter at the same face area will be greatly reduced.

Example 4-4

Question:

I am installing a ductless split system in a space that is being added on to the house. Must I use the designated MERV 13 filter?

Answer:

No. The filtration requirements do not apply unless there is at least 10 feet of duct attached to the unit.

Example 4-5

Question:

My customer has allergies and wants a MERV 16 or better filter. Is this in compliance?

Answer:

Yes. MERV rated filtration greater than MERV 13 meets (exceeds) the minimum particle removal efficiency requirement; thus, it may be used provided all other applicable requirements in Section 150.0(m)12 are complied with.

4.4.1.15 **Forced-Air System Duct Sizing, Airflow Rate, and Fan Efficacy**

§150.0(m)13

Adequate airflow is critical for cooling equipment efficiency. Further, it is important to maintain adequate airflow without expending excessive fan power. Section150.0(m)13 requires system airflow and watt draw to be HERS-verified. See RA3.3 for the applicable HERS verification procedures.

Forced-air systems that provide cooling must comply with either the airflow rate and fan efficacy verification, or may comply with the return duct design specifications given in Tables 150.0-B and C.

1. Airflow and watt draw measurement and determination of fan efficacy:

   When using the airflow (CFM/ton) and fan efficacy (watt/CFM) method, the following criteria must be met:

   a. Provide airflow through the return grilles that is equal to or greater than

      - 350 CFM per ton of nominal cooling capacity for systems that are not small-duct high-velocity systems.
      - 250 CFM per ton for small duct, high velocity systems.

   Nominal cooling capacity. To determine the required airflow for compliance in CFM/ton, the nominal cooling capacity of the system in tons must be known. The nominal cooling capacity system may be obtained from the manufacturer's product literature or from listings of certified product ratings from organizations such as AHRI, but the nominal capacity is usually shown in the unit model number on the manufacturers nameplate attached to the outdoor condensing unit. A two- or three-digit section of the manufacturer's model number indicates the nominal capacity in thousands of BTU/hour. Given that there are 12,000 BTU/hour per ton of cooling capacity, the nameplate will display something similar to one of the following number groupings: "018" which represents 1.5 tons; "024," which represents 2 tons; "030," which represents 2.5 tons; "036," which represents 3 tons; "042," which represents 3.5 tons; "048," which represents 4 tons; or "060," which represents 5 tons.

   b. At the same time, the fan watt draw must be less than or equal to

      - 0.45 watts per CFM for gas furnaces.
      - 0.58 watts per CFM for air handling units that are not gas furnaces.
      - 0.62 watts per CFM for small duct, high velocity systems.

   The methods for measuring the air-handling unit watt draw are described in RA3.3. Three acceptable apparatuses are:

   a. A portable watt meter.

   b. An analog utility revenue meter.

   c. A digital utility revenue meter.

   Note: When measuring fan watt draw in package air conditioners or heat pumps, it is recommended to use a portable true power clamp-on meter to provide flexibility for isolating the correct fan wires. These meters may need to be high-voltage-capable.

There are three acceptable methods for determining compliance with the system airflow requirement. They are described in RA3.3 and use one of the following:

a. An active or passive flow capture hood to measure the total airflow through the return grill(s).

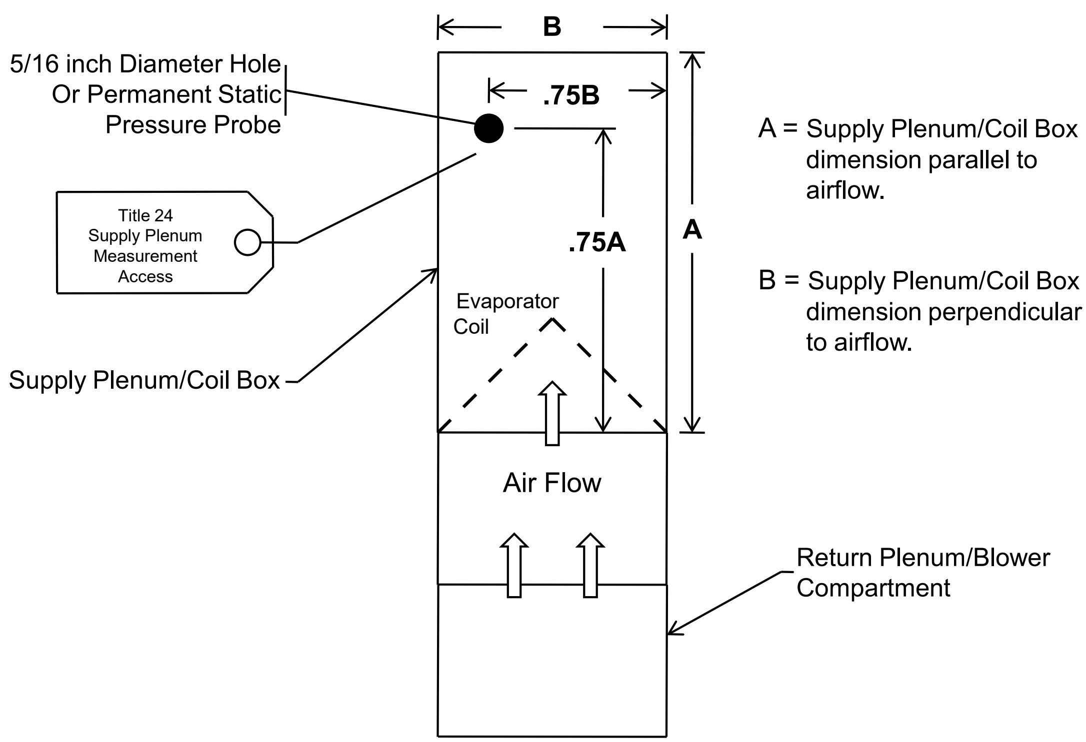
b. Flow grid device(s) at the return grill(s) or other location where all the central fan airflow passes through the flow grid.

c. Fan flow meter device (also known as a duct blaster) to perform the plenum pressure matching procedure.

The flow grid and the fan flow meter methods both require access to static pressure measurements of the airflow exiting the cooling coil, which requires use of a HSPP or PSPP (Section RA3.3.1.1).

The contractor must install either a hole for the placement of a static pressure probe (HSPP) or provide a permanently installed static pressure probe (PSPP) as shown in Figure 4-5 below and RA3.3.

Figure 4-5: Location of the Static Pressure Probe



Source: California Energy Commission

The HSPP or PSPP simplifies cooling coil airflow measurement when using devices/procedures that depend on supply plenum pressure measurements.

2. Return Duct System Design Method – This method allows the designer to specify, and the contractor to install, a system that does not have to be tested for airflow and fan efficacy. This method can be used for systems with either one, or two return grilles. Each return shall not exceed 30 feet as measured from the return plenum to the filter grille. When bends are needed, sheet metal elbows are desirable. Each return can have up to 180 degrees of bend, and flex duct can have no more than 90 degrees of bend. To use this method, the designer and installer must provide return system sizing that meets the appropriate criteria in Energy Code Table 150.0-B and C, also shown in Table 4-10 or Table 4-11 below.

4.4.1.16 **Airflow and Fan Efficacy Testing Versus Return Duct Sizing**

Studies have shown that adequate airflow is critical to the efficient operation of air-conditioning systems. Section 150.0(m)13B, 13C, and 13D establish mandatory requirements that are intended to ensure adequate cooling airflow through properly sized ducts and efficient fan motors.

There are two options allowed to ensure adequate air flow. The first option is to design and install the systems using standard design criteria and then have the airflow and fan efficacy (AF/FE) of the system tested and third-party verified in the field. The second option is to size the return ducts according to Table 4-10 and Table 4-11 (as specified by EXCEPTION 1 to §150.0(m)13B and D).

The California Green Code and the California Mechanical Code require that residential duct systems be designed according to ACCA Manual D, or equivalent. If reasonable care and judgment are used while designing the duct system (both return and supply ducts), and the system is designed to reasonable parameters for airflow per ton, static pressure across the fan, and friction rate, these systems should have no problem passing the diagnostic tests.

The following design guidelines can increase the chances of the system passing the AF/FE testing:

1. Right-size the HVAC system; if a 3-ton unit is enough to satisfy the cooling load, do not install a 4-ton unit "just to be safe." Oversizing equipment can cause comfort problems and excessive energy use.

2. The HVAC designer must coordinate closely with the architect and structural engineer to make sure that the ducts will fit into the home as designed.

3. Prepare a detailed mechanical plan that can be followed in the field. If deviations must occur in the field, make sure that they are coordinated with the designer and that the design is adjusted as needed.

4. Follow Manual D for duct sizing:
   a. Make sure that the correct duct type is being used (vinyl flex, sheet metal, rigid fiberglass, or other).
   b. Make sure that all equivalent lengths and pressure drops are correctly accounted for (bends, plenum start collars, t-wyes, filters, grilles, registers, and so forth.
   c. Select a furnace that will provide at least 400 CFM/ton at the desired static pressure of 125 to 150 Pa (0.5 to 0.6 inches w.c.).
   d. Design the duct system to a static pressure across the fan of no more than 150 Pa (0.6 inches w.c.).
   e. Consider upsizing the evaporator coil relative to the condenser to reduce the static pressure drop. This upsizing results in better airflow and slightly better capacity and efficiency. Manufacturers commonly provide performance data for such condenser coil combinations.
   f. Consider specifying an air handler with a high efficiency (brushless permanent magnet) fan motor.
5. Install a large grill area and use a proper filter for the system.
6. Locate registers and equipment to make duct runs as short as possible.
7. Make all short-radius 90-degree bends out of rigid ducting.
8. Install flex duct properly by stretching all flex duct tight and cut off excess ducting, ensure the duct is not kinked or compressed, ensure flex duct is properly supported every 4 feet or less using 1inch strapping having less than 2 inches of sag between supports.

Consider using better quality supply and filter grilles. “Bar-type” registers have considerably better airflow performance than standard “stamped-face” registers. Refer to the manufacturer’s specifications and select accordingly.

Energy Code Tables 150.0-B and C (Table 4-9 and Table 4-11) allow for only one or two returns. There may be times where three returns are necessary on a single system. Furthermore, Table 150.0-C does not allow for deviation from the two sizes specified. For example, the table requires two 16-inch return ducts for a 3.5-ton system, but specific airflow requirements and architectural constraints may dictate something more like a 20-inch and a 14-inch. In this situation, the designers would have to rely on standard engineering principles and trust that their design will pass the AF/FE diagnostic tests.

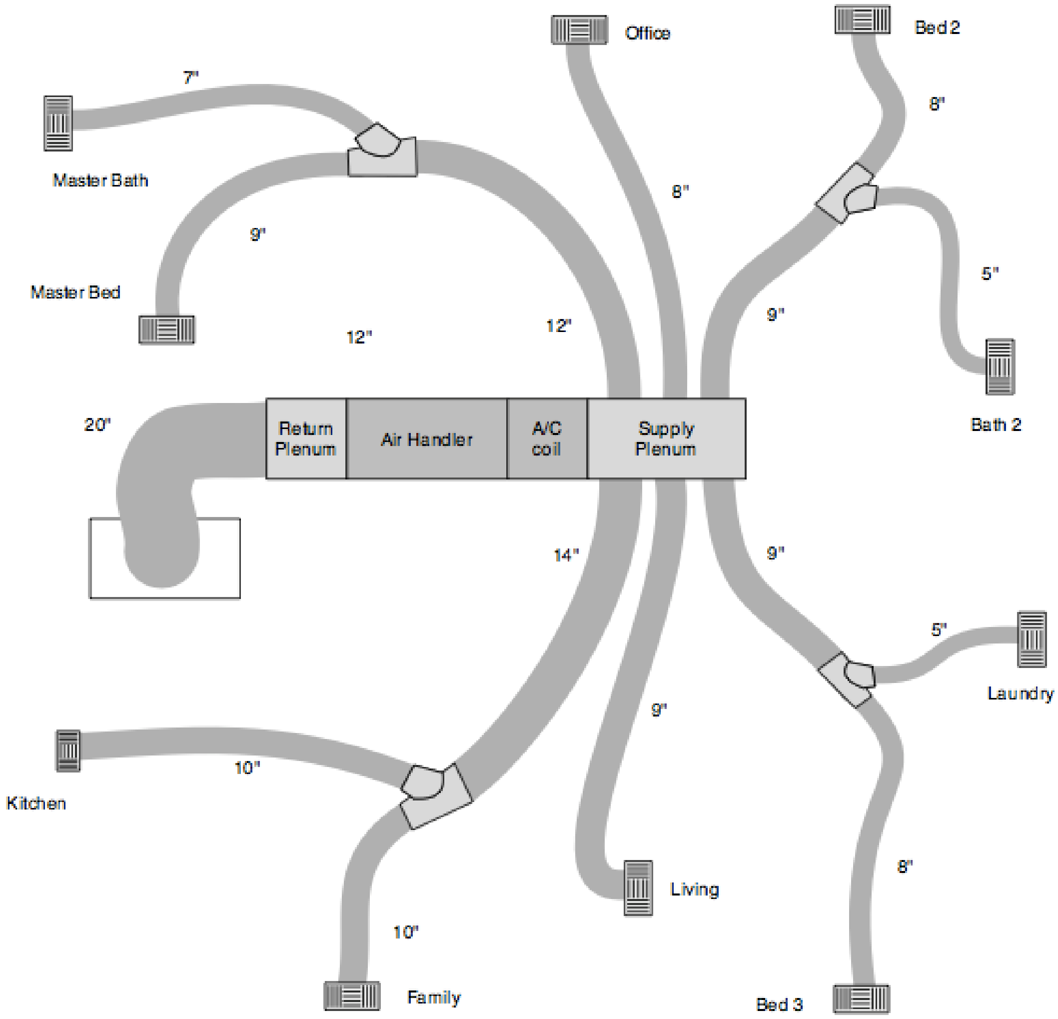
Having adequate room to run properly sized ducts has always been an issue. Historically, duct systems have been sized to fit into the home at the expense of proper airflow. The performance of these systems, in terms of efficiency and capacity, has suffered greatly because of this practice. These standards intend to change these practices. The home should be designed to accommodate properly sized ducts. This requires improved coordination among the architect, structural engineer, and mechanical designer earlier in the process.

Tables 150.0-B and C require the use of return grilles that are sized to achieve an optimal face velocity and static pressure drop. Tables 150.0-B and C also require the return grille devices to be labeled in accordance with the requirements in §150.0(m)12A to disclose the design airflow rate of the grille, and the maximum allowable clean-filter pressure drop for the air filter media as determined by the system design or applicable standards requirements. The nominal size of the air filter grille or air filter media should be used to calculate the return filter grille gross area for determining compliance with Tables 150.0-B and C. The nominal size of the filter grille is expected to be the same as the nominal size of the air filter media that is used in the grille and is most often the information used to identify these items for purchases. For example, a nominal 20-inch x 30-inch filter grille will use nominal 20-inch x 30-inch air filter media.

4.4.1.17 **Return Duct Sizing Example**

The mechanical contractor for a new home submitted the following mechanical design to the builder. It was designed using typical design specifications (400 CFM/ton at 125 Pa [0.5” w.c., friction rate = 0.1, etc.]). The system has a 4-ton condenser, and the air handler is rated for 1,600 CFM.

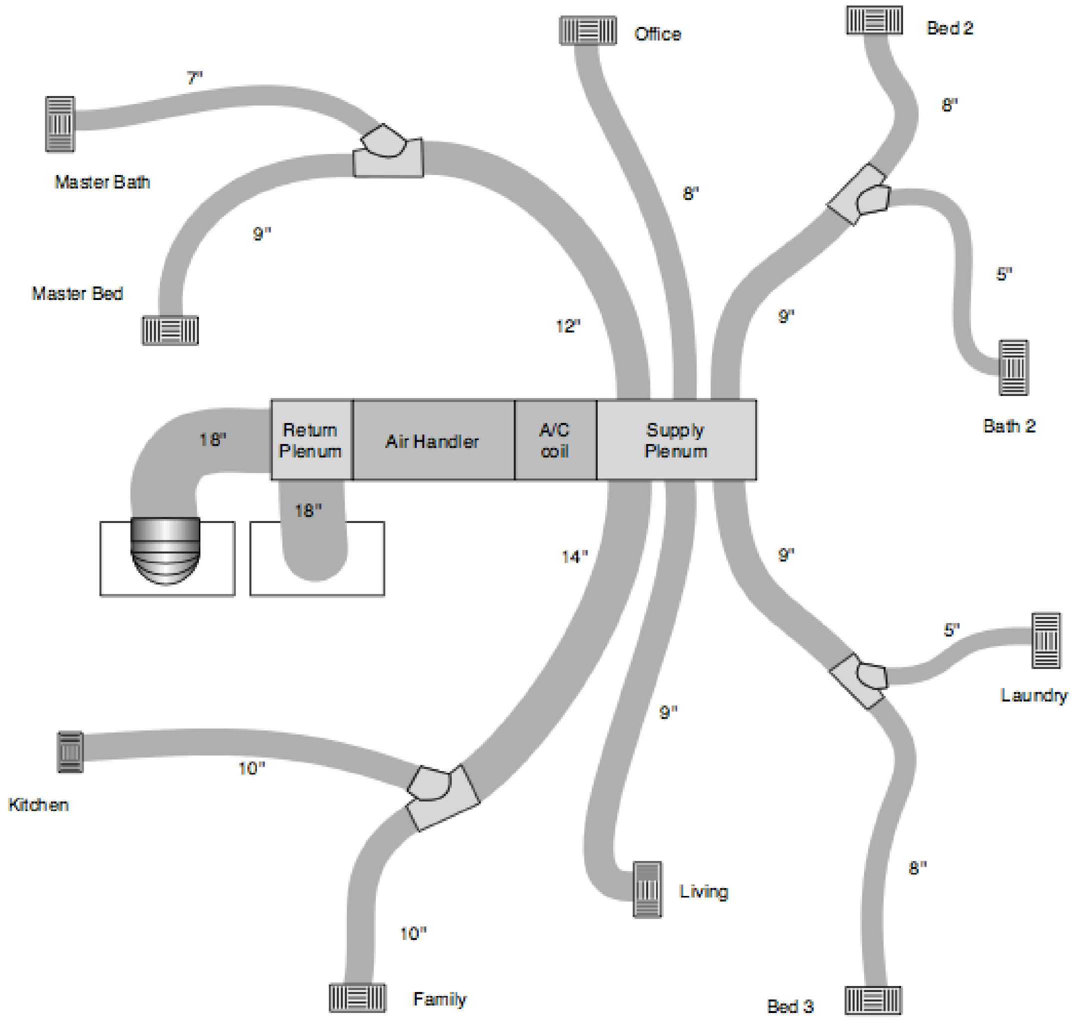
Figure 4-6: Return Duct Design Option 1



Source: California Energy Commission

Because the builder has specified a low-end air handler, he or she is concerned that the system may not pass the mandatory diagnostic testing requirement for airflow and fan efficacy. The builder requests that the system be redesigned with the return ducts sized according to Table 150.0-C. The following layout is the redesigned system (Figure 4-7). The only change is that the system now has two 18-inch return ducts and two filter grilles sized according to Table 150.0-C, rather than a 20-inch return duct and a filter grille. Because one of the return ducts had more than one 90-degree bend, one of the bends is required to be a metal elbow (to be insulated). The two return filters are 20-inch x 30-inch each and are rated by the manufacturer to show that they have a pressure drop of less than 125 Pa (0.1" w.c.) at 800 CFM each.

Figure 4-7: Return Duct Design Option 2



Source: California Energy Commission

Table 4-9: Return Duct Sizing for Single Return Duct Systems

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

Source: Table 150-B of the Energy Code

**Table 4-10: Return Duct Sizing for Multiple Return Duct Systems
Two Returns**

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

Source: Table 150-C of the Energy Code

4.4.1.18 **Zonally Controlled Central Forced-Air Cooling Systems**

The primary purpose of zoning ducted air conditioners, heat pumps, and furnaces is to improve comfort. Increased comfort is attained by having the capacity of the HVAC system (cooling or heating delivered) follow the shift in load as it changes across the house. For example, it is common for two-story homes to be too hot on the second floor in summer and winter. Zoning has the capability of diverting more of the HVAC capacity to the area with the increased load. Another common example is a home with a significant area of west-facing and east-facing windows. In the summer, the east rooms overheat in the morning, and the west rooms overheat in the afternoon.

Providing the most agreeable temperature to all the zones is comfortable, but it carries with it the possibility of increased energy consumption. Since the most common home is single-zoned and has only one thermostat placed near the center of the house, temperatures in the rooms distant from that thermostat will vary, sometimes significantly. If zoning is added, the more distant rooms may be conditioned to a more comfortable temperature. This increased conditioning requires more energy. When designed correctly, zoning allows only the zones that need conditioning to be conditioned, thus potentially saving energy.

It is common for single-speed zonally controlled central forced-air cooling systems to produce lower total system airflow through the returns when fewer than all zones are calling for conditioning. The reduced airflow lowers the sensible efficiency of single-stage heating or cooling equipment. Two primary causes of lower airflow in multiple zone-dampered systems are:

1. Restriction of some system supply ducts by closing zoning dampers in zones that do not need additional cooling, while other zones do need cooling.
2. Recirculation of already-cooled air from the supply plenum directly back to the return plenum without first delivering the cooled air to the conditioned space by use of a bypass duct.

To prevent the lower efficiency that results from reduced system airflow or from recirculated bypass duct airflow, single-speed compressor zonally controlled central cooling systems must demonstrate they simultaneously meet mandatory fan efficacy and airflow requirements in all zonal control modes, which is possible only with a superior duct system design that does not restrict the system total airflow when fewer than all zones are calling for conditioning, and does not use a bypass duct. § 150.1(c)13 prohibits use of bypass ducts prescriptively, but bypass ducts may be used if the efficiency penalty due to the reduced airflow through the return grille is modeled as described in Section 4.4.1.19 below.

Multispeed or variable-speed compressor-type zonally controlled cooling systems are not required to verify mandatory fan efficacy and airflow requirements in all zonal control modes; however, these systems must be HERS-verified to confirm they meet the mandatory fan efficacy and airflow requirements with the compressor on high speed and all zones calling for cooling.

4.4.1.19 Zonally Controlled Cooling Systems – Airflow and Fan Efficacy Requirements

Recent studies have shown that zonally controlled cooling systems with or without bypass dampers (multiple zones served by a single air handler with motorized zone dampers), usually do not meet the airflow and fan efficacy (AF/FE) requirements when fewer than all zones are calling. The energy penalty that results from this is greater than the benefit of having zonal control; therefore, zonal control is no longer simply assumed to be a "better-than-minimum" condition, and there are special compliance requirements for these systems.

Zonal control accomplished by using multiple single-zone systems is not subject to the requirements specified in Energy Code Section 150.0(m)13C.

Two-speed and variable-speed compressors are considered multispeed. Multispeed compressors allow the system capacity to vary to match reduced cooling loads more closely when fewer than all zones call for cooling. Therefore, an exception to Section 150.0(m)13C gives multispeed compressor systems special consideration when used in zoned systems and these systems are not required to verify performance in all zonal control modes. Instead, the airflow and fan efficacy testing is required to be performed only at the highest speed when all zones call for cooling. Zoned systems with single-speed compressors must be tested and pass in all operating modes.

An exception to Section 150.0(m)13C allows single-speed compressor systems to comply with HERS verification of the *mandatory* AF/FE requirements only at the highest fan speed when all zones call for cooling. The exception applies provided the system also uses the *performance* compliance approach and complies with HERS verification of the requirements for AF/FE in all zonal control modes specified by the software user input for minimum airflow rate when fewer than all zones call for cooling. Single-speed compressor systems, with or without bypass dampers, are less likely to meet the *mandatory* AF/FE requirements in Section 150.0(m)13C with fewer than all zones calling for cooling. Therefore, the performance compliance software calculates a penalty for the reduced airflow (specified by the user) during operation when fewer than all zones call for cooling. Other energy features for the building must offset this penalty for reduced airflow when fewer than all zones call for cooling. In the performance compliance software, if the system is modeled as a zoned system with a single-speed compressor, the minimum allowable airflow drops to 150 CFM/ton. But because the standard house is assumed to have an airflow of 350 CFM/ton, there is a penalty imposed on the compliance calculation unless the designer specifies a value of 350 or higher. Entering a value between 150 and 350 can lessen the penalty resulting from the minimum allowed value of 150 CFM/ton.

It is extremely important that the energy consultant model airflow and fan efficacy values that are reasonable and can be verified by a HERS Rater; otherwise, the system will fail HERS verification, and the compliance calculations will have to be revised to specify user input equivalent to the actual values that could pass HERS verification. Energy consultants should coordinate with the HVAC designer before registering the certificate of compliance.

Bypass dampers may be installed only if the certificate of compliance specifically states that the system was modeled as having a bypass damper.

Example:

1. A home is to be built with a heat pump connected to a zoned system (two zones) with a single-speed compressor and bypass ducts. From experience, the HVAC contractor knows that it will not be possible to meet the 350 CFM/ton requirement, but 275 CFM/ton is likely.
2. The energy consultant models the system in the proposed house with 275 CFM/ton and 0.45 W/CFM (value for a gas furnace). Because the standard house assumes 350 CFM/ton, there is an energy penalty that must be made up by including other better-than-standard features in the performance compliance input, but the penalty is not as large as it would be at a value of 150 CFM/ton.

3. 275 CFM/ton must be tested in all control modes.
4. The home is built, and the system is verified by a rater and passes at 287 CFM/ton with one zone calling, 298 CFM/ton with the other zone calling, and 372 CFM/ton with both zones calling. The system is also measured with all zones calling to confirm it meets or exceeds 350 CFM/ton.
5. If this same home was to be built with a multispeed compressor, it would be tested only with all zones calling, but the target airflow would be no less than the mandatory 350 CFM/ton. Compliance credit can be achieved by modeling airflows greater than the mandatory CFM/ton and/or fan efficacies less than the mandatory watts/CFM.

Table 4-11: Single-Zone Ducted Central Forced-Air Cooling Systems Single-Zone Ducted Cooling Systems (Single Zone Off a Single Air Handler)

Compressor Type	Mandatory Requirements for Airflow and Fan Efficacy	Performance Compliance Option Proposed System Defaults	Performance Compliance Option Modeled Airflow and Fan Efficacy
Single-Speed, Multispeed, or Variable-Speed: Testing Performed on Highest Speed only	Airflow: • ≥ 350 CFM/ton if not a small duct high velocity type • ≥ 250 CFM/ton if is a small duct high velocity (SDHV) type Fan Efficacy: • ≤ 0.45 W/CFM for gas furnaces (GF) • ≤ 0.58 W/CFM for air handlers that are not gas furnaces (non-GF) • ≤ 0.62 W/CFM for SDHV type Exception: Airflow and Fan Efficacy HERS verification not required if return system meets Tables 150.0-B or C. However, HERS verification that return duct installation meets Tables 150.0-B or C is required	Airflow: • 350 CFM/ton (non-SDHV) • 250 CFM/ton (SDHV) Fan Efficacy: • 0.45 W/CFM (GF) • 0.58 W/CFM (non-GF) • 0.62 W/CFM (SDHV)	Airflow: • ≥350 CFM/ton (non-SDHV) • ≥250 CFM/ton (SDHV) and/or Fan Efficacy: • ≤0.45 W/CFM (GF) • ≤0.58 W/CFM (non GF) • ≤0.62 W/CFM (SDHV)

Source: California Energy Commission

Table 4-12: Zonally Controlled Central Forced-Air Cooling Systems Zoned Ducted Cooling Systems (Multiple Zones off a Single Air Handler)

Compressor Type	Mandatory Requirements for Airflow and Fan Efficacy [1]	Performance Compliance [2] Proposed System Defaults [3]	Zoned Ducted Cooling Systems (Multiple Zones off a Single Air Handler) Modeled Airflow and Fan Efficacy
Single Speed	Airflow: ≥ 350 CFM/ton (non-SDHV) Fan Efficacy: ≤ 0.45 W/CFM (GF) ≤ 0.58 W/CFM (non-GF) For Prescriptive Compliance Method, verification is mandatory in all zonal control modes. When Performance Compliance Method is used, verification of the *mandatory* requirements are performed only at highest capacity operation with all zones calling, and the additional performance targets for W/CFM and CFM/ton specified by the user in the performance compliance software are required to be verified in all zonal control modes.	Airflow: 150 CFM/ton Fan Efficacy: 0.45 W/CFM (GF) 0.58 W/CFM (non-GF)	Airflow: ≥ 150 CFM/ton and/or Fan Efficacy: ≤ 0.45 W/CFM (GF) ≤ 0.58 W/CFM (non GF) Verification of modeled values required in all zonal control modes. The *mandatory* requirements for W/cfm and CFM/ton must also be verified at highest capacity operation with all zones calling
Multispeed or Variable Speed	Airflow: ≥ 350 CFM/ton Fan Efficacy: ≤ 0.45 W/CFM (GF) ≤ 0.58 W/CFM (non-GF) Verification is required at highest capacity operation and with all zones calling	Airflow: 350 CFM/ton Fan Efficacy: 0.45 W/CFM (GF) 0.58 W/CFM (non-GF)	Airflow ≥ 350 CFM/ton and/or Fan Efficacy: ≤ 0.45 W/CFM (GF) ≤ 0.58 W/CFM (non-GF) Verification of modeled values required at highest capacity operation with all zones calling

1 For the Prescriptive Compliance Method, all Mandatory Requirements for airflow and fan efficacy must be met and use of a bypass duct is not allowed.
2 For the Performance Compliance Method, all Mandatory Requirements for airflow and fan efficacy must be met and use of a bypass duct may be specified in the compliance software input for the zoned system type. Additionally, the requirements specified for performance compliance must be met
3 The Standard Design value for all cases is 350 CFM/ton (all system types); 0.45 W/CFM (GF); 0.58 W/CFM (non-GF).
Source: California Energy Commission

4.4.1.20 **Indoor Air Quality and Mechanical Ventilation**

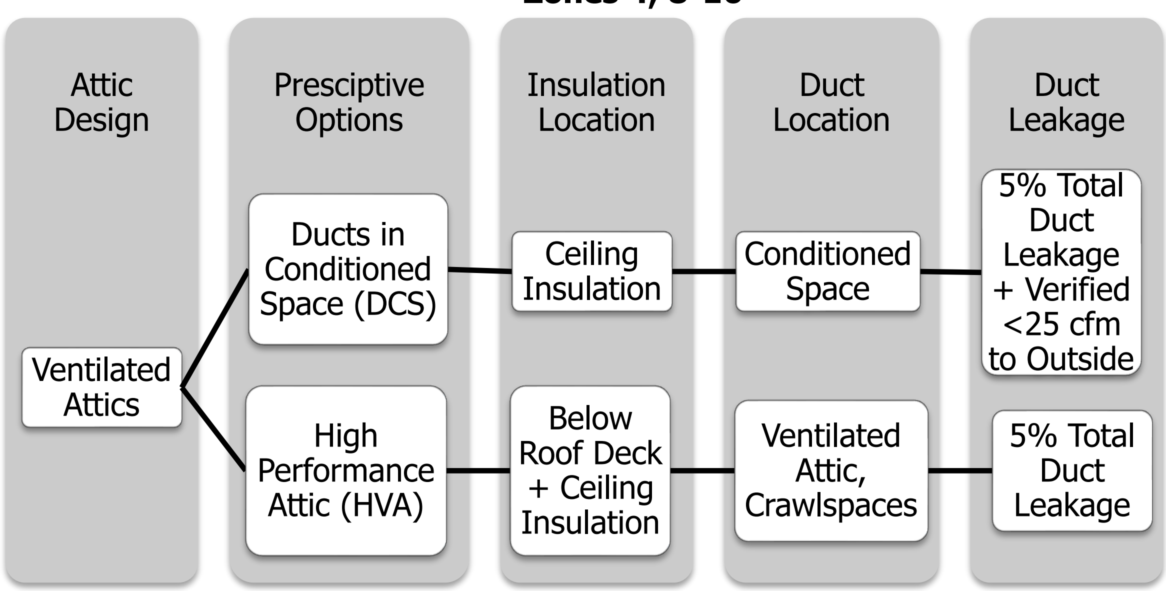
§150.0(o)

See Section 4.6 of this chapter for details.

4.4.2 Prescriptive Requirements for Air Distribution System Ducts, Plenums, and Fans

The 2022 Energy Code is designed to offer flexibility to the builders and designers of residential newly constructed buildings in achieving the intended energy efficiency targets. As such, several options are offered for achieving one of two design objectives related to improving energy performance of homes built with ventilated attics in Climate Zones 4, and 8-16, as shown in Figure 4-8.

Figure 4-8: Ventilated Attic Prescriptive Compliance Choices in Climate Zones 4, 8-16



Source: California Energy Commission

A high-performance attic (HPA) implements measures that minimize temperature difference between the attic space and the conditioned air being transported through ductwork in the attic. The package consists of insulation below the roof in addition to insulation at the ceiling, R-8 ducts, and 5 percent total duct leakage of the nominal air handler airflow. These requirements and approaches to meet the requirements are explained in Section 3.5.3 of this manual.

Ducts in conditioned space (DCS) is achieved when the ducts and air handler(s) are within the thermal envelope and air barrier of the building. This DCS option requires field verification to meet the prescriptive requirement. The following sections describe the duct related requirements for DCS.

4.4.2.1 **Duct Location**

§150.1(c)9

A typical residential construction practice in California is to place ducts and associated air handling equipment in the attic. When meeting the prescriptive requirements, there are two options for where this equipment can be located:

1. If meeting the prescriptive requirements for a high-performance attic (HPA) as explained above, the duct system and air handlers of HVAC systems are allowed to be located in the attic.
2. If meeting the prescriptive requirements for ducts in conditioned space (DCS) as explained above, the duct system and air handlers of HVAC systems must be located in conditioned space, which includes a joist cavity between conditioned floors, or in a sealed cavity below attic insulation.

If the DCS requirements are to be met, additional requirements apply:

1. Air handlers containing a combustion component should be direct-vent (sealed combustion chambers) and shall not use air from conditioned space as combustion air. Other types of combustion heating systems are possible given the system installer adheres to the combustion air requirements found in Chapter 7 of the California Mechanical Code.
2. Duct location needs to be verified through a visual inspection per RA 3.1.4.1.3.
3. Duct leakage to outside needs to be confirmed by field verification and diagnostic testing in accordance with RA3.1.4.3.8.
4. Ducts are insulated to a level required in Table 150.1-A.

Figure 4-9: Checklist for Prescriptive Requirement – Option C DCS (§ 150.1(c)1)

§150.1(c)1 Option C
☐ Vented attic ☐ R30 or R38 ceiling insulation (climate zone specific) ☐ R6 ducts (climate zone specific) ☐ Radiant Barrier ☐ Verified ducts in conditioned space

Source: California Energy Commission

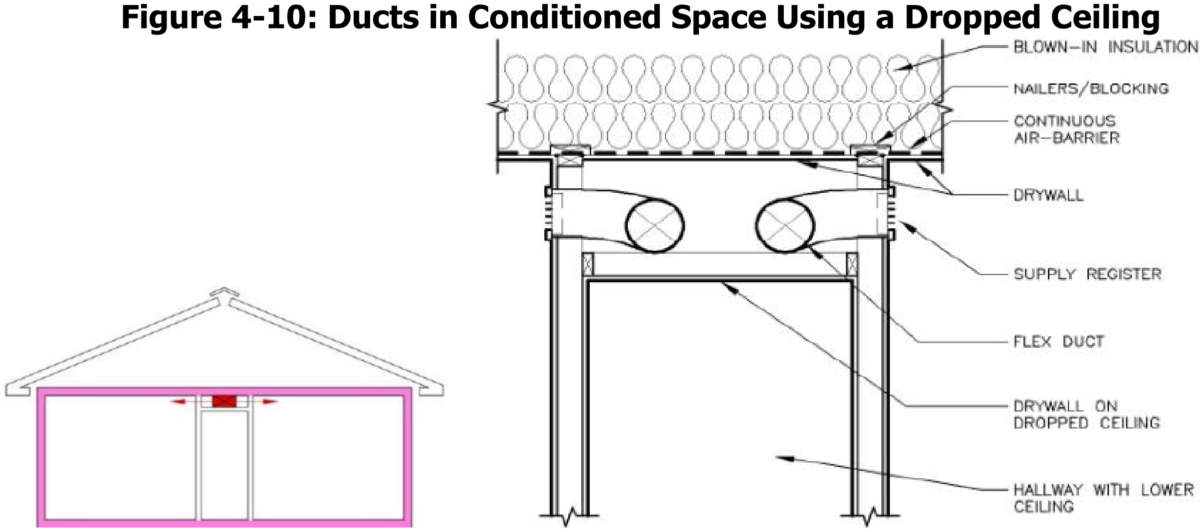
The checklist in Figure 4-9 lists all the requirements for complying prescriptively using DCS strategy. It is not enough to locate ducts in conditioned space, the insulation must also meet prescriptive values. If a building is not able to meet all of the requirements in this checklist, it must use the performance approach or Option B from Section150.1(c).1. Refer to Section 3.5 of the *Residential Compliance Manual* for more information on these options.

There are several methods of achieving the goal of DCS. The basic information of the strategies, related benefits, challenges, and potential solutions to those challenges are outlined below.

A. Vented Attic, Dropped Ceiling

This strategy places ducts within the thermal envelope without affecting the standard construction of the attic space. This strategy works well in linear plans where rooms branch out from a central hallway with the dropped ceiling.

Figure 4-10: Ducts in Conditioned Space Using a Dropped Ceiling



Source: www.ductsinside.org/

Figure 4-11: Ducts Routed Through a Dropped Ceiling

Source: BIRA Energy

Benefits of selecting this strategy include the following:

1. Attic ventilation remains the same as standard practice.
2. This strategy does not affect attic assembly or insulation; there are no changes to truss design.
3. The strategy works with simple and linear designs with rooms off the main hallway but can work with more complex plans.
4. The strategy can be integrated into architectural accents.

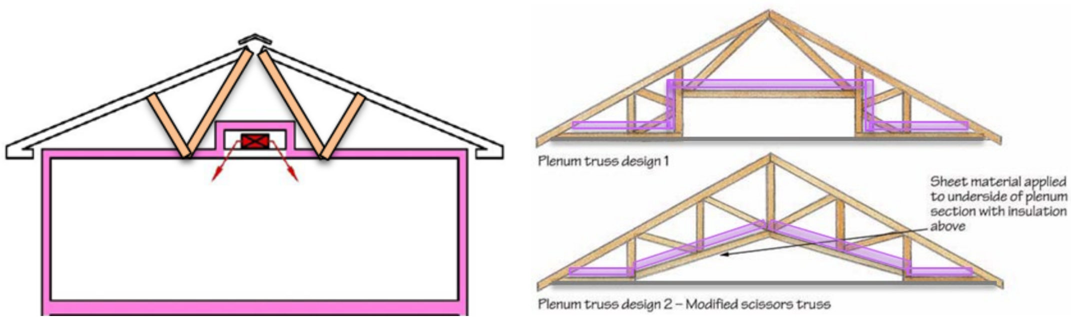
There are challenges associated with this strategy as outlined below, but they can be overcome with good design and installation practices.

1. Need to address air handler location – there may not be sufficient space (height, width) in the dropped ceiling to accommodate the air handler. In this case, the air handler would need to be installed in a separate closet within the thermal boundary of the home.
2. Coordination needed between trades – moving the ducts and air handlers and the need to isolate and seal the dropped ceiling would necessitate coordination between different trades (HVAC installer, drywall, framing, and electrical contractors) to ensure thermal integrity of the dropped ceiling.

B. Vented Attic, Conditioned Plenum Space

A conditioned plenum is created when a space within the attic is sealed off and insulated from the rest of the attic. To use this design option, a builder can specify two types of modified trusses: either scissor trusses or a truss configuration that creates a plenum box. Another way to create a conditioned plenum does not involve modified trusses, but rather to create the space by framing, sealing and insulating the plenum space above the ceiling plane.

Figure 4-12: Plenum Truss Design Example



Source: www.ductsinside.org

Similar to a dropped ceiling, this design is easier with a linear plan that allows the conditioned space in the attic to cover a central "spine" throughout the floor plan that can reach all spaces in need of supply registers. This design option allows for ducts in the attic space and does not affect aesthetics of the home.

Benefits for selecting the strategy:

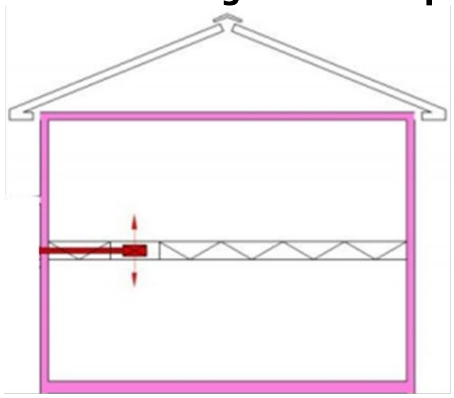
1. Vented attic space, same as standard construction
2. Aesthetically less disruptive than dropped ceiling
3. Works with simple and linear designs with rooms off main hallway

There are challenges associated with this strategy as outlined below, but they can be overcome with good design and installation practices.

1. Need to seal the plenum from attic – as with most of the DCS strategies, it is important that care and attention are provided to air-sealing the plenum space from the attic space.
2. May require modified trusses, in which case manufacturers need to be provided with specifications that can be met.

C. Vented Attic, Open Web Floor Truss

Figure 4-13: Open Web Floor Truss Example

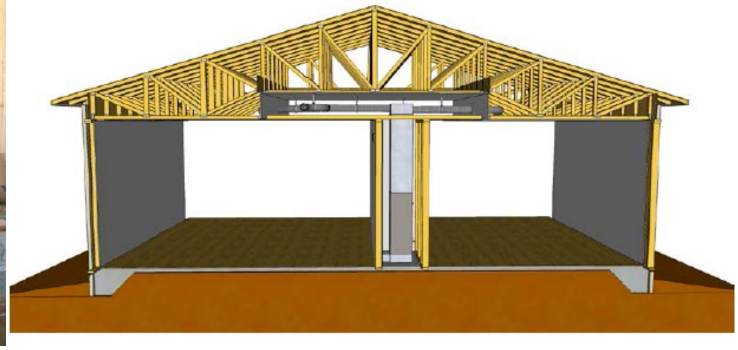



Source: www.ductsinside.org

This option can work for two-story construction and makes use of the space between floors to house ducts. Open-web floor trusses are uncommon in residential construction but are available from several floor joist manufacturers. The depth of floor joists may need to be increased to create a large enough space for supply ducts. The increased joist depth may affect interior details and wall heights. Because of the size constraints from using the floor truss, there is a need to preserve construction quality and prevent undesirable construction practices such as forcing 14-inch ducts into 12-inch joist spaces. Another option is to use alternatives to wire helix plastic flexible ducts that take up less space. Coordination between the architect and the HVAC engineer and/or contractor is needed to ensure that ducts are correctly sized and truss depths are appropriately selected. Using the area between floors to house ducts prescribes that supply registers be at the floor or lower wall in the second story and the ceiling or upper wall in the first story.

D. Mechanical Closet and Placement of Sealed Combustion Furnace

Figure 4-14: Mechanical Closet Placement Example



Source: IBACOS 2013

As part of the requirement for moving the duct system and air handler into a conditioned space, construction of a mechanical closet is necessary with some DCS strategies. For example, if ducts are placed in dropped ceiling space but there is not enough room to accommodate the air handler in that space, the mechanical closet could be placed inside the thermal boundary of the building. A conditioned plenum could provide enough space for ducts and equipment; therefore, a mechanical closet may not be needed.

One potential location for a mechanical closet is within the garage or other spaces normally not conditioned. In such instances, the air handler must be located within a specially built closet that is insulated to the same level as the exterior of the house so that the closet is not a part of the unconditioned space. Combustion air for the air handler must be taken directly from the outside through a direct vent to the outside.

4.4.2.2 **Duct Insulation**

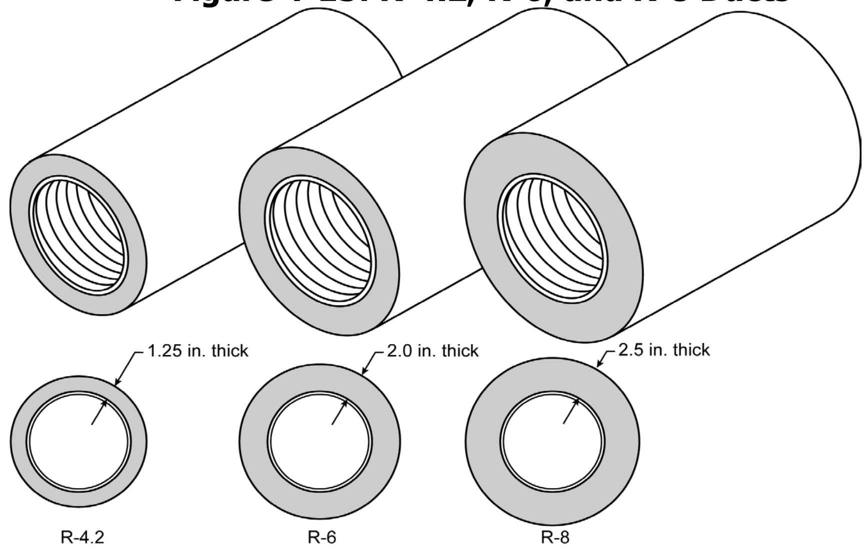
§150.1(c)9

All ducts shall be insulated to a minimum installed level as specified by Table 150.1-A, which requires either R-6 or R-8 depending on the climate zone and whether Option B or Option C is chosen for roof/ceiling Insulation. The prescriptive duct insulation requirement can be opted out by using the performance approach and trading off the energy penalty against some other features. The mandatory minimums for duct insulation are discussed in Section 4.4.1.1.

4.4.2.3 Central Fan-Integrated (CFI) Ventilation

There is a prescriptive requirement for ducted systems that have cooling and a CFI ventilation system to have the fan efficacy verified. This can be opted out using the performance approach.

Figure 4-15: R-4.2, R-6, and R-8 Ducts



Source: California Energy Commission

4.4.3 Compliance Options for Air Distribution System Ducts, Plenums, and Fans

The Energy Code provides credit for several compliance options related to duct design and construction.

4.4.3.1 System Airflow and Fan Efficacy

A performance compliance credit is available for HERS verification of the installation of a high-efficiency air handler and duct system that performs better than the applicable mandatory requirements for minimum system airflow (CFM/ton) and maximum system fan efficacy (W/CFM). The performance compliance method allows the user's proposed airflow and fan efficacy to be entered into the program, and credit will be earned if the airflow is greater than the minimum required, and fan efficacy is lower than the default. After installation, the contractor must test the actual fan efficacy of each system using the procedure in RA3.3 and show that it is equal or less than what was proposed in the compliance software analysis.

The fan efficacy and airflow must also be verified by a HERS Rater.

4.4.3.2 **Duct Location**

There are three ways to achieve credit for favorable duct location when using the performance compliance method:

1. Credit is available if no more than 12 linear feet (LF) of duct are outside the conditioned space and the user chooses the high-performance attic (HPA) as explained in Section 3.5.3. This total must include the air handler and plenum lengths. This credit results in a reduction of duct surface area in the computer compliance programs. This option requires certification by the installer and field verification by a HERS Rater.
2. The second alternative applies when 100 percent of the ducts are located in conditioned space and the user chooses high-performance attic (HPA) as explained in Section 3.5.3. This credit results in eliminating the conduction losses associated with the return and supply ducts; however, leakage rates still apply. This option requires field verification of the duct system by means of a visual inspection by a HERS Rater.
3. Credit for a high-efficiency duct design is available. This option requires field verification of the duct design layout drawing(s) by a HERS rater. Verified duct design, when required, will be included in the HERS Required Verification list on the certificate of compliance (CF1R). This approach provides energy savings credits for having shorter duct runs, fewer ducts, ducts in beneficial locations of ductwork, and other benefits of a well-designed duct system. This credit is available regardless of whether a high-performance attic (HPA) or ducts in conditioned space (DCS) option is chosen, as explained in Section 3.5.3.

There is no compliance credit provided for choosing a heating system such as a wall furnace, floor heater, or room heater, even though those systems typically have no ducts. For these cases, the standard design in the compliance calculation uses the same type of system and has no ducts. However, other systems, such as hydronic heating systems with a central heater or boiler and multiple terminal units, are considered central HVAC systems that are compared to a ducted system in the standard design. If the hydronic system has no ducts, there may be a significant energy credit through the performance method.

4.4.3.3 **Duct Insulation**

Performance credit is also available if all the ducts are insulated to a level higher than required by the prescriptive package. If ducts with multiple R-values are installed, the lowest duct R-value must be used for the entire duct system. However, the air handler, plenum, connectors, and boots can be insulated to the mandatory minimum R-value.

As an alternative when there is a mix of duct insulation R-values, credit is available through the method described in the next section.

4.4.3.4 Diagnostic Duct Location, Surface Area, and R-value

This compliance option allows the designer to take credit for a high-efficiency duct design that incorporates duct system features that may not meet the criteria for the duct location and/or insulation compliance options described above. This method requires that the designer must enter the design characteristics of all ducts that are not within the conditioned space. The information required for the input to the compliance software includes the length, diameter, insulation R-value, and location of all ducts. This method will result in a credit if the proposed duct system is better than the standard design.

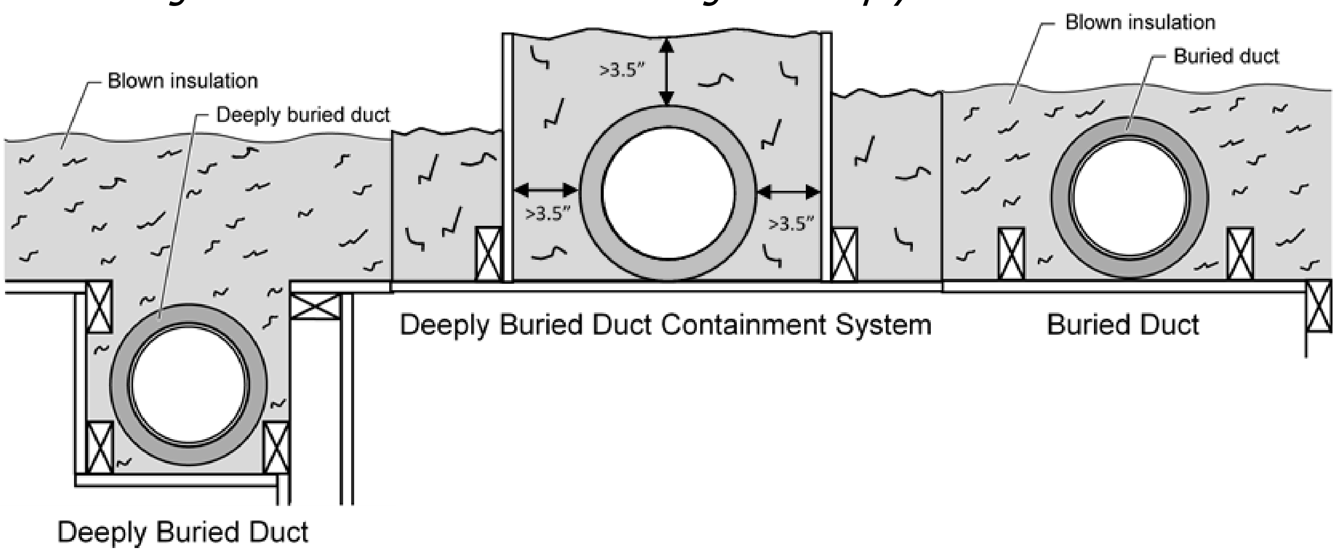
To claim this credit, the duct system design must be documented on plans that are submitted to the enforcement agency and posted at the construction site for use by the installers, the enforcement agency field inspector, and the HERS Rater. The duct system must be installed in accordance with the approved duct system plans, and the duct system installation must be certified by the installer on the CF2R form and verified by a HERS Rater on the CF3R. Details of this compliance option are described in the *Residential Alternative Calculation Method (ACM) Reference Manual*, and verification procedures are described in RA3.1.

4.4.3.5 Buried and Deeply Buried Ducts

This compliance option allows credit for the special case of ducts that are buried by blown attic insulation. For ducts that are within 3.5 inches of the ceiling, the effective R-value is calculated based on the duct size and R-value, depth of ceiling insulation, and type of blown insulation (fiberglass or cellulose) as shown in Tables 16, 17, and 18 in the *Residential ACM Reference Manual*. The user-entered duct system can be any combination of unburied, buried, and deeply buried duct runs. The software will determine the overall duct system effective R-value by weight averaging the user entered duct system.

Ducts must have a minimum insulation level prior to burial, R-6 for new ducts and R-4.2 for existing. This case is referred to as "Buried Ducts on the Ceiling." Additional credit is available for "Deeply Buried Ducts," which, in addition to the requirements for "Buried Ducts on the Ceiling," are ducts completely covered by at least 3.5 inches of attic insulation. Deeply buried ducts must be enclosed in a lowered portion of the ceiling or buried by use of a durable containment system (e.g. gypsum board, plywood, etc.), or buried under a uniform level of insulation that achieves the 3.5-inch burial level.

Figure 4-16: Buried Ducts on Ceiling and Deeply Buried Ducts



Source: California Energy Commission

Deeply buried containment systems must be installed such that the walls of the system are at least 7 inches wider than the duct diameter (3.5-inch clearance on each side of duct) extend at least 3.5 inches above the duct outer jacket, and the containment area surrounding the duct must be completely filled with blown insulation.

In addition to the above requirements, the attic area containing the buried or deeply buried ducts must have insulation with uniform depth (not mounded over the duct), level ceiling, and at least 6 inches of space between the duct outer jacket and the roof sheathing. Insulation raised by a containment system is an exception to the uniform depth requirement.

To take credit for buried ducts, the system must meet the verified duct system design criteria described above and meet the requirements for Quality Insulation Installation (QII) described in Reference Appendices RA3.5.

4.4.3.6 **Ducts in Attics with Radiant Barriers**

Installation of a radiant barrier in the attic increases the duct efficiency by lowering attic summer temperatures. Compliance credit for radiant barriers is available in cases where the prescriptive standard does not require radiant barriers and requires listing of the radiant barrier in the special features and modeling assumptions to aid the local enforcement agency's inspections. Compliance credit for a radiant barrier does not require HERS Rater verification.

Radiant barrier must be installed with the appropriate clearance and/or air gap as specified by the manufacturer. Insulation products installed in direct contact with the radiant barrier may negatively affect the performance of the radiant barrier. When a credit is taken for radiant barrier, an improperly installed radiant barrier assembly will require revision of the CF1R compliance document to remove the energy compliance credit taken.

4.4.4 Duct Installation Standards

The mandatory duct construction measures referenced in Section 4.4.1 above state that duct installations must comply with the California Mechanical Code Sections 601, 602, 603, 604, 605, and the applicable requirements of the Energy Code. Some highlights of these requirements are listed in this section, along with some guidance for recommended quality construction practice.

4.4.4.1 **Tapes and Clamps**

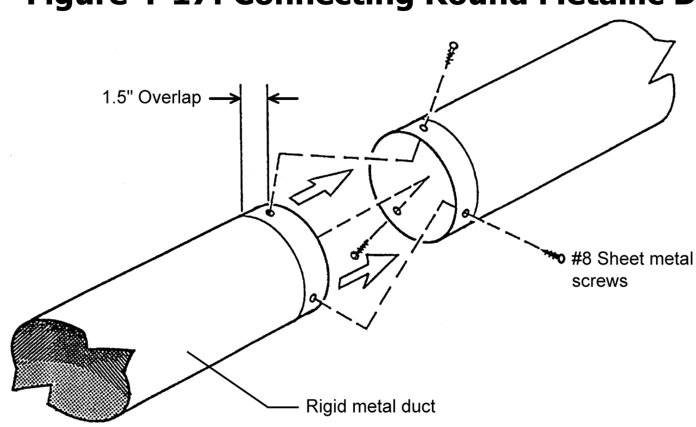
All tapes and clamps must meet the requirements of §150.0(m).

Cloth-backed, rubber-adhesive tapes must be used only in combination with mastic and draw bands or have on the backing the phrase "CEC approved," a drawing of a fitting to plenum joint in a red circle with a slash through it (the international symbol of prohibition), and a statement that it cannot be used to seal fittings to plenums and junction box joints.

4.4.4.2 **All Joints Must Be Mechanically Fastened**

For residential round metal ducts, installers must overlap the joint by at least 1½ inches and use three sheet metal screws equally spaced around the joint. (See Figure 4-17.)

Figure 4-17: Connecting Round Metallic Ducts

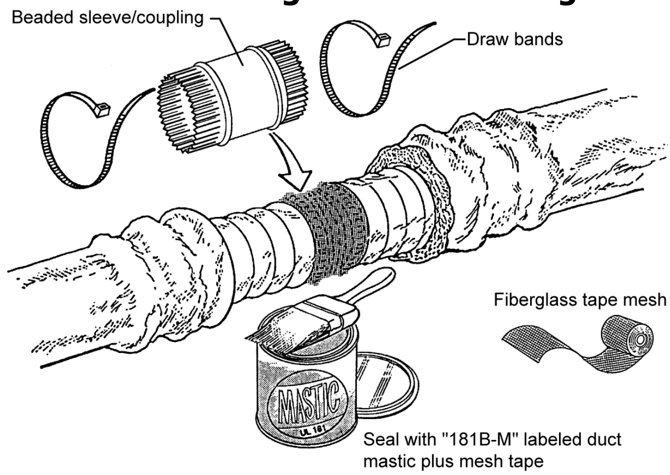


Source: Richard Heath & Associates/Pacific Gas and Electric Company

For round, nonmetallic flex ducts, installers must insert the core over the metal collar or fitting by at least 1 inch. This connection may be completed with either mesh, mastic and a clamp, or two wraps of tape and a clamp.

For a mesh and mastic connection, the installer must first tighten the clamp over the overlapping section of the core, apply a coat of mastic covering both the metal collar and the core by at least 1 inch, and then firmly press the fiber mesh into the mastic and cover with a second coat of mastic over the fiber mesh. (See Figure 4-18.)

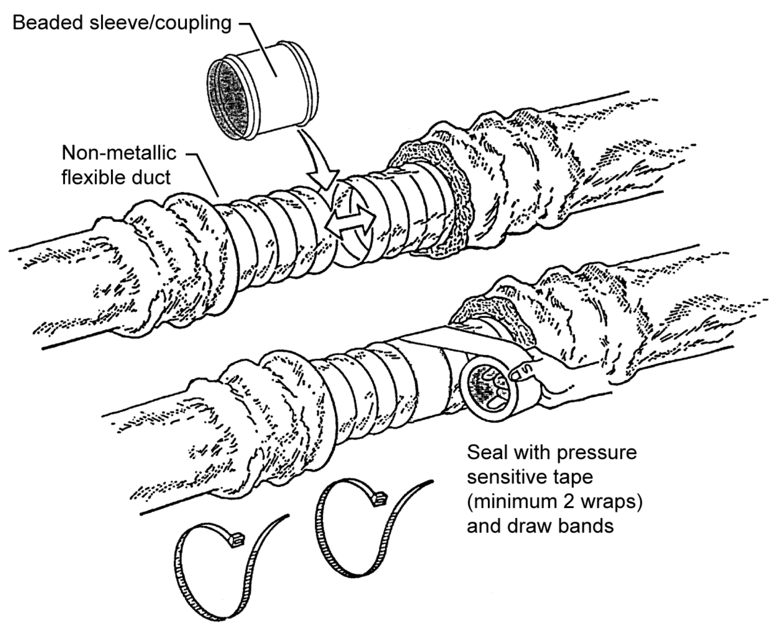
Figure 4-18: Connecting Flex Ducts Using Mastic and Mesh



Source: Richard Heath & Associates/Pacific Gas and Electric Company

For the tape connection first apply at least two wraps of approved tape covering both the core and the metal collar by at least 1 inch; then tighten the clamp over the overlapping section of the core. (See Figure 4-19.)

Figure 4-19: Connecting Flex Ducts Using Tape and Clamps



Source: Richard Heath & Associates/Pacific Gas and Electric Company

4.4.4.3 **All Joints Must Be Made Airtight**

§150(m)

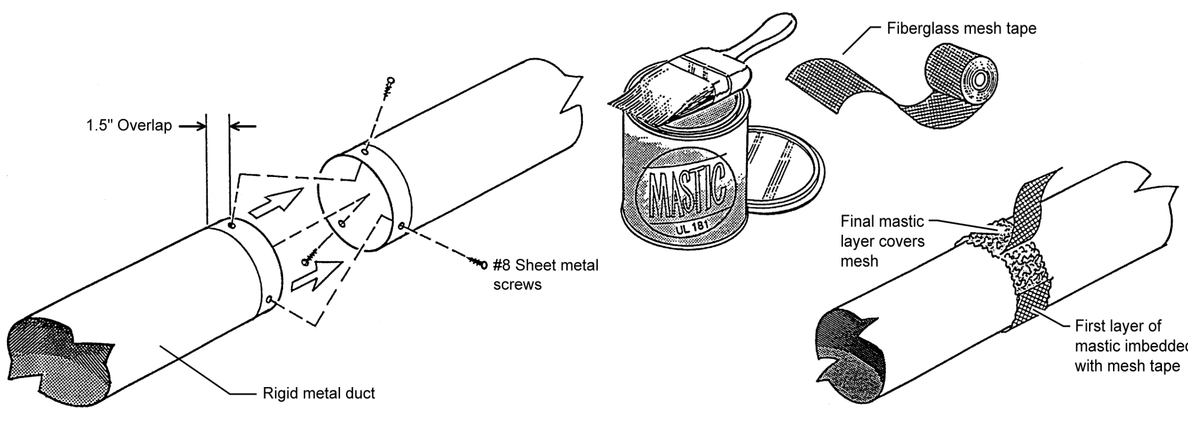
Seal all joints with either mastic, tape, aerosol sealant, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A, UL 181B, or UL 723. Duct systems shall not use cloth-backed, rubber-adhesive duct tape regardless of UL designation, unless it is installed in combination with mastic and clamps. The Energy Commission has approved three cloth-backed duct tapes with special butyl synthetic adhesives rather than rubber adhesive to seal flex duct to fittings. These tapes are:

1. Polyken® 558CA, manufactured by Berry Plastics Tapes and Coatings Division.
2. Nashua® 558CA, manufactured by Berry Plastics Tapes and Coatings Division.
3. Shurtape® PC 858CA, manufactured by Shurtape Technologies, Inc.

These tapes passed Lawrence Berkeley Laboratory tests comparable to those that cloth-backed, rubber-adhesive duct tapes failed. (The LBNL test procedure has been adopted by the American Society of Testing and Materials as ASTM E2342.) These tapes are allowed to be used to seal flex duct to fittings without being in combination with mastic. These tapes cannot be used to seal other duct system joints, such as the attachment of fittings to plenums and junction boxes. These tapes have on the backing a drawing of a fitting to plenum joint in a red circle with a slash through it (the international symbol of prohibition) to illustrate where they are not allowed to be used, installation instructions in the packing boxes that explain how to install them on duct core to fittings, and a statement that the tapes cannot be used to seal fitting to plenum and junction box joints.

Mastic and mesh should be used where round or oval ducts join flat or round plenums. (See Figure 4-20.)

Figure 4-20: Sealing Metallic Ducts with Mastic and Mesh



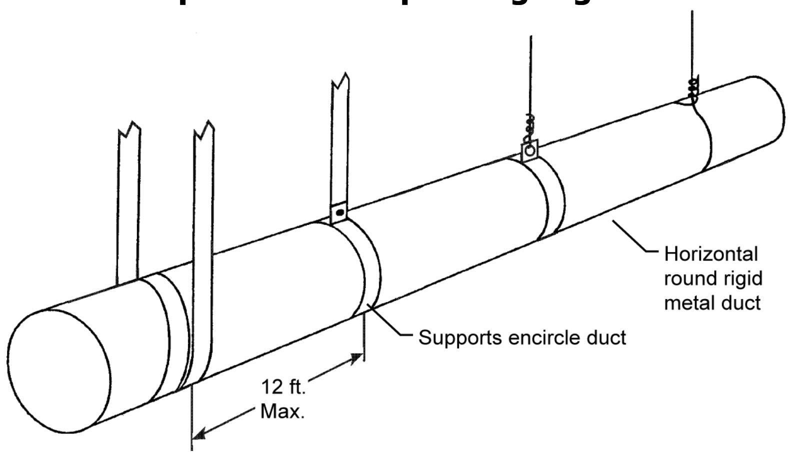
Source: Richard Heath & Associates/Pacific Gas and Electric Company

All ducts must be adequately supported.

Rigid ducts and flex ducts may be supported on rigid building materials between ceiling joists or on ceiling joists.

For rigid round metal ducts that are suspended from above, hangers must occur 12 ft. apart or less. (See Figure 4-21)

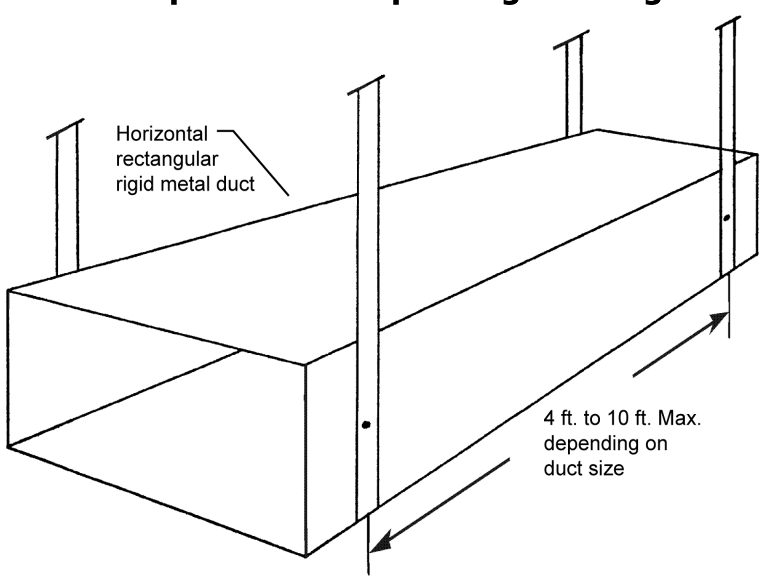
Figure 4-21: Options for Suspending Rigid Round Metal Ducts



Source: Richard Heath & Associates/Pacific Gas and Electric Company

For rectangular metal ducts that are suspended from above, hangers must occur at a minimum of 4 ft. to 10 ft., depending on the size of the ducts. (See Table 6-2A in Appendix A of the California Mechanical Code and refer to Figure 4-22.)

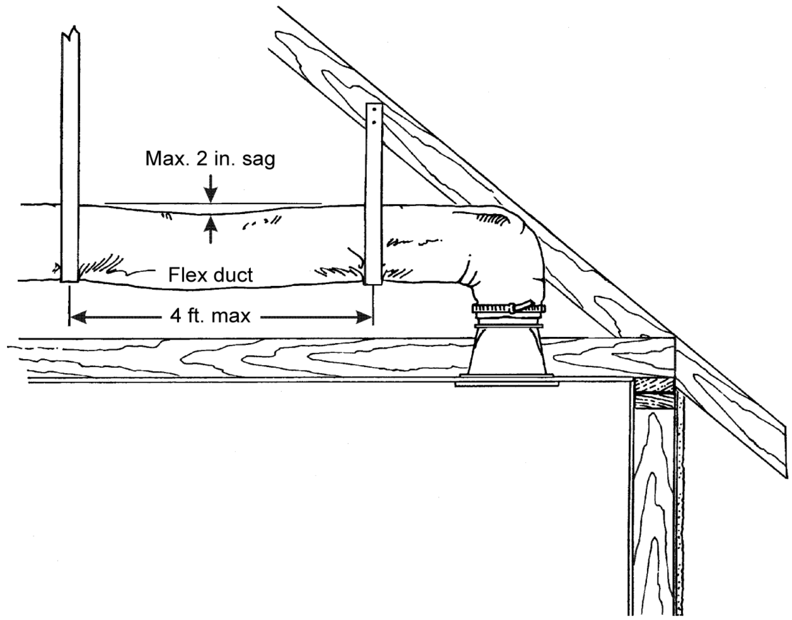
Figure 4-22: Options for Suspending Rectangular Metal Ducts



Source: Richard Heath & Associates/Pacific Gas and Electric Company

For flex ducts that are suspended from above, hangers must occur at 4 ft. apart or less, and all fittings and accessories must be supported separately by hangers. (See Figure 4-23.)

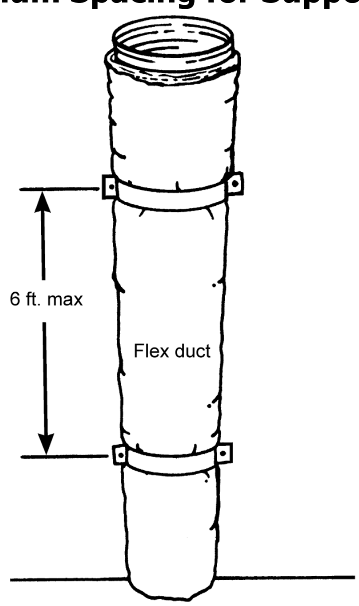
Figure 4-23: Minimum Spacing for Suspended Flex Ducts



Source: Richard Heath & Associates/Pacific Gas and Electric Company

For vertical runs of flex duct, support must occur at 6 ft. intervals or less. (See Figure 4-24)

Figure 4-24: Minimum Spacing for Supporting Vertical Flex Ducts

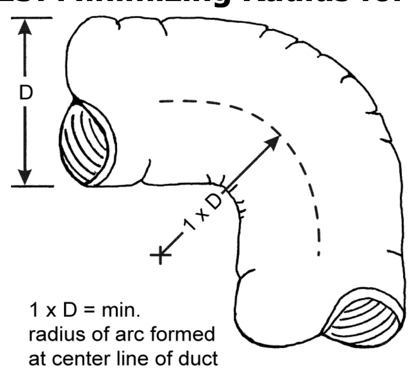


Source: Richard Heath & Associates/Pacific Gas and Electric Company

The routing and length of all duct systems can have significant effects on system performance due to possible increased airflow resistance. The Energy Commission recommends using the minimum length of duct to make connections and the minimum possible number of turns.

For flexible ducts, the Energy Commission recommends fully extending the duct by pulling the duct tightly, cutting off any excess duct, and avoiding bending ducts across sharp corners or compressing them to fit between framing members. (See Figure 4-25) Also avoid incidental contact with metal fixtures, pipes, or conduits or installation of the duct near hot equipment such as furnaces, boilers, or steam pipes that are above the recommended flexible duct use temperature.

Figure 4-25: Minimizing Radius for Flex Duct Bends



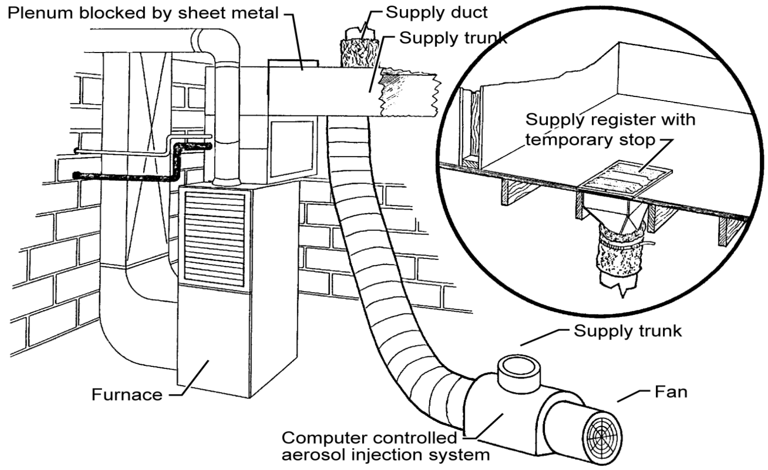
Source: Richard Heath & Associates/Pacific Gas and Electric Company

All joints between two sections of duct must be mechanically fastened and substantially airtight. For a flex duct, this must consist of a metal sleeve no less than 4 inches between the two sections of flex duct.

All joints must be properly insulated. For flex ducts, installers must pull the insulation and jacket back over the joint and use a clamp or two wraps of tape. Aerosol sealant injection systems are an alternative that typically combines duct testing and duct sealing in one process.

Figure 4-26 shows the computer-controlled injection fan temporarily connected to the supply duct. The plenum is blocked off by sheet metal to prevent the sealant from entering the furnace. Supply air registers are also blocked temporarily to keep the sealant out of the house. Ducts must still be mechanically fastened even if an aerosol sealant system is used.

Figure 4-26: Computer-Controlled Aerosol Injection System



Source: Richard Heath & Associates/Pacific Gas and Electric Company

4.5 Controls

4.5.1 Thermostats

Automatic setback thermostats can add comfort and convenience to a home. Occupants can wake up to a warm house in the winter and come home to a cool house in the summer without using unnecessary energy.

§110.2 (b) & (c), §150.0(i)

A thermostat is always required for central systems whether the prescriptive or performance compliance method is used. An exception is allowed only if the system is one of the following non-central types:

1. Non-central electric heaters.
2. Room air conditioners.
3. Room air conditioner heat pumps.
4. Gravity gas wall heaters.
5. Gravity floor heaters.
6. Gravity room heaters.
7. Wood stoves.
8. Fireplace or decorative gas appliances.

When it is required, the setback thermostat must have a clock or other mechanism that allows the building occupant to schedule the heating and/or cooling set points for at least four periods over 24 hours.

Thermostats for heat pumps must be “smart thermostats” that minimize the use of supplementary electric resistance heating during startup and recovery from setback, as discussed earlier in the heating equipment section.

Example 4-6

Question:

Am I exempt from the requirement for a thermostat if I have a gravity wall heater or any of the equipment types listed in the exception to §110.2(c)?

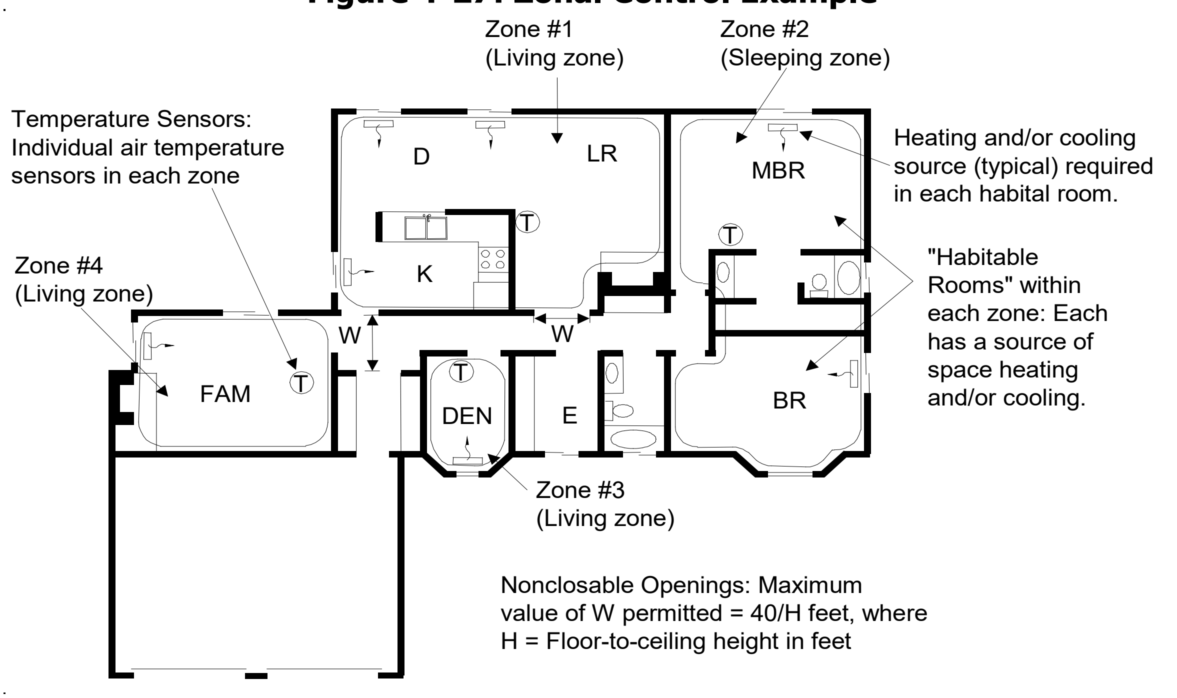
Answer:

Yes.

4.5.2 Zonal Control for Compliance Credit

An energy compliance credit is provided for zoned heating systems, which save energy by providing selective conditioning for only the occupied areas of a house. A house having at least two zones (living and sleeping) may qualify for this compliance credit. The equipment may consist of one heating system for the living areas and another system for sleeping areas or a single system with zoning capabilities, set to turn off the sleeping areas in the daytime and the living area unit at night. (See Figure 4-27)

Figure 4-27: Zonal Control Example



Source: Richard Heath & Associates/Pacific Gas and Electric Company

There are unique eligibility and installation requirements for zonal control to qualify under the Energy Code. The following steps must be taken for the building to show compliance with the Energy Code under this exceptional method:

1. **Temperature Sensors**. Each thermal zone, including a living zone and a sleeping zone, must have air temperature sensors that provide accurate temperature readings of the typical condition in that zone.
2. **Habitable Rooms**. For systems using central forced-air or hydronic heating, each habitable room in each zone must have a source of space heating, such as forced-air supply registers, radiant tubing, or a radiator. For systems using a combination of a central system and a gas-vented fireplace or other conditioning units, the zone served by the individual conditioning unit can be limited to a single room. Bathrooms, laundry, halls and/or dressing rooms are not habitable rooms.
3. **Noncloseable Openings**. The total noncloseable opening area (W) between adjacent living and sleeping thermal zones (such as halls, stairwells, and other openings) must be less than or equal to 40 ft^2. All remaining zonal boundary areas must be separated by permanent floor-to-ceiling walls and/or fully solid, operable doors capable of restricting free air movement when closed.
4. **Thermostats**. Each zone must be controlled by a central automatic dual-setback thermostat that can control the conditioning equipment and maintain preset temperatures for varying periods in each zone independent of the other. Thermostats controlling vented gas fireplace heaters that are not permanently mounted to a wall are acceptable as long as they have the dual-setback capabilities.

Other requirements specific to forced-air-ducted systems include the following:

1. Each zone must be served by a return air register located entirely within the zone. Return air dampers are not required.
2. Supply air dampers must be manufactured and installed so that when they are closed, there is no measurable airflow at the registers.
3. The system must be designed to operate within the equipment manufacturer's specifications.
4. Air is to positively flow into, though, and out of a zone only when the zone is being conditioned. No measurable amount of supply air is to be discharged into unconditioned or unoccupied space to maintain proper airflow in the system.

Although multiple thermally distinct living and/or sleeping zones may exist in a residence, the correct way to model zonal control for credit requires only two zones: a living zone and a sleeping zone. All separate living zone components must be modeled as one living zone; the same must be done for sleeping zones.

Example 4-7

Question:

In defining the living and sleeping zones for a home with a zonally controlled HVAC system, can laundry rooms and bathrooms (which are not habitable spaces) be included on whichever zone they are most suited to geographically (for example, a bathroom located near bedrooms)?

Answer:

Yes. For computer modeling, include the square footage of any not habitable or indirectly conditioned spaces with the closest zone.

Example 4-8

Question:

I have two HVAC systems and want to take zonal control credit. Can the return air grilles for both zones be located next to each other in the 5 ft. wide by 9 ft. high hallway (in the same zone)?

Answer:

No. Because of the need to prevent mixing of air between the conditioned zone and the unconditioned zone, it is necessary to (1) have the return air for each zone within that zone, and (2) limit any noncloseable openings between the two zones to 40 ft^2 or less. Unless these criteria and the other criteria listed in this chapter can be met, credit for a zonally controlled system cannot be taken.

Example 4-9

Question:

Can a gas-vented fireplace be used for zonal control heating, and qualify for the zonal control credit?

Answer:

Gas-vented fireplaces that meet zonal control requirements may qualify for the zonal control credit.

Example 4-10

Question:

Does a gas-vented fireplace with a handheld remote thermostat meet the thermostat requirement for the two-zone modeling credit?

Answer:

Yes, as long as the thermostat has manual "on" to start, automatic setback capability, and temperature preset capability, it does not have to be permanently wall-mounted.

4.6 Indoor Air Quality and Mechanical Ventilation

§150.0(o), §150.2(a)1C, and §150.2(a)2C

This section provides basic concepts and context to help navigate the mandatory requirements for exhaust fans in bathrooms and kitchens, and continuous low-cfm indoor-outdoor (I-O) air exchange in single-family homes.

The Energy Code requirement for mechanical ventilation of homes is a health and safety priority, not a building energy efficiency measure. Efficient homes are more airtight for comfort and efficiency, which makes it both easier and more important to use a small I-O fan to control air exchange.

Because mechanical ventilation is a continuous electrical end use in homes, energy efficiency is a factor to consider when selecting a ventilation system. Other factors include quiet operation, outdoor air filtration, and indoor air distribution. The Energy Code sets minimum standards for airflow, noise, ducting, and controls.

Unlike central forced-air space conditioning systems that heat, cool, mix and re-circulate indoor air to maintain comfort, the purpose of continuous mechanical ventilation is to ensure adequate I-O air exchange whenever windows are closed.

Central space conditioning systems use supply and return ductwork to move large amounts of air (over 1,000 cfm) as needed in response to a thermostat. Whole-dwelling mechanical ventilation systems use smaller (about 100 cfm) fans to continually exchange air through supply and/or exhaust ventilation ductwork.

Residential mechanical ventilation is a means to another end, which is acceptable indoor air quality (IAQ) for occupants. Energy Code-compliant ventilation systems can be expected to control the common types and levels of residential indoor air pollutants—moisture, odors, and volatile organic chemicals (VOCs). However, they cannot protect occupants from tobacco smoke or other high-polluting events that create excess moisture, odors, or VOCs in the home. In other words, because they cannot account for all the variables of occupant lifestyle and behavior, these ventilation systems do not guarantee good IAQ.

When possible, indoor air pollutants should be controlled at their source. That is the purpose of exhaust fans in bathrooms and kitchens, which occupants operate as needed. Also called local exhaust fans or spot fans, they are the best way to eliminate excess indoor moisture – operable windows are no longer sufficient.

4.6.1 Continuous Mechanical Ventilation for Indoor Air Quality

ASHRAE *Standard 62.2–Ventilation for Acceptable Indoor Air Quality in Residential Buildings* recognizes the need for controlled mechanical outdoor air supply in homes that are built tight for efficient space conditioning. Infiltration, or uncontrolled air leakage through the building, is highest during winter and lowest in mild weather, and too inconsistent to rely on for air exchange.

California's 2008 Energy Code adopted Standard 62.2-2007 with exceptions, and the 2013 Energy Code began requiring HERS field verification of airflow rates of residential I-O ventilation systems installed to meet this requirement. 2022 Energy Code incorporate updated versions of Standard 62.2 and extend its requirements to multifamily and high-rise residential buildings.

Standard 62.2 requires two residential mechanical ventilation functions:

- Local exhaust fans in bathrooms and kitchens to remove most occupant-generated moisture and odors where and when they are generated.
- Whole-dwelling ventilation systems to automatically ensure an adequate amount of I-O air exchange year-round, regardless of window operation.

It also discusses the need for tightening building envelopes and preventing habitable spaces from drawing air from polluted spaces such as garages, attics, crawlspaces, adjacent dwellings, and other sources of outdoor air pollution.

Since the Energy Code requirement for mechanical ventilation is a continuous electrical end use in new homes, fan efficacy (in W/cfm fan flow) is one factor to consider when selecting a ventilation system.

4.6.2 Types of Mechanical Ventilation Systems

There are three basic ways to meet the whole-dwelling ventilation requirement.

- Exhaust-only systems remove indoor air and create some degree of negative indoor pressure (depressurization) that induces air infiltration of the building envelope through the paths of least resistance.
- Supply-only systems filter outdoor air from a known location before delivering it to a home; this creates some degree of positive pressure (pressurization) that can serve to both prevent infiltration and buffer against depressurization.
- Balanced ventilation systems use an exhaust fan and a supply fan that move approximately the same amount of air at the same time; these opposite airflows have little effect on indoor pressure, and cannot prevent the forces of wind, stack effect, and other fans from pressurizing or depressurizing a home.

Indoor pressures cannot be avoided. In fact, the tighter and more energy-efficient the building envelope, the higher indoor pressures can and will be. Airflow requires both a driving force and a pathway. Regardless of the degree of indoor pressure, infiltration cannot occur unless there are leakage sites or designated pathways for air to flow.

The building science principle "Build Tight, Ventilate Right" acknowledges that energy efficient homes require tight building envelopes that make it possible for a continuous low-cfm ventilation system to control indoor-outdoor air exchange.

Balanced systems do not create indoor pressure or neutralize indoor pressure. The advantage of a balanced mechanical ventilation system is the ability to incorporate an engineered heat exchanger core that passively transfers thermal energy between the outgoing exhaust airstream and incoming supply airstream. This reduces the cost of heating and cooling the incoming supply ventilation air. However, balanced heat or energy recovery ventilation (HRV, ERV) systems cannot recover heat from air that infiltrates the home and bypasses the system's core.

The remainder of this section describes minimum requirements for residential mechanical ventilation, which can be readily exceeded or improved upon by:

- Using local exhaust fans as needed to remove moisture and odors.
- Using source control to minimize air pollutants within the building.
- Operating the whole-dwelling fan continuously to minimize VOC levels.

As residential buildings are tightened to improve energy performance, the dilution of indoor air through natural ventilation and infiltration has been reduced. As a result, the importance of controlling indoor pollutants and moisture generated and volatile organic compounds (VOCs) n homes has increased.

Energy Commission sponsored field research revealed that indoor concentrations of pollutants such as formaldehyde are higher than expected, and that many occupants do not open windows regularly for ventilation.

The Energy Code includes mandatory requirements for local mechanical exhaust and whole-dwelling unit mechanical ventilation to improve indoor air quality (IAQ) in homes and MERV 13 air filtration requirements for ventilation systems. As specified by §150.0(o), dwelling units must meet the requirements of ASHRAE Standard 62.2-2019 including Addenda v and d (ASHRAE 62.2), subject to the amendments specified in Section 150.0(o)1. A copy of this version of ASHRAE 62.2 may be obtained at the following URL:

https://www.techstreet.com/ashrae/standards/ashrae-62-2-2019?product_id=2087691

Opening and closing windows and continuous operation of central fan-integrated ventilation systems are not allowable options for meeting dwelling unit ventilation requirements. The requirements of ASHRAE Standard 62.2 focus on providing continuous dwelling unit mechanical ventilation, as well as local exhaust ventilation at known sources of pollutants or moisture, such as kitchens, bathrooms, and laundries. The California Air Resources Board (CARB) provides guidance for reducing indoor air pollution in homes by selecting low-VOC building materials, finishes, and furnishings. For more information, see the CARB Indoor Air Quality Guidelines:

http://www.arb.ca.gov/research/indoor/guidelines.htm

This section covers mandatory requirements for mechanical ventilation of homes, the process of compliance and enforcement, including HERS verifications, and requirements specified by ASHRAE 62.2 as amended in the Energy Code. Compliance with the whole-dwelling unit ventilation airflow specified in ASHRAE 62.2 is required in new dwelling units, in new dwelling units that are additions to an existing building except for junior accessory dwelling units, and in additions to existing dwelling units that increase the conditioned floor area of the existing dwelling unit by more than 1,000 square feet. Alterations to components of existing buildings that previously met any requirements of ASHRAE 62.2 must continue to meet requirements upon completion of the alteration(s).

The key requirements for most newly constructed buildings are summarized below:

1. A whole-dwelling unit mechanical ventilation system shall be provided. Typical solutions are described in Section 4.6.4 below. The airflow rate provided by the system shall be confirmed through field verification and diagnostic testing in accordance with the applicable procedures specified in RA3.7.
2. Kitchens and bathrooms must have local exhaust systems vented to outdoors.
3. Clothes dryer exhaust shall be vented to outdoors.

Additional indoor air quality design requirements include:

1. Ventilation air shall come from outdoors and shall not be transferred from adjacent dwelling units, garages, unconditioned attics, or crawl spaces.
2. Ventilation system controls shall be labeled, and the homeowner shall be provided with instructions on how to operate the system.
3. Combustion appliances shall be properly vented to outdoors and exhaust systems shall be designed to prevent back drafting.
4. Walls and openings between the house and attached garage shall be sealed or gasketed to prevent air exchange between the house and garage.
5. Habitable rooms shall have operable windows with a free opening area of at least 4 percent of the floor area.

6. Mechanical systems including space conditioning systems that supply air to habitable spaces shall have a MERV 13 or better filter and be designed to accommodate the air filter's rated pressure drop at the designed airflow rate.
7. Dedicated outdoor air inlets that are part of the ventilation system design shall be located away from known sources of outdoor contaminants.
8. A carbon monoxide alarm shall be installed in each dwelling unit in accordance with NFPA Standard 720.
9. Air-moving equipment used to meet the whole-dwelling unit ventilation requirement and local exhaust requirement shall be rated for airflow and sound:
    a. Whole-dwelling unit ventilation and continuously operating local exhaust fans must be rated at a maximum of 1.0 sone.
    b. Demand-controlled local exhaust fans must be rated at a maximum of 3.0 sones.
    c. Kitchen exhaust fans must be rated at a maximum of 3.0 sones at one or more airflow settings greater than or equal to 100 CFM.
    d. Remotely located air-moving equipment (mounted outside habitable spaces) are exempt from the sound requirements provided there is at least 4 feet of ductwork between the remote fan and interior grille.

4.6.3 Compliance and Enforcement

Compliance with ASHRAE 62.2 requirements must be verified by the enforcement agency, except for the following requirements that must be HERS verified in accordance with the procedures in Residential Appendix RA3.7:

- Whole-dwelling unit ventilation airflow rate
- HVI or AHAM ratings for kitchen local mechanical exhaust fan airflow or capture efficiency, and sound.

All applicable certificates of compliance, installation, and verification must be registered with an approved HERS Provider.

Title 24 Part 6 amendments to ASHRAE 62.2 do not require a blower door measurement when calculating the dwelling unit mechanical ventilation rate (Q_{fan}). Instead, the Q_{fan} calculation applies a default infiltration leakage rate of 2 ACH_{50} (air changes per hour at 50 Pascals). Blower door measurement of actual dwelling unit enclosure leakage is required only when performance compliance modeling uses an infiltration leakage rate less than 2 ACH_{50} - which requires HERS verification of enclosure leakage for energy compliance and for determining Q_{fan}.

If a central heating/cooling system air-handler fan is used to ventilate the dwelling (central fan-integrated ventilation, also known as CFI ventilation), the air-handler must be less than or equal to the mandatory fan efficacy criteria. This requires the installer to perform the test given in Reference Appendix RA3.3 and a HERS Rater to verify the efficacy (W/CFM) of the central air-handler fan.

4.6.3.1 Certificate of Compliance Reporting Requirements

When using the prescriptive compliance approach, the mechanical ventilation rate (Q_{fan}) must be calculated using the applicable equations in Energy Code Section 150.0(o)1, also shown in Section 4.6.4 below. The value for Q_{fan} must be reported on the CF1R. When using the performance compliance approach, the compliance model automatically calculates Q_{fan} based on inputs for conditioned floor area, number of bedrooms, and climate zone (Table 4-14), and uses the Q_{fan} ventilation airflow value when calculating the building energy use. The performance certificate of compliance (CF1R-PRF-01) will report the following parameters for the whole-dwelling unit ventilation system:

1. Minimum mechanical ventilation airflow rate (calculated value) that must be delivered by the system.
2. Type of ventilation system (exhaust, supply, balanced, CFI).
3. Fan efficacy (W/CFM) for the selected system.
4. Recovery efficiency (%) applicable only to HRV or ERV systems
5. For CFI systems--HERS verification of air handler fan efficacy is required.

The installed dwelling unit ventilation system must conform to the performance requirements on the CF1R.

The local enforcement agency may require additional information/documentation describing the ventilation systems be submitted along with the CF1R at plan check.

4.6.3.2 Certificates of Installation and Verification Reporting Requirements

The builder/installer must complete two certificates of installation (CF2R-MCH-27 and CF2R-MCH-32) for the dwelling. The HERS Rater must complete a certificate of verification (CF3R-MCH-27) for the dwelling.

4.6.3.2.1 CF2R-MCH-27

The following information must be provided on the CF2R-MCH-01 for each ventilation fan/system in the dwelling that will require HERS verification.

For dwelling unit ventilation systems:

1. System type, name, and location

2. Control type
3. Minimum required continuous airflow rate
4. Ventilation fan or system manufacturer, and model number
5. Energy Commission certification number for variable system/control (if any)

For kitchen exhaust ventilation systems:

1. Type of exhaust fan control (intermittent, demand-controlled, or continuous)
2. Type of exhaust fan (range hood, over-the-range microwave, downdraft, other).
3. Required airflow or capture efficiency.
4. Manufacturer name and model number.

4.6.3.2.2 **CF2R-MCH-32**

The following additional information must be provided on the CF2R-MCH-32 to document compliance with §150.0(o). Refer also to the procedures in RA 3.7.4.

For dwelling unit ventilation systems:

- Measured airflow rate of the installed dwelling unit ventilation system. For balanced systems, both exhaust and supply airflows must be measured and recorded; system airflow rate is the average (not the sum) of exhaust and supply airflows.

For kitchen exhaust ventilation systems:

- Confirmation that the installed system is rated by HVI or AHAM to meet the required airflow or capture efficiency, and sound requirements.

For all ventilation systems:

- Confirmation that the other applicable requirements given in Sections 6 and 7 of ASHRAE 62.2 as amended in 150.0(o)1 have been met (see Sections 4.6.7 and 4.6.8 below).

4.6.3.2.3 CF3R-MCH-2**7**

The following additional information must be provided on the CF3R-MCH-27 to document compliance with §150.0(o):

For dwelling unit ventilation systems:

- Measured airflow rate of the installed dwelling unit ventilation system. For balanced systems, both exhaust and supply airflows must be measured and recorded.

For kitchen exhaust ventilation systems:

- Confirmation the installed system is rated to meet the required airflow and sound requirements.

4.6.4 Typical Solutions for Single-Family Dwelling Unit Ventilation

> From ASHRAE 62.2, Section 4.2, System Type.
>
> The dwelling-unit mechanical ventilation system shall consist of one or more supply or exhaust fans and associated ducts and controls. Local exhaust fans shall be permitted to be part of a mechanical exhaust system. Where local exhaust fans are used to provide dwelling-unit ventilation, the local exhaust airflow may be credited toward the dwelling-unit ventilation airflow requirement. Outdoor air ducts connected to the return side of an air handler shall be permitted as supply ventilation if manufacturers' requirements for return air temperature are met.

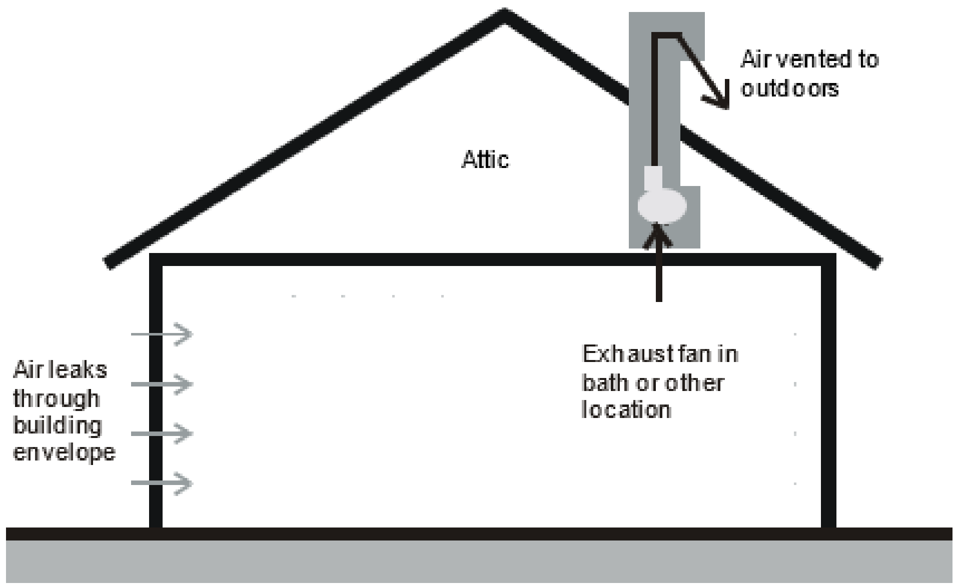
There are four basic strategies for meeting the whole-dwelling unit air ventilation requirement:

1. Exhaust ventilation – indoor air is exhausted from the dwelling and replaced by infiltration.
2. Supply ventilation - outdoor air is filtered before being supplied directly to the dwelling unit.
3. Central fan-integrated (CFI) ventilation – a ventilation system configuration in which the ventilation ductwork is connected to the duct system of the space conditioning system to enable distribution of ventilation air to the dwelling unit while the space conditioning system air handler is operating.
4. Balanced ventilation – may be a single packaged unit containing supply and exhaust fans that move approximately the same airflow through a heat or energy recovery core, or may use separate fans without heat exchange. In both cases, air supplied from outdoors must be filtered. (See Section 4.4.1.14 for filter requirements.)

4.6.4.1 Exhaust Ventilation

Exhaust ventilation is typically provided using a quiet, continuously operating ceiling-mounted fan or attic-mounted inline fan. Air is drawn from the house or unit and exhausted to the outdoors. Outdoor air enters the house or unit through infiltration. Many high-quality, quiet fans are available for this purpose. For larger homes, more than one fan may be used. The same fan can be used to meet dwelling unit and local (bathroom or laundry) exhaust ventilation requirements. Inline fans can be used to exhaust air from one or more bathrooms. Remotely located fans (fans mounted outside habitable spaces) are exempt from the sound requirements if there is at least 4 feet of ductwork between the fan and the interior grille.

Figure 4-28: Exhaust Ventilation Example

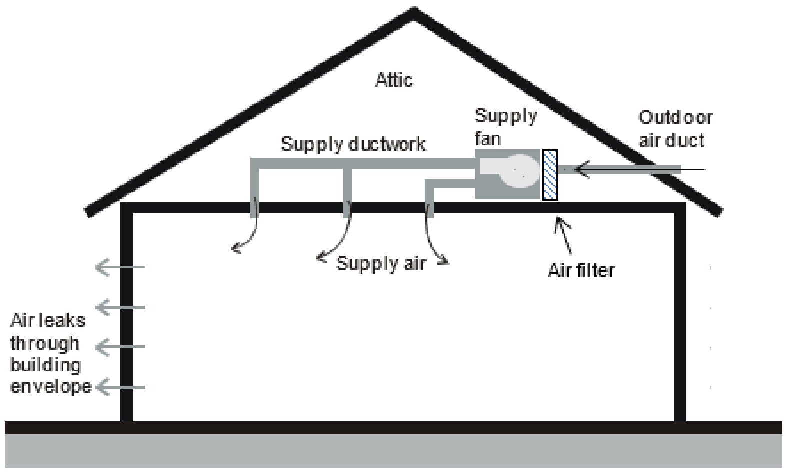


Source: California Energy Commission

4.6.4.2 **Supply Ventilation**

Supply ventilation systems draw outdoor air into the house using a dedicated supply fan and most likely distribute ventilation air through supply ductwork, although that is not a requirement. Indoor air escapes through leaks in the building envelope (exfiltration), as shown in Figure 4-29. For larger homes, more than one fan may be used. Remotely located fans (fans mounted outside habitable spaces) are exempt from the sound requirements if there is at least 4 feet of ductwork between the fan and the interior grille. Thus, if less than 4 feet of ductwork are used, the supply fan must meet the maximum 1.0 sone rating requirement for dwelling unit ventilation fans.

Figure 4-29: Supply Ventilation Example



Source: California Energy Commission

Section 150.0(m)12 requires that outside air be filtered using MERV 13 (or greater) air filters. The installed filter must be accessible for routine inspection and replacement. Supply systems may locate the MERV 13 air filter either upstream or downstream of the fan as long as the incoming outdoor air is filtered prior to delivery to the dwelling unit habitable space. Supply fans may be located in attics, dropped ceilings, soffits, or other spaces dedicated for installation of mechanical equipment.

With supply ventilation, the source of outdoor air should be carefully chosen to avoid introducing contaminants such as vehicle exhaust, vents from indoor combustion appliances or local exhaust fans, and smoke from outdoor barbeque areas. To optimize the indoor distribution of filtered outdoor air, the supply airstream can be ducted directly to bedrooms and living areas using an appropriately sized, and sealed ventilation-only supply duct system.

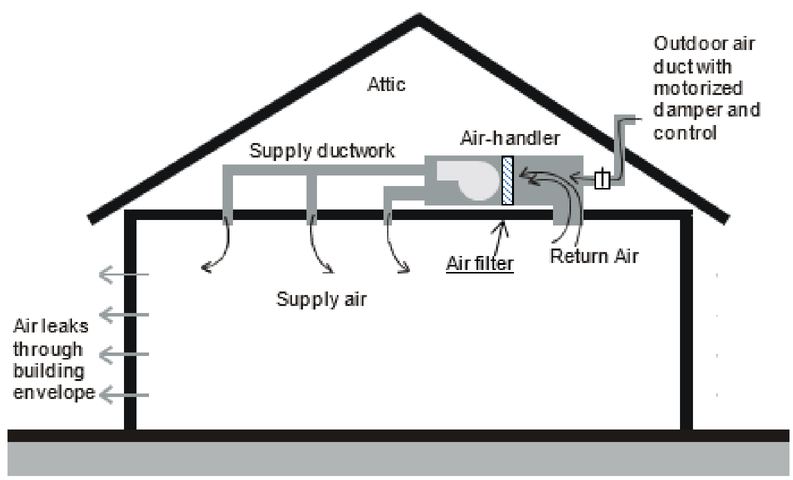
4.6.4.3 **Central Fan-Integrated (CFI) Ventilation**

A central fan integrated (CFI) ventilation system is a configuration where the ventilation ductwork is connected to the space conditioning duct system, to enable distribution of ventilation air to the dwelling unit when the space conditioning system air handler is operating. This strategy mixes the outdoor air with the large volume of return air from the dwelling unit before being distributed. CFI ventilation systems consume a relatively high amount of energy compared to the other ventilation types because it uses the air handler fan. The Energy Code includes the following requirements specific to CFI ventilation systems:

1. Continuous Operation is Prohibited – The continuous operation of a space conditioning air handler is prohibited in providing whole-dwelling unit ventilation.

2. Outdoor Air Damper(s) – A motorized damper must be installed on any ventilation duct that connects outdoor air to the space conditioning duct system and must prevent airflow into or out of the space conditioning duct system when the damper is in the closed position.
3. Damper Control – The outdoor air damper must be controlled to be in the open position only when outdoor air is required for whole-dwelling unit ventilation and must be in the closed position when outdoor air is not required. The damper must be in the closed position when the air handler is not operating. If the outdoor airflow is fan-powered, then the outdoor air fan must not operate when the outdoor air damper is in the closed position.
4. Variable Ventilation Control – CFI ventilation systems must have controls that track outdoor air ventilation run time, and either open or close the motorized damper depending on whether the required whole-dwelling unit ventilation airflow rate is being met. During periods when space conditioning is not called for by the space conditioning thermostat, the controls must operate the air handler fan and the outdoor air damper(s) when necessary to ensure the required whole-dwelling unit ventilation airflow rate is met. This control strategy must be in accordance with ASHRAE 62.2 section 4.5 which requires controls to operate the fan at least once every three hours, and the average whole-dwelling unit ventilation airflow rate over any 3-hour period must be greater than or equal to the required whole-dwelling unit ventilation airflow rate.

Figure 4-30: Central Fan-Integrated (CFI) Ventilation Example



Source: California Energy Commission

Section 150.0(m)12 requires that outside air be filtered using MERV 13 (or greater) rated air filters. Filters must be accessible to simplify replacement. For CFI systems, the filters must be installed upstream of the cooling or heating coil; thus, the filter rack provided at the inlet to the air handler may be used. Otherwise, filters must be provided at the return grill(s) for the central fan, and another filter must be provided in the outside air ductwork before the point the outside air enters the return plenum of the central fan.

When considering system design and HERS verification compliance for CFI ventilation systems, it is important to distinguish between the central forced-air system fan total airflow and the much smaller outdoor ventilation airflow rate. Both of these airflows must be verified by a HERS Rater. Refer to Figure 4-30 and note that the total airflow through the air handler is the sum of the return airflow and the ventilation airflow. CFI ventilation systems, devices, and controls may be approved for use for compliance with the HERS field verification requirements for whole-dwelling unit mechanical ventilation in accordance with RA3.7.4.2. CFI ventilation systems are considered intermittent mechanical ventilation systems and must be certified to the Energy Commission that the CFI ventilation system will meet the minimum whole-dwelling unit ventilation requirements of Section 150.0(o).

A listing of certified CFI ventilation systems is posted at the following URL:

http://www.energy.ca.gov/title24/equipment_cert/imv/

The outside air ducts for CFI ventilation systems are not allowed to be sealed/taped off during duct leakage testing. However, CFI outdoor air ductwork are required to have controlled motorized dampers that open only when outdoor air ventilation is required and close when outdoor air ventilation is not required, may be closed during duct leakage testing. See RA3.1.4.3 for duct leakage verification and diagnostic test protocols.

Because CFI ventilation systems can use a large amount of electricity annually compared to other ventilation system types, the air handlers used in CFI ventilation systems are required to meet the fan watt draw requirements given in Section 150.0(m)13B in all climate zones.

4.6.4.4 **Balanced Ventilation**

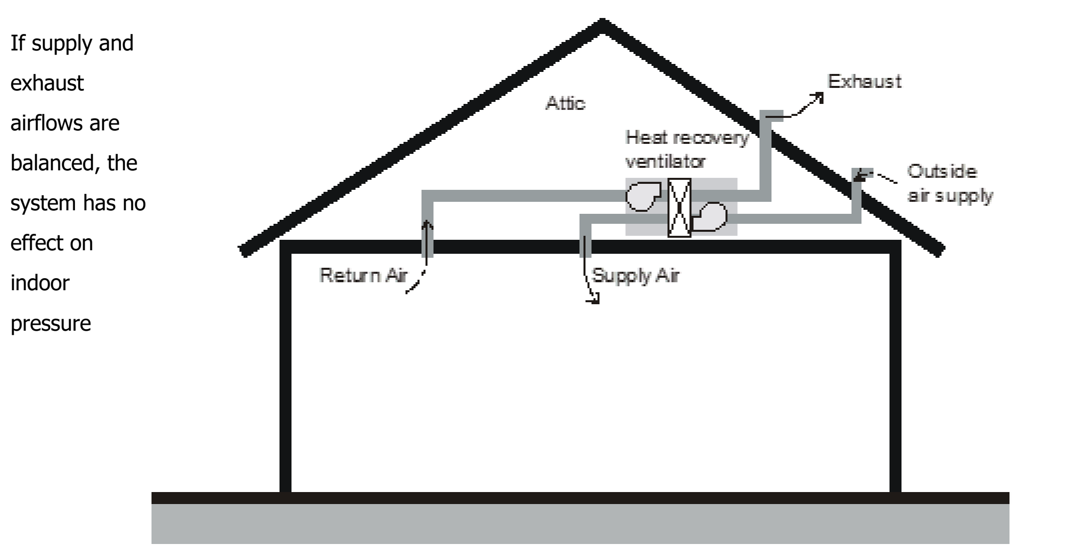
Balanced systems use an exhaust fan and a supply fan to move approximately the same volume of air into and out of the dwelling. To be considered a balanced ventilation system, the total supply airflow and the total exhaust airflow must be within 20 percent of each other. For determining compliance, the average of the supply and exhaust airflows is equal to the balanced system airflow rate. (Refer to RA3.7.4.1.2.)

Some balanced systems are small packaged systems that include heat exchangers that temper incoming air with outgoing air, which reduces the thermal effect of ventilation on heating and cooling loads, but the dual fans also increase electrical energy use. They are most practical for use in tightly sealed houses and in multifamily units where exhaust type systems have difficulty drawing adequate outside air due to limited exterior wall area.

Section 150.0(m)12 requires that outside air be filtered using MERV 13 (or greater) air filters. The filters must be accessible to facilitate replacement. An example of a heat recovery ventilator is shown in Figure 4-31.

The outdoor air inlet should be located to avoid areas with contaminants such as smoke produced in barbeque areas and products of combustion emitted from gas appliance vents. Air may not be drawn from attics or crawlspaces.

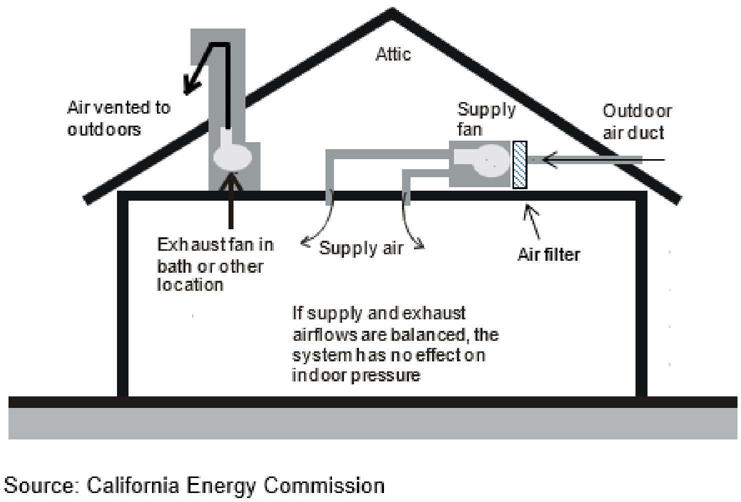
Figure 4-31: Balanced Ventilation Example 1 – HRV or ERV



Source: California Energy Commission

Another balanced system configuration uses a stand-alone supply fan coupled with a stand-alone exhaust fan, both wired to a common switch or control to ensure they operate simultaneously. The controls must make it possible to adjust the speed of the fans for balancing the airflows within 20 percent. An example is shown in Figure 4-32.

Figure 4-32: Balanced Ventilation Example 2 – Separate Supply and Exhaust Fan



Source: California Energy Commission

4.6.5 Whole-Dwelling Unit Ventilation Airflow Measurement

Residential Appendix RA3.7.4 provides direction for field measurement of supply, exhaust, and balanced ventilation system types. These measurement procedures are applicable for ventilation systems that operate at a specific airflow rate or systems that operate intermittently at a fixed speed (averaged over any three-hour period), according to a control with a fixed schedule that is verifiable by a HERS rater on site. (Refer to ASHRAE 62.2 Section 4.5.1 Short Term Average Ventilation.)

Variable or intermittent operation that complies with ASHRAE 62.2 Sections 4.5.2 and 4.5.3 complies with the dwelling unit mechanical ventilation requirements by use of varying ventilation airflow rates based on complicated calculations for relative exposure as specified in ASHRAE 62.2 Normative Appendix C. These calculation procedures provide the basis for "smart" ventilation controls implemented by use of digital controls that rely on the manufacturer's product-specific algorithms or software. Any ventilation system models that use these complex ventilation system controls in a ventilation product designed to be used to comply with Standards Section 150.0(o) must submit an application to the Energy Commission to have the ventilation technology approved. These manufacturers are expected to provide with their applications evidence that the system will perform to provide the required dwelling unit mechanical ventilation. The manufacturers are also expected to provide a method that could be used by a HERS Rater to verify that an installed system is operating as designed.

Listings of systems approved by the Energy Commission are located at the following URL: https://www.energy.ca.gov/rules-and-regulations/building-energy-efficiency/manufacturer-certification-building-equipment

4.6.6 Dwelling Unit Ventilation Rate

Dwelling unit ventilation systems may operate continuously or intermittently. If fan operation is not continuous, the average ventilation rate over any three-hour period must be greater than or equal to the Q_{fan} value calculated using equations in this section.

ASHRAE 62.2 allows for scheduled ventilation and real-time control, but these control approaches require "equivalent exposure" calculations using methods in Normative Appendix C, and complex controls would be required to operate the fan.

Equations for calculating Q_{fan} (the required mechanical ventilation rate) for single-family houses and townhouses are listed below. Single-family detached dwelling units and attached dwelling units not sharing ceilings or floors with other dwelling units, occupiable spaces, public garages, or commercial spaces (e.g. duplexes and townhomes) can take credit for building infiltration using the calculations below.

For ventilation airflow calculations, building infiltration rate (Q_{inf}) varies by climate zone (Table 4-14) and building height. Therefore, the value for Q_{fan} for a single-family dwelling or townhome may also vary based on climate zone and building height.

When the performance compliance approach is used, the compliance software completes all the calculations given in Equations 4-1, 4-2, 4-3, and 4-4, and Q_{fan} is reported on the CF1R. If the prescriptive compliance approach is used, the Data Registry performs the calculations and the value for Q_{fan} is recorded on the CF1R.

4.6.6.1 Total Ventilation Rate (Q_{tot})

The total ventilation rate is the combined volume of ventilation air provided by infiltration and the mechanical ventilation provided from fans, as follows:

$$Q\_tot = 0.03A\_floor + 7.5(N\_br + 1) \qquad \textit{Equation 4-1}$$

Where:

Q_tot = total required ventilation rate (CFM)

A_floor = conditioned floor area (ft^2)

N_br = number of bedrooms (not less than one)

4.6.6.2 **Infiltration Rate (Q_{inf})**

For single-family homes, when determining the required dwelling unit mechanical ventilation airflow rate (Q_{fan} in Equation 4-4), the calculated value for estimated infiltration rate (Q_{inf} in Equation 4-2) is deducted from the value of Q_{tot} (determined by Equation 4-1). The calculated value for estimated infiltration rate depends on the building leakage, building height, and the weather and shielding factor, which varies by climate zone (Table 4-14). A default envelope leakage value of 2 ACH_{50} is mandatory for the fan sizing calculations unless a blower door measurement is performed that determines a leakage rate below 2 ACH_{50}. Leakage in ACH_{50} must be converted to CFM_{50} for use in subsequent calculations. Conversion of 2 ACH_{50} is shown in Equation 4-2.

$$Q_{50} = V_{du} \times 2\ \mathrm{ACH}_{50})/ 60 \qquad \textit{Equation 4-2}$$

Where:

Q_{50} = leakage rate at 50 Pa, CFM

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

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

V_{du} can be approximated by multiplying the average ceiling height by the dwelling conditioned floor area. If the field-verified value for ACH_{50} is less than 2, then the verified value is used in Equation 4-2 instead of 2.

The effective annual infiltration rate (Q_{inf}) is calculated using the weather/shielding factor (wsf) for the applicable climate zone and the building height. See Table 4-14 below and Energy Code Table 150.0-D for values for wsf.

$$Qinf = 0.052 \times Q_{50} \times wsf \times [H/H_r]^z\ (CFM) \qquad \textit{Equation 4-3}$$

Where:

Q_{inf} = effective annual infiltration rate, CFM

Q_{50} = leakage rate at 50 Pa, CFM

wsf = weather and shielding factor from Table *4-13*

H = vertical distance between the lowest and highest above-grade points within the pressure boundary

H_r = reference height = 8.2 ft

z = 0.4, for the purpose of calculating Q_{inf}

The number of stories multiplied by the average ceiling height (as entered in compliance software) provides sufficient accuracy for determining *H*.

Table 4-13: Weather and Shielding Factors by Climate Zone

CZ	WSF	CZ	WSF
1	0.56	9	0.39
2	0.49	10	0.42
3	0.54	11	0.50
4	0.48	12	0.51
5	0.52	13	0.45
6	0.45	14	0.58
7	0.40	15	0.45
8	0.36	16	0.44

Source: Energy Code Table 150.0-D

4.6.6.3 **Required Mechanical Ventilation Rate (Qfan)**

The required mechanical ventilation rate, Q_{fan} is the total outside airflow required to be supplied to (or total indoor air required to be exhausted from) the building by fans. For balanced ventilation system, the average of the supply and exhaust airflows must be greater than or equal to Q_{fan}.

Q_{fan} is calculated using Equation 4-4 below, which uses the values for Q_{tot} and Q_{inf} determined above. Equation 4-4 accounts for reduced exterior wall leakage area in attached units (e.g., townhomes and duplexes). Equation 4-4 also accounts for the differences in ventilation effectiveness of balanced systems compared to exhaust/supply (unbalanced) systems due to varying dwelling infiltration leakage rates. If Q_{fan} is less than 10 CFM, then no fan is required.

$$Q_{fan} = Q_{tot} - \Phi\ (\ Q_{inf} \times A_{ext}) \qquad \textit{Equation 4-4}$$

Where:

Q_total = total required ventilation rate (CFM)

Q_inf = effective annual average infiltration rate (CFM)

Φ = 1 for balanced ventilation systems or Q_{inf}/Q_{tot} for other system types

A_{ext} = 1 for single-family detached homes. For attached dwelling units not sharing ceilings or floors with other dwelling units, occupiable spaces, public garages, or commercial spaces (e.g., duplexes and townhomes), A_{ext} is the ratio of exterior envelope surface area that is not attached to garages or other dwelling units to total envelope surface area.

Example 4-11 – Required Ventilation

Question:

What is the required continuous ventilation rate for a three-bedroom, 1,800 ft² 2-story townhouse located in Climate Zone 8 that has 9-foot ceilings, and where 25% of the exterior wall surface area adjoins another unit? Ventilation is provided by a bathroom exhaust fan. No extraordinary measures have been taken to seal the building.

Answer:

Equation 4-1 yields a total ventilation rate of 84 CFM

$$Qtot = 0.03A\_floor + 7.5(N\_br + 1) = 0.03(1800) + 7.5(3 + 1) = 84 \text{ CFM}$$

The volume is 1,800 x 9 = 16,200 ft^3. Solving for Equation 4-2 results in a leakage rate of 540 CFM

$$Q_{50} = Vdu \times 2\ ACH50/\ 60 = 16{,}200 \times 2/60 = 540 \text{ CFM}$$

Using Equation 4-3: $Q\_inf = 0.052 \times Q_{50} \times wsf \times [H/H_r]^z = 0.052 \times 540 \times 0.36 \times (18/8.2)^{0.4} = 14$ CFM

And applying Equation 4-4, the mechanical ventilation system must move 82 CFM.

$$Q_{fan} = Q_{tot} – (Q_{inf}/Q_{tot})(Q_{inf} \times A_{ext}) = 84 – (14/84)(14 \times (1\text{-}0.25)) = 82 \text{ CFM}$$

Due to the reduction in infiltration resulting from reduced exterior wall area and to the use of an exhaust fan instead of a balanced system, the effective infiltration credit is only 2 CFM.

Example 4-12

Question:

The two-story house I am building in Climate Zone 12 has a floor area of 2,240 ft² and four bedrooms. I am using an HRV that delivers 80 CFM of outdoor air and exhausts 90 cfm of indoor air. My calculations come out to 86 CFM. Can I use this system?

Answer:

No. For balanced systems, the supply and exhaust airflows can be averaged, and in this case, they average 85 CFM, which is slightly less than the required 86 CFM.

The nominal rating of a fan can be different than what it actually delivers when installed and connected to ductwork, so designers should always include a safety margin when sizing equipment. The length and size of ducting should be used to calculate the pressure drop. This is why dwelling unit ventilation rates must be verified by a HERS Rater.

Example 4-13

Question:

A 2,300 ft² house has exhaust fans running continuously in two bathrooms, providing a total exhaust flow rate of 90 CFM, but the requirement is 98 CFM. What are the options for providing the additional 8 CFM?

Answer:

Option 1: The required additional CFM could be provided either by increasing the size of either or both exhaust fans such that the combined airflow exceeds 98 CFM.

Option 2: Another solution would be to use a balanced system, which may reduce the airflow requirement to below 90 CFM. Adding another 8 CFM fan is not an acceptable solution.

Example 4-14

Question:

A CFI system is connected to the return air plenum of a furnace such that when operating, 10% of the air supplied by the furnace is outdoor air. The CFI control limits furnace fan operation to 30 minutes of every hour. If the house requires 100 CFM of continuous ventilation air, what volume of air must the furnace deliver?

Answer:

Since the furnace operates half the time, the volume of outside air delivered when it is operating must be 2 x 100 = 200 CFM. Therefore, the furnace must be able to deliver 200/0.1 = 2,000 CFM.

Example 4-15

Question:

Can an exhaust fan be used to supplement ventilation air provided by a CFS system?

Answer:

Yes. In the example above, if an exhaust fan is operated continuously to deliver 50 CFM, then the volume of air required of the CFI system is reduced to 100 CFM, or an average of 50 CFM over the hour such that the sum of ventilation air delivered averages 100 CFM. A 1,000 CFM furnace providing 10% outside air could be used in this case. Even though such a combined ventilation system is partially balanced, it would not qualify as a balanced system in the calculation of Qf_{an}.

Example 4-16

Question:

I want to provide controls that disable the ventilation system so it does not bring in outside air during the hottest two hours of the day, and the calculations show I need 80 CFM continuous. How large must my fan be?

Answer:

If the average rate over three hours is 80 CFM and the fan only operates one hour, then it must be capable of delivering 3 x 80 = 240 CFM. ASHRAE 62.2 does not allow averaging ventilation over more than a three-hour period.

4.6.6.4 Control and Operation

> From ASHRAE 62.2, Section 4.4, Control and Operation. A readily accessible manual ON-OFF control, including but not limited to a fan switch or a dedicated branch-circuit overcurrent device, shall be provided. Controls shall include text or an icon indicating the system's function.
>
> Exception: For multifamily dwelling units, the manual ON-OFF control shall not be required to be readily accessible.
>
> From Energy Code Section 150.0(o)1J: 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."

ASHRAE 62.2 requires that the ventilation system have an override control that is accessible to the occupants. The control must be capable of being accessed quickly and easily by the occupants. It can be a labeled wall switch or a circuit breaker located in the electrical panel, or it may be integrated into a labeled wall-mounted control. It cannot be buried in the insulation in the attic or inside the installed ventilation fan cabinet. The occupant must have easy access to modify the fan control settings or turn off the system, if necessary.

Bathroom exhaust fans may serve a dual purpose to provide whole-dwelling unit ventilation when operating at a low constant airflow rate and to provide local demand controlled ventilation by operating at a higher "boost" airflow rate, when needed. For these system types, the continuous whole-dwelling unit airflow operation must have an ON/OFF override, which may be located in the bathroom or in a remote accessible location. The "boost" function is controlled by a separate wall switch located in the bathroom or by a motion sensor or humidistat located in the bathroom.

Time-of-day timers or duty-cycle timers can be used to control intermittent dwelling unit ventilation. Manual crank timers cannot be used since the system must operate automatically without intervention by the occupant. Some controls "look back" over a set time interval to see if the CFI system air handler has already operated for heating or cooling before it turns on the air handler for ventilation-only operation.

See Section 4.6.4 for additional information about Energy Commission approval of ventilation controls.

Example 4-17 – Control Options

Question:

A bathroom exhaust fan is used to provide dwelling unit ventilation for a house. The fan is designed to be operated by a typical wall switch. Is a label on the wall plate necessary to comply with the requirement that controls be "appropriately labeled"?

Answer:

Yes. Since the fan is providing the required dwelling unit ventilation, a label is needed to inform the occupant that this switch controls the indoor air quality ventilation for the home and directs the occupant to leave it on unless the outdoor air quality is very poor. If the exhaust fan were serving only the local exhaust requirement for the bathroom, then a label would not be required.

Example 4-18 – Thermostatic Control

Question:

Ventilation air is provided whenever the air handler operates via a duct run connecting the return side of the central air handler to the outdoors. The system is estimated to run on calls for heating and cooling about 40 percent of the time, averaged over the year. If it is assumed that the air handler runs only 25 percent of the time, and the airflow is sized accordingly, can the system be allowed to run under thermostatic control?

Answer:

No. A system under thermostatic control will go through periods with little or no operation when the outdoor temperature is near the indoor set point, or if the system is in setback mode. An intermittently operating ventilation system must be controlled by a timer that will cycle at least once every three hours to assure that adequate ventilation is provided regardless of outdoor conditions. Alternatively, a more complex control may be used if it complies with the requirements in ASSHRAE 62.2 Appendix C. These systems must be approved by the Energy Commission before being allowed for use for compliance with the required dwelling unit ventilation.

Cycle timer controls are available that keep track of when (and for how long) the system operates to satisfy heating/cooling requirements in the home. These controls turn on the central fan to provide additional ventilation air when heating/cooling operation of the central fan has not already operated for a long enough period to provide the required ventilation. When choosing cycle timer controls for compliance, it is necessary to use models that have been approved by the Energy Commission for use for compliance with dwelling unit mechanical ventilation.

4.6.7 Whole-Dwelling Unit Mechanical Ventilation Energy Consumption

For builders using the performance compliance approach, the energy use of whole-dwelling unit ventilation fans is factored into the compliance of the proposed building. Proposed designs with lower fan efficacy, higher W/CFM, than the standard design will get a compliance penalty and proposed designs with higher fan efficacy will get a compliance credit. Whole-dwelling unit ventilation airflow rate is also a factor in the performance approach. Proposed designs exceeding the standard design ventilation airflow rate, higher CFM than the standard, will see a compliance penalty due to the additional fan energy. In most cases the standard design will match the proposed design ventilation rate and compliance will be neutral for airflow rate. However, the standard design will only match the proposed design airflow rate up to a limit and additional airflow will count against the proposed design energy budget. More information on the standard design ventilation fan efficacy and airflow rate limit can be found in the *Residential ACM Reference Manual*. For balanced heat recovery or energy recovery ventilators (H/ERVs), the HVI rated heat recovery efficiency can help offset higher fan energy use for balanced ventilation systems.

The fan efficacy of the central air handler used for a CFI ventilation system must conform to the same fan watt draw (W/CFM) limit as for cooling systems in all climate zones as verified by a HERS Rater in accordance with the diagnostic test protocols given in RA3.3. The RA3.3 verification of CFI systems determines the W/CFM of the total central system airflow, not the W/CFM of the ventilation airflow.

The Energy Code does not regulate the energy use of ventilation fans installed for other purposes, such as local exhaust.

4.6.7.1 **Central Fan-Integrated Ventilation Systems – Watt Draw**

§150.1(f)10

CFI system automatic controls must operate the central system air handler fan (generally part of every hour of the year) to draw in and distribute ventilation air throughout the dwelling, even when there is no heating or cooling required. The Energy Code prohibits CFI systems from operating continuously. Because the CFI ventilation control increases the central system air handler fan run time significantly, and because typical central system air handler fan and duct systems require a large amount of power, a CFI ventilation system can use a large amount of electricity annually.

The fan efficacy of CFI systems must be verified using the same methods as required for furnaces and air handlers. (See RA3.3.) The central system air handler must be operating in ventilation mode with the outdoor air damper open and with ventilation air flowing into the return plenum from outside the building. Furthermore, the airflow that must be measured is the total airflow through the air handler (system airflow), which is the sum of the return airflow, and the outside air ducted to the return plenum (ventilation airflow). To pass the test, the watt draw must be less than or equal to 0.45 W/CFM for furnaces, and 0.58 W/CFM for air handlers that are not gas furnaces, or 0.62 W/CFM for small duct high velocity systems.

4.6.7.1.1 **Other Whole-Dwelling Unit Ventilation Systems – Watt Draw**

Using the prescriptive or performance approach, the maximum mandatory fan efficacy for HRV/ERVs is 1.0 W/CFM. This must be HERS verified in accordance with RA3.7.4.4. For balanced systems without heat recovery, exhaust, or supply ventilation fans there are no mandatory or prescriptive fan efficacy requirements.

When using the performance approach, the airflow rate and fan watt draw of the fan must be entered into the compliance software. Values for airflow and fan W/CFM information may be available from the HVI directory at https://www.hvi.org/proddirectory/CPD_Reports/section_1/index.cfm. If HVI does not list fan energy for the installed model, use information from the manufacturer's published documentation. When fan energy is listed as CFM/W instead of W/CFM, it is necessary to invert the value to provide W/CFM as input to the compliance software (for example: 4 CFM/ W = 1/4 W/CFM = 0.25 W/CFM).

Dwelling unit ventilation is not compliance neutral and performance compliance will be affected by the proposed design W/CFM, ventilation airflow rate, and heat recovery if present. Installation of designs exceeding the standard design W/CFM or ventilation rate will get a compliance penalty. More information on the standard design ventilation fan W/CFM and airflow rate can be found in the *Residential ACM Reference Manual*.

If an H/ERV is specified, the heat recovery efficiency of the proposed system must be entered into the compliance software so that the heat recovery effect can be accounted for in the compliance simulation. Many factors affect the benefit of heat recovery on ventilation, like climate zone and building design, but in general heat recovery will increase building compliance.

4.6.8 Local Mechanical Exhaust

Local exhaust (sometimes called *spot ventilation*) has long been required for bathrooms and kitchens to remove moisture and odors at the source. Building codes have required an operable window or an exhaust fan in bathrooms for many years and have generally required kitchen exhaust either directly through a fan or indirectly through a recirculating range hood and an operable window. The Energy Code recognizes the limitations of these indirect methods of reducing moisture and odors and requires that these spaces be mechanically exhausted directly to outdoors, even if windows are present. Moisture condensation on indoor surfaces is a leading cause of mold and mildew in buildings. The occurrence of asthma is also associated with high interior relative humidity. Therefore, it is important to exhaust the excess moisture from bathing and cooking directly at the source.

The Energy Code requires that each kitchen and bathroom have a local mechanical exhaust system. Generally, this will be a dedicated exhaust fan in each room that requires local exhaust, although ventilation systems that exhaust air from multiple rooms using a duct system connected to a single exhaust fan are allowed as long as the minimum local exhaust requirement is met in all rooms served by the system.

The Energy Code follows the ASHRAE 62.2 definitions for kitchens and bathrooms for these ventilation requirements. Kitchens are any rooms containing cooking appliances, and bathrooms are any rooms containing a bathtub, shower, spa, or other similar source of moisture. A room containing only a toilet is not required to have an exhaust fan; ASHRAE 62.2 assumes there is an adjacent bathroom with local exhaust.

Non-enclosed kitchens are required to have demand-controlled local exhaust (as described in Section 4.6.7.1). Enclosed kitchens and bathrooms can have either demand-controlled local exhaust or continuous local exhaust (as described in Section 4.6.7.2). Local exhaust systems must be rated for airflow in accordance with ASHRAE 62.2 section 7.1.

Building codes may require that fans used for kitchen range hood exhaust ventilation be safety-rated by UL or some other testing agency for the particular location and/or application. Typically, these requirements address fire safety issues of fans placed within an area defined by a set of lines at 45° outward and upward from the cooktop. Few bathroom exhaust fans will have this rating, so they cannot be used in these locations.

Example 4-19 – Local Exhaust Required for Toilet

Question:

I am building a house with 2½ baths. The half-bath consists of a room with a toilet and sink. Is local exhaust required for the half bath?

Answer:

No. Local exhaust is required only for bathrooms, which are defined in the Energy Code as rooms with a bathtub, shower, spa or some other similar source of moisture. This does not include a simple sink for occasional hand washing.

Example 4-20

Question:

The master bath suite in a house has a bathroom with a shower, spa, and sinks. The toilet is in a separate, adjacent room with a full door. Where do I need to install local exhaust fans?

Answer:

The standards require local exhaust only in the bathroom, not the separate toilet room.

4.6.8.1 **Demand-Controlled (Intermittent) Local Exhaust**

The Energy Code requires that local exhaust fans be designed to be operated by the occupant. This usually means that a wall switch or some other control is accessible and obvious. There is no requirement to specify where the control or switch needs to be located, but bathroom exhaust fan controls are generally located next to the light switch, and kitchen exhaust fan controls are generally integrated into the range hood or mounted on the wall or counter adjacent to the range hood.

Bathrooms can use a variety of exhaust strategies. They can use ceiling-mounted exhaust fans or may use a remotely mounted fan ducted to two or more exhaust grilles. Demand-controlled local exhaust can be integrated with the dwelling unit ventilation system to provide both functions. Kitchens can have range hood exhaust fans, down-draft exhausts, ceiling- or wall-mounted exhaust fans, or pickups for remote-mounted inline exhaust fans. Generally, HRV/ERV manufacturers do not allow exhaust ducting from the kitchen because of the heat, moisture, grease, and particulates that should not enter the heat exchange core. Building codes require kitchen exhaust fans to be connected to metal ductwork for fire safety.

Example 4-21 – Ducting Kitchen Exhaust to the Outdoors

Question:

How do I know what kind of duct I need to use? I've been using recirculating hoods my entire career, now I need to vent to the outdoors. How do I do it?

Answer:

A kitchen range hood or downdraft duct is generally a smooth metal duct that is sized to match the outlet of the ventilation device. It is often a six-inch or seven-inch-round duct, or the range hood may have a rectangular discharge. If it is rectangular, the fan will typically have a rectangular-to-round adapter included. Always use a terminal device on the roof or wall that is sized to be at least as large as the duct. Try to minimize the number of elbows used.

Example 4-22

Question:

How do I know what the requirements are in my area?

Answer:

Ask your code enforcement agency for that information. Some enforcement agencies will accept metal flex; some will not.

A. Control and Operation for Intermittent Local Exhaust

The choice of control is left to the designer. It can be a manual switch or automatic control like an occupancy sensor. Some exhaust fans have multiple speeds, and some fan controls have a delay-off function that operates the exhaust fan for a set time after the occupant leaves the bathroom. New control strategies continue to come to the market. The only requirement is that there is a control. Title 24, Part 11 may specify additional requirements for the control and operation of intermittent local exhaust.

B. Ventilation Rate for Demand-Controlled Local Exhaust

Cooking is a regularly occurring activity inside a home that causes indoor pollution. The most effective method in removing pollutants generated from cooking is to use a vented kitchen range hood, which removes pollutants above the cooking surface before they mix with the air in the rest of the home. The 2022 Energy Code incorporates a new metric for local exhaust called capture efficiency. Capture efficiency is defined as the fraction of emitted tracer gas that is directly exhausted by a range hood.

To adequately capture the moisture, particulates, and other products of cooking and/or combustion in kitchens, the Energy Code requires minimum ventilation rates or capture efficiencies in Table 4-15 and Table 4-16. Only in kitchens that are enclosed, the exhaust requirement can also be met with either a ceiling or wall-mounted exhaust fan or with a ducted fan or ducted ventilation system that can provide at least five air changes of the kitchen volume per hour. Recirculating range hoods that do not exhaust pollutants to the outside cannot be used to meet the requirements of ASHRAE Standard 62.2.

Table 4-15: Demand-Controlled Local Ventilation Exhaust Airflow Rates *(from Table 150.0-E)*

Application	Airflow
Enclosed Kitchen	• Vented range hood (including appliance-range hood combinations): capture efficiency or airflow rate specified in Table 4-14. • Other kitchen exhaust fans, including downdraft: 300 CFM (150 L/s) or a capacity of 5 ACH
Non-Enclosed Kitchen	• Vented range hood (including appliance-range hood combinations): capture efficiency or airflow rate specified in Table 4-14. • Other kitchen exhaust fans, including downdraft: 300 CFM (150 L/s)
Bathroom	• 50 CFM (25 L/s)

Table 4-14: Kitchen Range Hood Airflow Rates and Capture Efficiency Ratings *(from Table 150.0G)*

Dwelling Unit Floor Area (ft^2)	Hood Over Electric Range	Hood Over 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

The Energy Code requires verification that range hoods are HVI or AHAM-certified to provide at least one speed setting at which they can deliver at least 100 CFM at a noise level of 3 sones or less. Verification must be in accordance with the procedures in RA3.7.4.3. Range hoods that have a minimum airflow setting exceeding 400 CFM are exempt from the noise requirement.

Ratings for Local Exhaust Fans are listed at the following web pages:

- Home Ventilating Institute (HVI) at https://www.hvi.org/proddirectory/CPD_Reports/section_1/index.cfm
- Association of Home Appliance Manufacturers (AHAM) at https://www.aham.org/AHAM/What_We_Do/Kitchen_Range_Hood_Certification

ASHRAE Standard 62.2 limits exhaust airflow when atmospherically vented combustion appliances are located inside the pressure boundary. This is particularly important to observe when large range hoods are installed. Refer to Section 4.6.9.4 below for more information.

Example 4-23 – Ceiling or Wall Exhaust vs Demand-Controlled Range Hood in an Enclosed Kitchen

Question:

I am building a house with an enclosed kitchen that is 12 ft. x 14 ft. with a 10 ft. ceiling. What size ceiling exhaust fan or range hood fan is required?

Answer:

If a range hood exhaust is not used, either 300 CFM or 5 ACH minimum airflow is required. The kitchen volume is 12 ft. x 14 ft. x 10 ft. = 1,680 ft^3. Five air changes are a flow rate of 1,680 ft^3 x 5/ hr. ÷ 60 min/hr = 140 CFM. So, this kitchen must have a ceiling or wall exhaust fan of 140 CFM. Otherwise, a vented range hood fan that provides at least 100 CFM is required.

4.6.8.2 **Continuous Local Exhaust**

The Energy Code allows the designer to install a local exhaust system that operates without occupant intervention continuously and automatically during all occupiable hours. Continuous local exhaust is generally specified when the local exhaust ventilation system is combined with a continuous dwelling unit ventilation system. For example, if the dwelling unit ventilation is provided by a continuously operating exhaust fan located in the bathroom, this fan may also satisfy the local exhaust requirement for that bathroom, provided the fan provides airflow greater than or equal to the minimum continuous local ventilation airflow rate. Continuous local exhaust may also be part of a pickup, or an interior grille, for a remote fan or HRV/ERV system.

Continuously operating bathroom exhaust fans must operate at a minimum of 20 CFM. Continuously operating kitchen exhaust fans are permitted only for enclosed kitchens.

Table 4-17: Continuous Local Ventilation Exhaust Airflow Rates *(from Table 150.0-F)*

Application	Airflow
Enclosed Kitchen	5 ACH, based on kitchen volume
Bathroom	20 CFM (10 L/s)

Example 4-24 – Continuous Kitchen Exhaust

Question:

A new house has an open-design, 12 ft. x18 ft. ranch kitchen with 12 ft. cathedral ceilings. What airflow rate will be required for a continuous exhaust fan?

Answer:

A continuous exhaust fan cannot be used in non-enclosed kitchens. A vented range hood must be provided.

4.6.9 Other Requirements (Section 6 of ASHRAE 62.2)

4.6.9.1 Adjacent Spaces and Transfer Air

From ASHRAE 62.2,

6.1 Adjacent Spaces and Transfer Air. Measures shall be taken to minimize air movement across envelope components to dwelling units from adjacent spaces such as garages, unconditioned crawlspaces, unconditioned attics, and other dwelling units. Pressure boundary wall, ceiling, and floor penetrations shall be sealed, as shall any vertical chases adjacent to dwelling units. Doors between dwelling units and common hallways shall be gasketed or made substantially airtight.

Supply and balanced ventilation systems shall be designed and constructed to provide ventilation air directly from the outdoors.

ASHRAE Standard 62.2 requires that the air used for ventilation come from outdoors. Air may not be drawn in as transfer air from other spaces that are outside the occupiable space of the dwelling unit, or from between dwelling units and corridors. This is to prevent airborne pollutants originating in those other spaces from contaminating the dwelling unit. For example, drawing ventilation air from the garage could introduce VOCs or pesticides into the indoor air. Drawing ventilation air from an unconditioned crawlspace could cause elevated allergen concentrations in the dwelling such as mold spores, insects, or rodent allergens. Likewise, drawing air from an adjacent dwelling could introduce unwanted contaminants such as cooking odors or cigarette smoke.

In addition to designing the ventilation system to introduce outdoor air, ASHRAE 62.2 also requires that measures be taken to prevent air movement between adjacent spaces, such as attics, garages, crawlspaces, and utility chases. This includes thorough air sealing of envelope components, pressure management and use of airtight recessed ceiling light fixtures. The measures must apply to adjacent units above and below, as well as side by side.

Air sealing must include pathways in vertical components such as demising walls and walls common to the unit and an attached garage, and in horizontal components such as floors and ceilings. Pipe and electrical penetrations are examples of leakage areas that require sealing.

4.6.9.2 **Instructions and Labeling**

From ASHRAE 62.2, Section 6.2, Instructions and Labeling.

Information on the ventilation design and/or ventilation systems installed, instructions on their proper operation to meet the requirements of this standard, and instructions detailing any required maintenance (similar to that provided for HVAC systems) shall be provided to the owner and the occupant of the dwelling unit. Controls shall be labeled as to their function (unless that function is obvious, such as toilet exhaust fan switches).

From Energy Code Section 150.0(o)1J:

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.*

Field studies have shown that switches for exhaust fans do not have the required labels, and that many homeowners do not understand the importance of continuous operation of the ventilation fans for maintaining indoor air quality. Standards Section 10-103(b)4 require the builder to leave in the building, for the building owner at occupancy, a description of the quantities of outdoor air that the ventilation system(s) are designed to provide to the conditioned space of the building and instructions for proper operation and maintenance of the ventilation system.

Because the concept of a designed dwelling unit ventilation system may be new to many occupants, the standards section requires that ventilation system controls be labeled as to function. One acceptable option is to affix a label to the electrical panel that provides some basic system operation information.

4.6.9.3 **Clothes Dryers**

From ASHRAE 62.2, Section 6.3, Clothes Dryers.

Clothes dryers shall be exhausted directly to the outdoors. Exception: Condensing dryers plumbed to a drain.

All laundry rooms must be built with a duct to the outdoors, designed to be connected to the dryer. Devices that allow the exhaust air to be diverted into the indoor space to provide extra heating are not permitted. This requirement is consistent with existing clothes dryer installation and design standards.

Example 4-25 – Clothes Dryer Exhaust Diverter

Question:

I am building a home that has been purchased prior to completion. The buyer has asked for an exhaust air diverter to be installed in the dryer exhaust duct. He says that it is wasteful of heating energy to exhaust the warm humid air to the outdoors during the winter when the furnace and humidifier are working. He says that the screen on the diverter will prevent excess dust being released into the space. Can I install the device for him?

Answer:

No. The feature will not comply with the Energy Code. The device is specifically prohibited. Significant amounts of dust are released from such devices, and the moisture in the dryer exhaust can lead to humidity problems, particularly in warmer climates.

4.6.9.4 **Combustion and Solid-Fuel Burning Appliances**

From ASHRAE 62.2, Section 6.4, Combustion and Solid-Fuel Burning Appliances

6.4.1 Combustion and solid-fuel burning appliances must be provided with adequate combustion and ventilation air and installed in accordance with manufacturers’ installation instructions, NFPA 31, NFPA 54/ANSI Z223.1, NFPA 211,or other equivalent code acceptable to the building official.

> 6.4.2 Where atmospherically vented combustion appliances or solid-fuel burning appliances are located inside the pressure boundary, the total net exhaust flow of the two largest exhaust fans (not including a summer cooling fan intended to be operated only when windows or other air inlets are open) shall not exceed 15 CFM per 100 ft2 (75 L/s per 100 m2) of occupiable space when in operation at full capacity. If the designed total net flow exceeds this limit, the net exhaust flow must be reduced by reducing the exhaust flow or providing compensating outdoor air. Gravity or barometric dampers in nonpowered exhaust makeup air systems shall not be used to provide compensating outdoor air. Atmospherically vented combustion appliances do not include direct-vent appliances. Combustion appliances that pass safety testing performed according to ANSI/BPI-1200, shall be deemed as complying with Section 6.4.2.

ASHRAE Standard 62.2 requires that the vent system for combustion appliances be properly installed, as specified by the instructions from the appliance manufacturer and by the California Building Code. Compliance with venting requirements involves determining the type and size of duct material to be used, and routing requirements for the exhaust ducting system.

ASHRAE Standard 62.2 includes a provision intended to prevent back drafting, where one or more exhaust fans are installed in a home with atmospherically vented or solid fuel combustion appliances. If the two largest exhaust fans have a combined capacity that exceeds 15 CFM/100 ft² of floor area, then makeup air must be provided. This provision applies only when the atmospherically vented appliance is inside the pressure boundary and the house does not include a summer cooling fan that is designed to be operated only when windows are open. Direct-vent appliances are not considered "atmospherically vented."

The two largest exhaust fans are normally the kitchen range hood and the clothes dryer (if located inside the dwelling unit pressure boundary). Large-range hoods, particularly downdraft range hoods, can have capacities of 1,000 CFM or more.

Issues relating to this can be solved in several ways. First, all atmospherically vented combustion appliances can be located outside the pressure boundary of the house (to the garage or outdoor utility closet). Second, the flow rate of one or more of the fans can be reduced so the combined exhaust flow is less than 15 CFM/100 ft² floor area Finally, outdoor makeup air can be mechanically provided to reduce the net exhaust rate.

In addition to meeting ASHRAE 62.2, Section 6.4, all dwelling units must also conform to the applicable requirements specified in the California Mechanical Code Chapter 7 for combustion air.

Example 4-26 – Large Exhaust Fan

Question:

I am building a 3,600 ft^2 custom home that has four bedrooms. The kitchen will have a high-end range hood that has three speeds, nominally 1,000 CFM, 1,400 CFM and 1,600 CFM. The house will include an atmospherically vented gas water heater located in the basement. If I am using a central exhaust fan for the dwelling unit ventilation of 75 CFM, and there is a clothes dryer installed, how much compensating outdoor airflow (makeup air) is needed?

Answer:

You must use the high-speed value for the range hood of 1,600 CFM. The clothes dryer flow is assumed to be 150 CFM for sizing purposes. These two flows are added together for a total exhaust capacity of 1,750 CFM. Since the whole-dwelling unit ventilation fan is not one of the two largest exhaust fans, it does not figure into the makeup air calculation. Using the equation above, at least 1,750 CFM – (15 CFM x 3,600 ft^2 / 100 ft^2) = 1,210 CFM of makeup outside airflow must be provided

Example 4-27

Question:

The same custom house will have the water heater located in the garage instead of the basement. Does that change anything?

Answer:

Garages (and attics) are normally located outside the pressure boundary, so makeup air is not required. If the garage is inside the pressure boundary of the living space, makeup air is required.

Example 4-28

Question:

For this house, I need to keep the natural gas water heater in the basement. What are my options that would avoid the requirement to provide makeup air?

Answer:

There are several things you could do. First, you could use a direct vent water heater that would also provide higher fuel efficiency. You could use a lower capacity range hood, one that is less than 390 CFM (15 CFM x 3,600 ft^2 / 100 ft^2 – 150 CFM). Use of continuous supply-only dwelling unit ventilation would allow the hood capacity to increase to 465 CFM (15 CFM x 3,600 ft^2 / 100 ft^2 – 150 CFM + 75 CFM). There are also commercial range hoods available that are designed to provide makeup air.

4.6.9.5 **Garages**

> From ASHRAE 62.2, Section 6.5.1, Garages.
>
> When an occupiable space adjoins a garage, the design must prevent migration of contaminants to the adjoining occupiable space. Air seal the walls, ceilings, and floors that separate garages from occupiable space. To be considered air-sealed, all joints, seams, penetrations, openings between door assemblies and their respective jambs and framing, and other sources of air leakage through wall and ceiling assemblies separating the garage from the residence and its attic area shall be caulked, gasketed, weather stripped, wrapped, or otherwise sealed to limit air movement. Doors between garages and occupiable spaces shall be gasketed or made substantially airtight with weather stripping.

Garages often contain numerous sources of air contaminants, including. vehicle exhaust, gasoline fumes, pesticides, paints and solvents. When a garage is attached to the house, these contaminants be prevented from entering the living space. Walls between the home and garage (or garage ceiling in designs with living space above garages) shall be designed and constructed to prevent air flow through the wall or ceiling. Common doors and any air handlers or ducts located in the garage shall also be sealed, weather-stripped, or gasketed.

Energy Code Section 150.0(o) specifies that compliance with ASHRAE 62.2 Section 6.5.2 (Space Conditioning System Ducts) shall not be required. However, applicable duct leakage verification requirements are given in Energy Code Sections 150.0(m)11 for newly constructed buildings, and 150.2(b)iD for alterations to systems in existing buildings. All ducted space conditioning systems in newly constructed buildings are required to pass HERS verification that the duct system leaks less than or equal to 5 percent of the system airflow rate. This requirement also applies to portions of the system that may be in a garage space.

For alterations to space conditioning systems in existing buildings that have all or portions of the forced air ducts, plenums or air-handling units in the garage, Section 150.2(b)1D specifies two compliance approaches:

1. The measured system duct leakage shall be less than or equal to 6 percent of system air handler airflow as determined using the procedures in RA3.1.4.3.1.
2. All accessible leaks located in the garage space shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater using the methods specified in RA3.1.4.3.5.

For additions and alterations to existing buildings, any length of new or altered duct located in the garage or any new or altered air-handling unit located in the garage triggers these duct leakage testing requirements.

Example 4-29 – Garages

Question:

In a newly constructed building, the building designer located the air handler in the garage. The main return trunk from the dwelling is connected to the air handler. Is this acceptable?

Answer:

Yes. The duct system must be leak-tested and verified to leak no more than 5 percent of air handler airflow.

Example 4-30

Question:

For an alteration to an existing building, the air handler is located in the dwelling unit, and a portion of the return duct is run through the garage to a bedroom above the garage. The return duct has 4 feet of length located in the garage, and this 4-foot section is being replaced. How do I test that length of the duct for leakage?

Answer:

First, test the leakage for the entire duct system to determine whether the total system duct leakage is no greater than 6 percent of the total fan flow. If the system does not meet the 6 percent target for compliance, then use the visual inspection and smoke test specified in RA3.1.4.3.5 and seal all accessible leaks in the 4-foot section of duct that is in the garage space.

4.6.9.6 **Ventilation Opening Area**

From ASHRAE 62.2, Section 6.6 Ventilation Opening Area

Spaces shall have ventilation openings as listed in the following subsections. Such openings shall meet the requirements of Section 6.8.

Exception: Attached dwelling units and spaces that meet the local ventilation requirements set for bathrooms in Section 5.

6.6.1 Habitable Spaces. Each habitable space shall be provided with ventilation openings with an openable area not less than 4% of the floor area or less than 5 ft2 (0.5 m2).

6.6.2 Toilets and Utility Rooms. Toilets and utility rooms shall be provided with ventilation openings with an openable area not less than 4% of the room floor area or less than 1.5 ft2 (0.15 m2).

Exceptions:

1. Utility rooms with a dryer exhaust duct.

2. Toilet compartments in bathrooms.

The dwelling unit mechanical ventilation rate is intended to provide adequate ventilation to typical new homes under normal circumstances. On occasion, however, houses experience unusual circumstances where high levels of contaminants are released into the space. When this occurs, a means of providing the significantly higher levels of ventilation required to remove the contaminants is needed. Operable windows are the most likely means of providing the additional ventilation.

This section of ASHRAE Standard 62.2 requires ventilation openings in habitable spaces, toilets, and utility rooms. Ventilation openings usually mean operable windows, although a dedicated nonwindow opening for ventilation is acceptable. Spaces that meet the local exhaust requirements are exempted from this requirement.

4.6.9.7 **Habitable Spaces**

Habitable spaces are required to have ventilation openings with an openable area equal to at least 4 percent of conditioned space floor area, but not less than 5 ft^2. Dining rooms, living rooms, family rooms, bedrooms, and kitchens are considered habitable space. Closets, crawl spaces, garages, and utility rooms are generally not. If the clothes washer and dryer are located in an open basement that is also the family room, it would be considered habitable space.

The openings do not have to be windows. They can also be operable, insulated, weather-stripped panels.

Ventilation openings, which include operable windows, skylights, through-the-wall vents, window vents, or similar devices, shall be readily accessible to the occupant. This means that the occupant must be able to operate the opening without having to climb on anything. An operable skylight must have some means of being operated while standing on the floor: a push rod, a long crank handle, or an electric motor.

If a ventilation opening is covered with louvers or otherwise obstructed, the openable area is the unobstructed free area through the opening.

Example 4-31 – Ventilation Openings

Question:

I am building a house with a 14 ft. by 12 ft. bedroom. What size window do I need to install?

Answer:

It depends on the type of window. The standard requires that the openable area of the window, not the window unit, be 4 percent of the floor area, or 14 ft x 12 ft x 0.04 = 6.7 ft^2. The fully opened area of the window or windows must be greater than 6.7 ft^2. The requirement for this example can be met using two double-hung windows, each with a fully opened area of 3.35 ft^2. Any combination of windows whose opened areas add up to at least 6.7 ft^2 will meet the requirement.

4.6.9.8 **Minimum Filtration**

Compliance with ASHRAE 62.2 Sections 6.7 (Minimum Filtration) and 6.7.1 (Filter Pressure Drop) are not required (Energy Code Section 150.0(o)1D). However, air filtration for mechanical systems must conform to the specifications in Energy Code Section 150.0(m)12. Information on air filtration requirements is given in Section 4.4.1.14 of this chapter.

4.6.9.9 **Air Inlets**

> From ASHRAE 62.2, Section 6.8, Air Inlets.
>
> Air inlets that are part of the ventilation design shall be located a minimum of 10 ft (3 m) from known sources of contamination such as a stack, vent, exhaust hood, or vehicle exhaust. The intake shall be placed so that entering air is not obstructed by snow, plantings, or other material. Forced air inlets shall be provided with rodent/insect screens (mesh not larger than 1/2 in. [13 mm]).
>
> Exceptions:
>
> 1. Ventilation openings in the wall may be as close as a stretched-string distance of 3 ft (1 m) from sources of contamination exiting through the

> roof or dryer exhausts.
>
> 2. No minimum separation distance shall be required between windows and local exhaust outlets in kitchens and bathrooms.
>
> 3. Vent terminations covered by and meeting the requirements of the National Fuel Gas Code (NFPA 54/ANSI Z223.1)7 or equivalent.
>
> 4. Where a combined exhaust/intake termination is used to separate intake air from exhaust air originating in a living space other than kitchens, no minimum separation distance between these two openings is required. For these combined terminations, the exhaust air concentration within the intake airflow shall not exceed 10%, as established by the manufacturer.
>
> 6.8.1 Ventilation Openings.
>
> Operable windows, skylights, through-the-wall inlets, window air inlets, or similar devices shall be readily accessible to occupants. Where openings are covered with louvers or otherwise obstructed, openable area shall be based on the free, unobstructed area through the opening.

When the ventilation system is designed with outdoor air inlets, the inlets must be located away from locations that can be expected to be sources of contamination. The minimum separation is 10 ft. Inlets include not only inlets to ducts, but windows that are needed to achieve the minimal opening area.

For residential buildings, typical sources of outdoor air contaminants include:

1. Vents from combustion appliances
2. Fireplace chimneys.
3. Exhaust fan outlets.
4. Barbeque grills.
5. Driveways or any location where vehicles may be idling.
6. Any other locations where outdoor air contaminants are generated.

The Energy Code also requires that air intakes be placed so that they will not become obstructed by snow, plants, or other material. Forced air inlets must also be equipped with insect/rodent screens with mesh is no larger than 1/2 inch.

4.6.10 Air-Moving Equipment (Section 7 of ASHRAE 62.2)

> From ASHRAE 62.2, Section 7.1, Selection and Installation.
>
> Ventilation devices and equipment serving individual dwelling units shall be tested in accordance with ANSI/ASHRAE Standard 51/AMCA 210 and ANSI/AMCA Standard 300 and rated in accordance with the airflow and

sound rating procedures of the Home Ventilating Institute (HVI 915, 916, 920). Installations of systems or equipment shall be carried out in accordance with manufacturers' design requirements and installation instructions.

Ventilation systems used to meet whole-dwelling unitor local exhaust ventilation requirements shall be rated to deliver the required airflow and have sound ratings that meet the requirements of this section.

4.6.10.1 **Selection and Installation**

ASHRAE Standard 62.2 requires that equipment used to comply with the standard be selected based on tested and certified ratings for airflow and sound. Fan selections must meet the requirements of the standard. The HVI or AHAM certified product directories lists equipment that has been tested for performance and sound at available settings and configurations.

In addition, the Energy Code requires that fans be installed in accordance with the manufacturer's instructions. Adherence to the installation instructions and other literature shipped with the fan will ensure the installation complies with the ratings.

4.6.10.2 **Sound Ratings for Fans**

From ASHRAE 62.2, Section 7.2, Sound Ratings for Fans.

Ventilation fans shall be rated for sound at no less than the minimum airflow rate required by this standard as noted below. These sound ratings shall be at a minimum of 0.1 in. w.c. (25 Pa) static pressure in accordance with the HVI procedures referenced in Section 7.1.

Exception: HVAC air handlers and remote mounted fans need not meet sound requirements. To be considered for this exception, a remote mounted fan must be mounted outside the habitable spaces, bathrooms, toilets, and hallways, and there must be at least 4 ft (1 m) of ductwork between the fan and the intake grille.

7.2.1 Dwelling-Unit Ventilation or Continuous Local Exhaust Fans. These fans shall be rated for sound at a maximum of 1.0 sone.

7.2.2 Demand-Controlled Local Exhaust Fans. Bathroom exhaust fans used to comply with Section 5.2 shall be rated for sound at a maximum of 3 sones. Kitchen exhaust fans used to comply with Section 5.2 shall be rated for sound at a maximum of 3 sones at one or more airflow settings greater than or equal to 100 CFM (47 L/s).

Exception: Fans with a minimum airflow setting exceeding 400 CFM (189 L/s) need not comply.

Energy Code Section 150.0(o)1G requires kitchen range hoods to be rated for sound in accordance with Section 7.2 of ASHRAE 62.2 and provides an exception to allow kitchen range hoods to be rated for sound at a static pressure determined at working speed as specified in HVI 916 Section 7.2. The static pressure at working speed may be lower than 0.1 inch w.c.

One common reason ventilation equipment may not be operated by occupants, particularly local exhaust fans, is the noise the fans may create. To address this, ASHRAE Standard 62.2 requires that certain fans be rated for sound and that installed fans shall have ratings below specified limits. The sound rating must be done at an airflow that is no less than the airflow that the fan must provide to meet the ventilation airflow requirement.

Because of the variables in length and type of duct and grille, there is no standard test method for rating the sound of ventilation fans that are not mounted in the ceiling or wall surface. Consequently, air handlers, HRV/ERVs, inline fans, and remote fans are exempted from the sound rating requirements that apply to surface-mounted fans. However, to reduce the noise conducted from the fan to the grille, the Energy Codes requires at least 4 feet of ductwork between the fan and surface grille. Especially if hard metal duct is used, flexible insulated sound-attenuating duct can be used to reduce the transmitted sound into the space.

A. Continuous Ventilation Fans (Surface-Mounted Fans)

Continuously operated fans shall be rated at 1.0 sone or less. This applies to both whole-dwelling unit and local exhaust ventilation fans.

B. Intermittent or Demand Controlled Fans (Surface-Mounted Fans)

Intermittently operated dwelling unit ventilation fans shall be rated at a maximum of 1.0 sone. Demand-controlled local exhaust fans shall be rated at a maximum of 3.0 sones unless the maximum rated airflow is greater than 400 CFM.

ASHRAE Standard 62.2 extends the requirement for quiet fans to include range hoods and bath exhaust fans. Dwelling unit ventilation fans or systems that operate continuously must be -rated at 1.0 sone or less. However demand-controlled local exhaust fans must be 3.0 sones or less. Range hood exhaust fans must also be -rated at 3.0 sones or less at the minimum required speed of 100 CFM.

4.6.10.3 **Airflow Measurements and Airflow Ratings**

§150.0(o)1Gv and §150.0(o)2All whole-dwelling unit ventilation systems must demonstrate compliance by direct measurement of airflow using a flow hood, flow grid, or other approved measuring device. HERS verification of whole-dwelling unit ventilation airflow is required for newly constructed buildings and existing buildings with additions greater than 1,000 square feet or an increase in the number of dwelling units.

There are two ways that the installer may demonstrate compliance with airflow requirements for local exhaust ventilation:

1. Test the ventilation system using an airflow measuring device after completion of the installation to confirm that the delivered ventilation airflow meets the requirement.
2. Conformance to a prescriptive requirement that the fan has a certified airflow rating that meets or exceeds the required ventilation airflow, and ventilation ducts that meet the prescriptive duct design requirements given in Table 4-18.

When using the prescriptive duct sizing table, the certified airflow rating of the fan must be based on tested performance at the 0.25 inches water column (w.c.) static pressure, except for when a vented range hood utilizes the capture efficiency rating to demonstrate compliance. When the capture efficiency rating is used, the airflow listed in the approved directory corresponding to the compliant capture efficiency rating point must be applied to Table 4-18.

The use of Table 4-18 is limited to ventilation systems that meets all of the following specifications.

1. Total duct length is less than or equal to 25 ft (8m);
2. Duct system has no more than three (3) elbows, and;
3. 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.

The prescriptive duct design criteria given in Table 4-18 provide maximum exhaust duct lengths based on duct type and diameter. The higher the airflow, the larger in diameter the duct must be. Smooth duct can be used to manage longer duct runs. Interpolation and extrapolation of Table 4-18 are not allowed. For airflow rates not listed, use the next higher value. The table is not applicable for systems with airflow greater than 800 CFM at 62 Pa (0.25 inches water column) static pressure.

Table 4-18: Prescriptive Ventilation System Duct Sizing *(From Table 150.0-H)*

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)
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)
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)

Fan Airflow Rating, cfm at minimum static pressure[f] 0.25 in. water (L/s at minimum 62.5 Pa)	≤250 (120)	≤350 (165)	≤400 (190)	≤450 (210)	≤700 (330)	≤800 (380)
Minimum Duct Diameter, in. (mm) [a,b] For Rigid duct	8 (205)	9 (230)	10 (255)	10 (255)	12 (305)	12 [d] (305)
Minimum Duct Diameter, in. (mm) [a,b] For Flex duct [c]	8 (205)	9 (230)	10 (255)	NP	NP	NP

Source: California Energy Commission

Footnotes for Table 150.0-H [ASHRAE 62.2:Table 5-3]:

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 150.0(o)1Giiib, 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 150.0-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.

Example 4-32 – Prescriptive Duct Sizing

Question:

I need to provide 75 CFM of continuous ventilation, which I plan to do using a central exhaust fan. I plan to connect the fan to a roof vent termination using flex duct. The duct will be about 8 feet long with no real elbows but some slight bends in the duct. What size duct do I need to use?

Answer:

From Table 150.0-H, using ≤80 CFM and the flex duct row, the minimum duct diameter is 5 inches.

Example 4-33

Question:

I will need a 100 CFM range hood. The ductwork is 35 feet long but requires only one elbow. What size flex duct do I need to use?

Answer:

The prescriptive duct sizing Table 150.0-H is limited to ductwork less than or equal to 25 feet, therefore it cannot be used here. In this case the airflow must be tested with an airflow measuring device to confirm that delivered airflow meets the required airflow.

4.6.10.4 **Exhaust Ducts**

From ASHRAE 62.2, Section 7.3, Exhaust Ducts.

7.3.1 Multiple Exhaust Fans Using One Duct. Exhaust fans in separate dwelling units shall not share a common exhaust duct. If more than one of the exhaust fans in a single dwelling unit shares a common exhaust duct, each fan shall be equipped with a backdraft damper to prevent the recirculation of exhaust air from one room to another through the exhaust ducting system.

7.3.2 Single Exhaust Fan Ducted to Multiple Inlets. Where exhaust inlets are commonly ducted across multiple dwelling units, one or more exhaust fans located downstream of the exhaust inlets shall be designed and intended to run continuously, or a system of one or more backdraft dampers shall be installed to isolate each dwelling unit from the common duct when the fan is not running.

ASHRAE Standard 62.2 limits how multiple exhaust fans can be connected through a shared duct system, intending to prevent air from moving between spaces through the exhaust ducts.

If two or more exhaust fans in a home share a duct, then each fan must be equipped with a backdraft damper so that air exhausted from one room cannot enter another area of the home. Exhaust fans in multiple dwelling units may not share a common duct.

4.6.10.5 **Supply Ducts**

> From ASHRAE 62.2, Section 7.4, Supply Ducts.
>
> Where supply outlets are commonly ducted across multiple dwelling units, one or more supply fans located upstream of all the supply outlets shall be designed and intended to run continuously, or a system of one or more backdraft dampers shall be installed to isolate each dwelling unit from the common duct when the fan is not running.

Supply air outlets to more than one dwelling unit may be served by a single fan upstream of all the supply outlets if the fan is designed to run continuously or if each supply outlet is equipped with a backdraft damper to prevent cross-contamination when the fan is not running.

4.7 Alternative Systems

4.7.1 Hydronic Heating Systems

Hydronic heating is the use of hot water to distribute heat. Hydronic heating is discussed in this compliance manual as an "alternative system" because it is much less common in California than in other parts of the United States.

A hydronic heating system consists of a heat source, which may be a boiler, water heater, or heat pump, and a distribution system. There are three main types of hydronic distribution systems, and they may be used individually or in combination: baseboard convectors or radiators, air handlers, and radiant panel systems. Radiant panel surfaces can include floors, walls, and/or ceilings. Air handlers and radiant panels may be used for heating and cooling. Hot water air handlers may also be equipped with DX coils for cooling. The three distribution options are illustrated in Figure 4-32. Ducting is used only with air handlers.

4.7.1.1 **Mandatory Requirements**

For hydronic heating systems without ducts, the mandatory measures cover pipe insulation, tank insulation, and boiler efficiency. For fan coils with ducted air distribution, the mandatory air distribution measures also apply. For combined hydronic systems, as described below, mandatory water heating requirements also apply to the water heating portion of the system.

A. Pipe and Tank Insulation

§150.0(j) Insulation for Piping, and Tanks

§120.3 Requirements for Pipe Insulation

The typical residential hydronic heating system operating between 105° and 140° F must have at least 1 inch (25 mm) of insulation on pipes less than 1 inch in diameter and 1.5 inch (38 mm) of insulation on pipes 1 inch or more in diameter. Systems operating between 141° and 200° F must have at least 1.5 inches of insulation on pipes less than 1.5 inches in diameter. For other temperatures and pipe insulation characteristics, see Table 4-5.

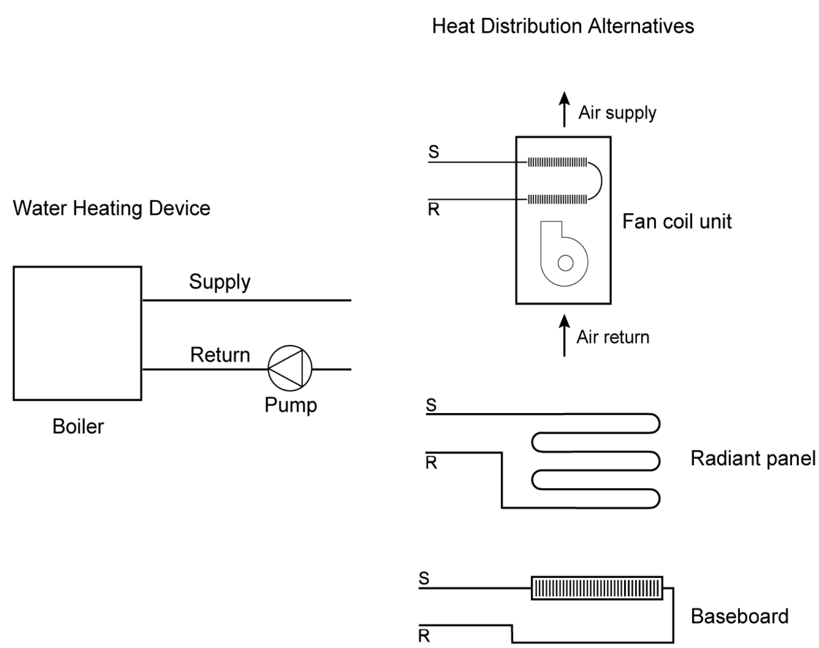
There are a few exceptions where insulation is not required:

1. Sections of pipes where they penetrate framing members
2. Pipes that provide the heat exchange surface for radiant heating and/or cooling
3. Piping in the attic that is covered by at least 4 inches (100 mm) of blown insulation on top
4. Piping installed within walls if all the requirements for Insulation Installation Quality are met (see Chapter 3 Building Envelope Requirements).

If the system includes an unfired hot water storage tank, then the tank must be either wrapped with R-12 insulation or insulated internally to at least R-16.

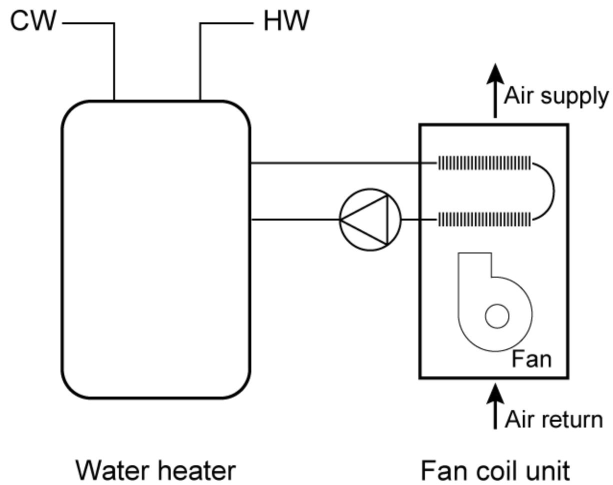
Piping used to deliver chilled water to panels or air handlers should be continuously insulated with closed-cell foam to prevent condensation damage.

Figure *4-33: Hydronic Heating System Components*



Source: Richard Heath & Associates/Pacific Gas and Electric Company

Figure 4-34: Combined Hydronic System With Water Heater as Heat Source



Source: Richard Heath & Associates/Pacific Gas and Electric Company

For pipes in hydronic heating systems that operate at pressure greater than 15 psi, the requirements of §120.3 apply. These are the same requirements that apply to nonresidential piping systems.

B. Equipment Efficiency

Gas or oil boilers used for residential space heating (typically less than 300,000 Btu/h capacity) must be rated with an AFUE of 80 percent or greater. (See *Appliance Efficiency Regulations, Title 20* for minimum efficiencies of other heating equipment.*)* A gas or oil water heater may also be used as a dedicated source for space heating. Other hot water sources, including heat pumps or electric resistance water heaters, are not allowed for use in dedicated space-heating systems. Therefore, some water heaters may be used for space heating only if used as part of a combined hydronic system, as described below. In that case, the mandatory water heater requirements apply.

There are no minimum efficiency requirements for heat pumps that produce hot or chilled water, but compliance calculations must use information listed in the Energy Commission’s [Title 20 appliance database](https:/cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx) under the category “Central Heat Pumps” and Appliance Type “Heat Pump Water Heating Packages”, including compressor speed.

https:/cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx

Thermostat requirements also apply to hydronic systems, as described in Section 4.5.1.

4.7.1.2 **Prescriptive Requirements**

There are no specific prescriptive requirements that apply to hydronic systems. However, if the system has a fan coil with ducted air distribution, the relevant prescriptive requirements apply, including duct insulation and duct sealing.

4.7.1.3 **Performance Compliance Options**

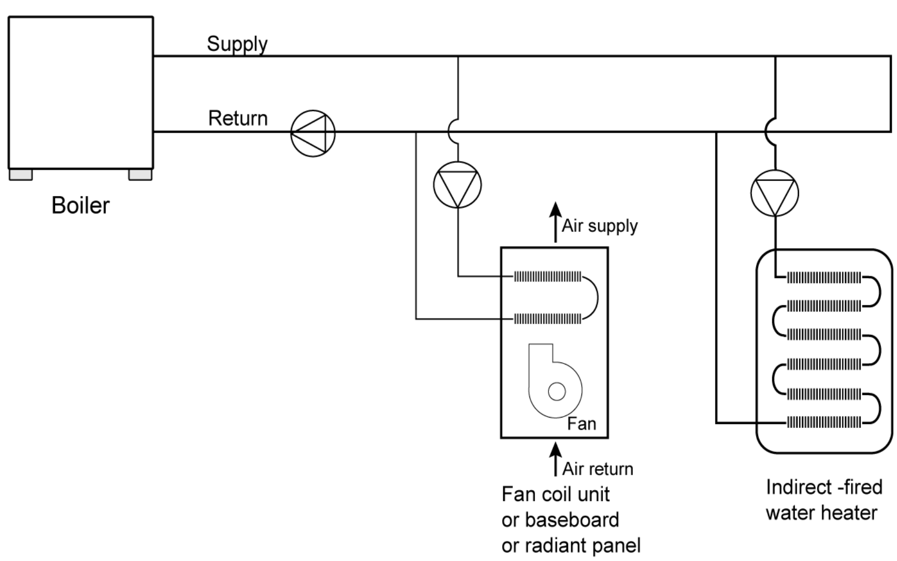
Credit for choosing a hydronic heating system is possible using the performance compliance method. The standard design is assumed to have a heat pump in climate zones 3, 4, 13, and 14 and a gas furnace in all other climate zones. In all cases, the system is of minimum efficiency rating with a ducted air distribution system. Therefore, hydronic systems without ducts can take credit for avoiding duct leakage penalties. In addition, minimizing the amount of pipe outside conditioned space will provide some savings. Hydronic heating and cooling compliance calculations are described in the *Residential ACM Manual*.

If the proposed hydronic system includes ducted air distribution, then the associated compliance options described earlier in this chapter may apply, such as improved airflow (if there is air conditioning) and supply duct location.

A "combined hydronic" system is another compliance option that is possible when using the performance method. *Combined hydronic heating* refers to the use of a single water heating device as the heat source for space and domestic hot water heating.

Combined hydronic systems may use either a boiler (as in the figure below), heat pump, or a water heater as a heat source. The boiler heats domestic water by circulating hot water through a heat exchanger in an indirect-fired water heater. The water heater provides domestic hot water as usual.

Figure 4-35: Combined Hydronic System With Boiler and Indirect Fired Water Heater



Source: Richard Heath & Associates/Pacific Gas and Electric Company

Space heating is accomplished by circulating water from the heat source through the space heating delivery system. Sometimes a heat exchanger is used to isolate potable water from the water circulated through the delivery system. Some water heaters have built-in heat exchangers for this purpose.

For compliance calculations, the water-heating function of a combined hydronic system is analyzed for water-heating performance as if the space-heating function were separate. For the space-heating function, an "effective" AFUE or HSPF rating is calculated. These calculations are performed automatically by the compliance software.

4.7.2 Radiant Floor System

§110.8(g) and Table 118.0-A

Radiant floor systems, using either hydronic tubing or electric cable, must meet mandatory insulation measures. (See below.) Radiant floors may take one of several forms. Tubing or electric elements for radiant floor systems may be:

1. Embedded in a concrete floor slab.
2. Installed over the top of a wood subfloor and covered with a concrete topping.
3. Installed over the top of a wood subfloor in between wood furring strips.
4. Installed on the underside surface of a wood subfloor

In the latter two types of installations, aluminum fins are typically installed to spread the heat evenly over the floor surface and to reduce the temperature of the water as required. All hydronic systems use one or more pumps to circulate hot water. Pumps are controlled directly or indirectly by thermostats or by special outdoor reset controls. When concrete slabs are heated by radiant tubing or cables, one of the insulation methods listed below must be complied with to prevent excessive heat loss from the slab edge.

Table 4-19: Slab Insulation Requirements for Heated Slabs

Location of Insulation	Orientation of Insulation	Installation Criteria	Climate Zone	Insulation R-Value
Outside edge of heated slab, either inside or outside the	Vertical	From the level of the top of the slab, down 16 inches or to the frost line, whichever is greater. Insulation may stop at the top of the footing where	1-15	5

Location of Insulation	Orientation of Insulation	Installation Criteria	Climate Zone	Insulation R-Value
foundation wall		this is less than the required depth. For below-grade slabs, vertical insulation shall be extended from the top of the foundation wall to the bottom of the foundation (or the top of the footing) or frost line, whichever is greater.		
Outside edge of heated slab, either inside or outside the foundation wall	Vertical	From the level of the top of the slab, down 16 inches or to the frost line, whichever is greater. Insulation may stop at the top of the footing where this is less than the required depth. For below-grade slabs, vertical insulation shall be extended from the top of the foundation wall to the bottom of the foundation (or the top of the footing) or frost line, whichever is greater.	16	10
Outside edge of heated slab, either inside or outside the foundation wall	Vertical	From the level of the top of the slab, down 16 inches or to the frost line, whichever is greater. Insulation may stop at the top of the footing where this is less than the required depth. For below-grade slabs, vertical insulation shall be extended from the top of the foundation wall to the	1-15	5

Location of Insulation	Orientation of Insulation	Installation Criteria	Climate Zone	Insulation R-Value
		bottom of the foundation (or the top of the footing) or frost line, whichever is greater.		
Between heated slab and outside foundation wall	Vertical and Horizontal	Vertical insulation from the top of the slab at the inside edge of the outside wall down to the top of the horizontal insulation. Horizontal insulation from the outside edge of the vertical insulation extending 4 feet toward the center of the slab in a direction normal to the outside of the building in the plan view.	16	10 vertical and 7 horizontal

Source: 2022 Energy Code Table 110.8-A

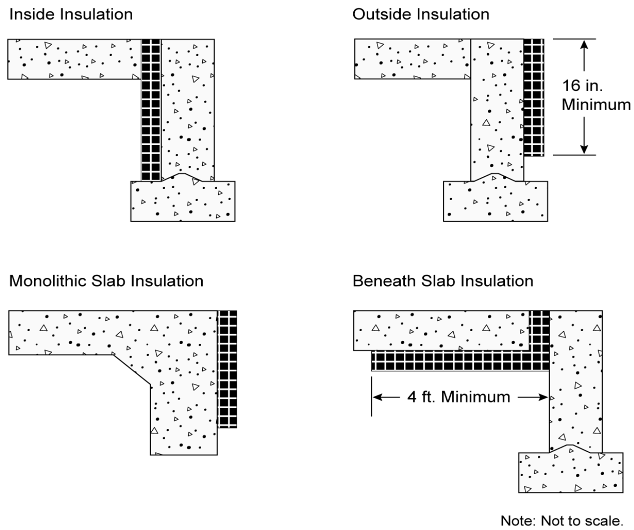
The required insulation value for each of these insulating methods is shown in Table 4-19.

Slab edge insulation applied to basement or retaining walls (with heated slab below grade) must be installed so that insulation starts at or above ground level and extends down to the bottom of the foundation or to the frost line, whichever is greater.

When using the performance compliance method with slab-on-grade construction, the standard design includes slab edge insulation as described above using the F-factors in JA4, Table 4.4.8.

When tubing or heating cables are set into a lightweight concrete topping slab laid over a raised floor, the edges of the radiant panel must not extend beyond the inside surface of insulated walls, and underside insulation must meet the mandatory minimum R-value for wood floor assemblies.

Figure 4-*36***:** *Heated Slab-On-Grade Floor Insulation Options*



Source: California Energy Commission

Local conditions (such as a high water table) may require special insulation treatment to achieve satisfactory system performance and efficiency. To determine the need for additional insulation, follow the recommendations of the manufacturer of the hydronic tubing or heating element being installed. Where there is any danger of termite infestation, install termite barriers to prevent hidden access for insects from the ground to the building framing. Termite barrier flashing should be embedded into the concrete.

In addition to the insulation R-value requirements, §110.8(g)1 also sets mandatory measures related to moisture absorption properties of the insulation and protection of the insulation from physical damage or pest intrusion.

Example 4-34

Question:

My client wants a dedicated hydronic-heating system (space heating only), but a few things are unclear: (1) What piping insulation is required? (2) Can I use any compliance approach? (3) Do I have to insulate the slab with slab edge insulation? (4) What special documentation must be submitted for this system type?

Answer:

(1) The supply lines not installed within a concrete radiant floor must be insulated in accordance with §150.0(j)2— Systems operating between 105° and 140° F must have at least 1 inch of insulation on pipes less than 1 inch in diameter, and 1.5 inches of insulation on pipes between 1 inch and less than 1.5 inches in diameter. Systems operating between 141° and 200° F must have at least 1.5 inches of insulation on pipes less than 1.5 inches in diameter.

(2) You can use any compliance approach, but the boiler must meet the mandatory efficiency 80 percent AFUE.

(3) The slab edge insulation shown in

Table 4-19 is required only when the distribution system is a slab-on-grade radiant floor system (pipes in the slab). When this is the case, the insulation values shown are mandatory measures (no modeling or credit).

(4) No special documentation is required.

Example 4-35

Question:

What are the slab edge insulation requirements for a hydronic-heating system with the hot water pipes in the slab?

Answer:

The requirements for slab edge insulation can be found in §110.8 and §150.0(l).

Material and installation specifications are as follows:

1. Insulation values as shown in
2. Table 4-19
3. Protected from physical damage and ultraviolet light deterioration
4. Water absorption rate no greater than 0.3 percent (ASTM-C272)
5. Water vapor permeance no greater than 2.0 per inch (ASTM-E96-14).

4.7.3 Evaporative Cooling

Evaporative coolers cool a building by passing outdoor air through a wetted evaporative medium (direct evaporative cooler), by indirect cooling through a nonporous heat exchanger separating evaporatively cooled secondary air from outdoor air, or by a system that combines an indirect heat exchanger with a downstream direct evaporative process. Although direct coolers are most common, the indirect and indirect-direct systems offer generally lower supply air temperatures with less moisture introduced to the indoor space. For the Energy Code, performance credit is allowed only for indirect and indirect-direct evaporative cooling systems. All coolers receiving credits within the *ACM Manual* must be listed in the CEC's Title 20 Evaporative Cooler appliance database at https:/cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx.

Evaporative coolers may be used with any compliance approach. In the prescriptive compliance approach, all evaporative coolers are treated as a minimum efficiency 13.0 SEER air conditioner.

In the performance approach, the compliance software uses an hourly model based on unit effectiveness, supply airflow, and power to determine the magnitude of the credit based on climate conditions and unit sizing relative to the loads. Typical cooling budget credits are 20-30 percent, depending upon these factors.

The evaporative cooling system must meet the following requirements to receive credit based on the hourly performance method described above. Direct coolers, as well as indirect and indirect-direct coolers not meeting these criteria, shall be modeled as a minimum efficiency (13.0 SEER) central air conditioner.

1. The equipment manufacturer shall certify to the Energy Commission that water use does not exceed 7.5 gallons per ton hour based on the Title 20 Appliance Efficiency Regulations testing criteria.
2. Equipment shall be permanently installed (no window or portable units).
3. Installation shall provide for automatic relief of supply air from the house with maximum air velocity through the relief dampers not exceeding 800 feet per minute (at the Title 20 rated airflow). Pressure relief dampers and ductwork shall be distributed to provide adequate airflow through all habitable rooms. For installations with an attic, ceiling dampers shall be installed to relieve air into the attic and then outside through attic vents. For installations without an attic, sidewall relief dampers are acceptable.
4. To minimize water consumption, bleed systems are not allowed.
5. A water quality management system (either "pump down" or conductivity sensor) is required. "Pump down" systems can either be integral to the evaporative cooler or they can be accessories that operate on a timed interval. The time interval between pumps shall be set to a minimum of 6 hours of

cooler operation. Longer intervals are encouraged if local water quality allows. Automatic systems that use conductivity sensors provide the best water efficiency compared to a timed pump down system. These sensors monitor the water quality and don't unnecessarily drain the water based on elapsed time.

6. Automatic thermostats are required. Manual on/off controls are not allowed.
7. If the evaporative cooler duct system is shared with a heating and/or cooling system, the installed duct system shall employ backdraft dampers at the evaporative cooler supply.
8. The installing contractor must provide a winter closure device that substantially blocks outdoor air from entering the indoor space.
9. The size of the water inlet connection at the evaporative cooler shall not exceed 3/8 inch.
10. Unless prohibited by local code, the sump overflow line shall not be directly connected to a drain and shall terminate in a location that is normally visible to the building occupants.

Example 4-36

Question:

How are applications with vapor compression cooling systems and evaporative cooling systems handled?

Answer:

In situations where evaporative cooling system(s) and vapor compression system(s) are installed in a house, the size of the evaporative cooler will dictate the magnitude of the credit. The performance approach will ensure that an evaporative cooler sized to meet most of the cooling loads will generate a higher credit than one sized to meet a fraction of the design cooling load.

Example 4-37

Question:

How do you model multiple evaporative coolers on one house?

Answer:

In situations with multiple evaporative coolers, effectiveness inputs should be averaged, and airflow and power inputs should be totaled. Performance characteristics of each piece of equipment should be listed on the compliance forms.

4.7.4 Ground-Source Heat Pumps

Table *4-20* – Standards for Ground Water-Source and Ground-Source Heat Pumps Manufactured on or *After October 29, 2003*

Appliance	Rating Condition	Minimum Standard
Ground water-source heat pumps (cooling)	59º F entering water temperature	16.2 EER
Ground water-source heat pumps (heating)	50º F entering water temperature	3.6 COP
Ground-source heat pumps (cooling)	77º F entering brine temperature	13.4 EER
Ground-source heat pumps (heating)	32º F entering brine temperature	3.1 COP

Source: Section 1605.3 Table C-7 of the 2015 California Appliance Efficiency Regulations

A geothermal or ground-source heat pump uses the earth as a source of energy when heating the home and as a heat sink for energy when cooling. Some systems pump water from an aquifer in the ground and return the water to the ground after exchanging heat with the water. A few systems use refrigerant directly in a loop of piping buried in the ground. Those heat pumps that either use a water loop or pump water from an aquifer have efficiency test methods that are accepted by the Energy Commission.

The mandatory minimum efficiencies for ground water-source heat pumps shown in Table 4-17 are certified to the Energy Commission by the manufacturer and are expressed in terms of coefficient of performance (COP) for heating and EER for cooling.

Verify that the system will meet local code conditions before choosing this type of system to comply with the Energy Code.

4.7.5 Solar Space Heating

Solar space-heating systems are not recognized within either the prescriptive packages or the performance compliance method.

4.7.6 Wood Space Heating

The Energy Commission's exceptional method for wood heaters with any type of backup heating is available in areas where natural gas is not available. If the required eligibility criteria are met, a building with one or more wood heaters may be shown to comply with the Energy Code using either the prescriptive or performance approaches as described below.

4.7.6.1 **Prescriptive Approach**

The building envelope conservation measures of the component package must be installed. The overall heating system efficiency (wood stove plus backup system) must comply with the prescriptive requirements.

4.7.6.2 **Performance Approach**

A computer compliance method may be used by modeling wood heat, which simulates an 80 percent AFUE central furnace with ducts that meet prescriptive requirements.

4.7.6.3 **Wood Heater Qualification Criteria**

The Energy Code establishes exceptional method guidelines for the use of wood heaters. If all the criteria for the wood heat exceptional method are not met, a backup heating system must be included in the compliance calculations as the primary heat source.

The building department having jurisdiction must determine that natural gas is not available.

Note: Liquefied petroleum gas, or propane, is not considered natural gas.

The following eligibility criteria apply:

1. The local or regional air quality authority must determine that its authorization of this exceptional method is consistent with state and regional ambient air quality requirements according to Sections 39000 to 42708 of the California Health and Safety Code.
2. The wood heater must be installed in a manner that meets the requirements of all applicable health and safety codes, including, but not limited to, applicable requirements for maintaining indoor air quality.
3. The wood heater must meet the EPA definition of a wood heater as defined in Title 40, Part 60, Subpart AAA of the Code of Federal Regulations (40CFR60 Subpart AAA) (See below.)
4. The performance of the wood heater must be certified by a nationally recognized agency and approved by the building department having jurisdiction to meet the performance standards of the EPA.
5. The rated output of the wood heater must be at least 60 percent of the design heating load, using calculation methods and design conditions as specified in §150(h).
6. At the discretion of the local enforcement agency, a backup heating system may be required and designed to provide all or part of the design heating load, using calculation methods and design conditions as specified in §150(h).

7. The wood heater must be located such that transfer of heat from the wood heater is effectively distributed throughout the entire residential dwelling unit, or it must be used in conjunction with a mechanical means of providing heat distribution throughout the dwelling.
8. Habitable rooms separated from the wood heater by one free opening of less than 15 ft^2 or two or more doors must be provided with a positive heat distribution system, such as a thermostatically controlled fan system. Habitable rooms do not include closets or bathrooms.
9. Wood heaters on a lower level are considered to heat rooms on the next level up, provided they are not separated by two or more doors.
10. The wood heater must be installed according to manufacturer and local enforcement agency specifications and must include instructions for homeowners that describe safe operation.
11. The local enforcement agency may require documentation that demonstrates that a particular wood heater meets all these requirements.

Federal regulation 40CFR60 Subpart AAA includes minimum criteria for wood heaters established by the U.S. EPA. These criteria define a wood heater as an enclosed, wood-burning appliance capable of and intended for space heating or domestic water heating that meets all the following criteria:

1. An air-to-fuel ratio averaging less than 35 to 1
2. A firebox volume less than 20 ft^3.
3. A minimum burn rate less than 5 kilogram/hour (11.0 lbs/hr)
4. A maximum weight of less than 800 kilograms (1,760 lbs)
5. The federal rules explicitly exclude furnaces, boilers, cook stoves, and open masonry fireplaces constructed on site, but include wood-heater inserts.

Example 4-38

Question:

Are pellet stoves treated the same as wood stoves for compliance with the Energy Code?

Answer:

Yes.

Example 4-39

Question: If a wood stove is installed in a wall, does it have to meet the fireplace requirements of §150(e)?

Answer:

No. A wood stove that meets EPA certification requirements does not have to meet any requirements applicable to fireplaces.

4.7.7 Gas Appliances

§110.5 Pilot Lights

Pilot lights are prohibited in fan-type central furnaces, pool heaters, spa heaters, and natural gas indoor and outdoor fireplaces.

Household cooking appliances are also prohibited from having a pilot light unless there is no electrical supply voltage connection and each pilot consumes less than 150 Btu/h.

For requirements related to installation of fireplaces, decorative gas appliances, and gas logs, see Chapter 3 of this manual.

4.7.8 Evaporatively Cooled Condensers

Evaporatively cooled condenser air conditioners are a type of air-conditioning system that can provide significant space-cooling savings, especially in hot, dry climates. The equipment minimal efficiencies are determined according to federal test procedures. The efficiencies of these air conditioners are reported in terms of energy efficiency rating (EER).

If credit is taken for a high EER, field verification by a HERS Rater is required. Other HERS-verified measures are also required, including duct sealing, airflow, fan efficacy, and refrigerant charge or fault indicator display.

Besides the HERS verification, there are additional special requirements for evaporatively cooled condensing air conditioners. These include that the manufacturer provide certification that water use is limited to no more than 0.15 gallon per minute per ton of capacity and that the supply line be no larger than ¼-inch in diameter. For a listing of all the requirements for evaporatively cooled condensing air conditioners, see the CF2R compliance form.

4.7.9 Variable Capacity Heat Pump Systems

Several manufacturers offer variable capacity mini-split or multi-split heat pump equipment that may or may not use air distribution ducts to heat or cool spaces. These systems provide advanced controls and multispeed compressors for optimizing performance through a wide range of conditioning loads.

These systems are required to be modeled as minimally efficient systems unless the variable capacity heat pump (VCHP) compliance credit is taken. This option is available to provide credit for systems meeting the eligibility requirements published in the 2022 Residential Appendices RA3.4.4.3. The credit can be applied through a CEC-approved modeling software by selecting the VCHP compliance option for the

HVAC system type. The Certificate of Compliance will indicate when a space conditioning system requires verification of the VCHP compliance option eligibility requirements. A system that does not meet the eligibility requirements upon verification will not be eligible to claim the VCHP performance compliance credit for the specified space conditioning system.

Compliance with the mandatory duct system sealing and leakage (Section 150.0(m)11) and fan airflow rate and fan efficacy testing (Section 150.0(m)13) are not required for systems that use this VCHP performance compliance option. However, there are requirements to verify that VCHP system indoor unit ducts are located entirely in conditioned space that are specified as eligibility requirements for this compliance option. There are also requirements for verification of minimum airflow rates for VCHP system indoor units that are specified as eligibility requirements for this compliance option.

Additional verification requirements apply depending on the system type and credit taken, see below.

- Low-Static Certification for Ducted Systems
- Non-Continuous Indoor Unit Fan Operation
- Refrigerant Charge Verification
- Ducts Located Entirely in Conditioned Space
- Indoor Units Located Entirely in Conditioned Space
- Supply to All Habitable Spaces
- Wall-Mounted Thermostat
- Space-Conditioning System Airflow
- Air Filter Sizing
- Air Filter Pressure Drop Rating

Default indoor unit fan configuration settings may require modification in order for the installed fan airflow to meet the required rate. The manufacturer's product documentation should provide direction for configuring the indoor unit fan for operation at airflow rates equal to or greater than the minimum rates required for compliance. The list of low-static ducted VCHP systems certified to the Energy Commission including the manufacturer's product documentation can be found at:

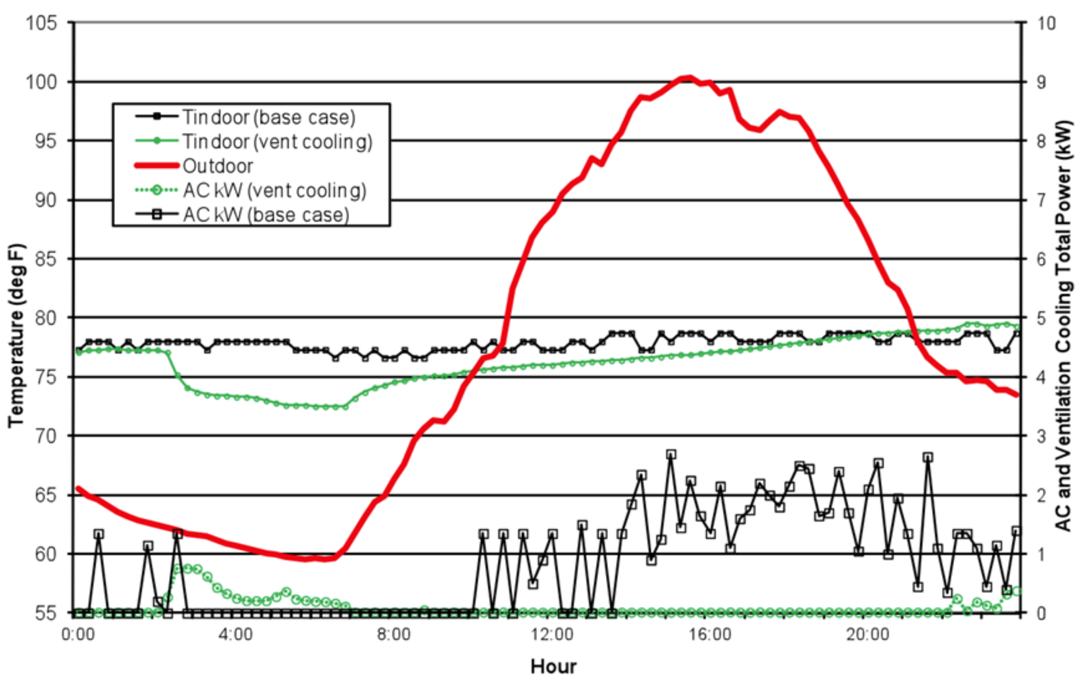
https://www.energy.ca.gov/rules-and-regulations/building-energy-efficiency/manufacturer-certification-building-equipment-2

4.7.10 Ventilation Cooling

Ventilation cooling is differentiated from the mechanical ventilation provided to maintain adequate indoor air quality, in that the primary focus is to bring in higher volumes of cool outdoor air (if available) to cool the dwelling unit to reduce the use of conventional vapor compression air conditioning. Ventilation cooling systems generally operate during summer evenings and nights when cooler outdoor air is available. The cooler outdoor air ventilation reduces indoor air temperatures during the evening and nighttime hours, and in the process cools the building interior thermal mass, which may offset or eliminate the next-day cooling loads of the dwelling. Ventilation cooling systems may cool the dwelling to temperatures that are below the normal air conditioner set point, which may improve the effectiveness of the next-day cooling load offset. The effectiveness of ventilation cooling depends upon the climate conditions, thermal envelope, and how much indoor temperature variation the occupant will tolerate.

Figure 4-37 compares cooling energy use over a day for two identical houses, one with and one without ventilation cooling, and illustrates how ventilation cooling can offset most of the air-conditioning energy by use of a relatively small amount of off-peak ventilation fan operation.

Figure 4-37: Diurnal Temperature Variation and Ventilation Cooling



Source: California Energy Commission

4.7.10.1 **Whole-House Fans**

The simplest form of ventilation cooling is a whole-house fan (WHF), which draws cooler outdoor air through open windows, exhausts the warmer air into the attic, and then expels the air outside through attic vents.

Traditional whole-house fans have a simple barometric damper (Figure 4-38) and either a belt-driven or direct-drive motor driving a prop fan. Figure 4-39 shows the damper open with the fan immediately above.

Figure 4-40 shows a similar product that moves less air but provides an insulated damper with a better leakage seal between the attic and conditioned space. These units are generally designed to fit between standard rafter spacing, simplifying retrofit installations.

Finally, Figure 4-41 shows a remote whole-house fan design that removes the fan farther from indoor space, reducing noise during operation.
WHFs cool a dwelling space most effectively when all windows throughout the house are opened only enough to produce a fairly uniform airflow into all rooms throughout the dwelling while not restricting the WHF total airflow. This results in the greatest interaction of the cool air with the interior mass throughout the dwelling, providing the greatest amount of stored cooling. Running the fan all night long increases the effectiveness of the next-day cooling offset by more fully “charging” the thermal mass. Noise can be reduced through either use of a variable-speed control or installation of a multispeed fan, allowing low-speed nighttime operation.

Security concerns may arise if windows are left open at night, but most window products can be secured if they are only partially open, thus providing the minimum open area for air to enter the room but preventing unauthorized entry from outside the dwelling.

Homeowners who have sensitivities to particulate matter in the outdoor air should consider that dust and allergens present in the outdoor air will easily enter the dwelling through the open windows during operation of a WHF.

The WHFs used to comply with the Energy Code must be listed in the HVI Certified Products Directory.

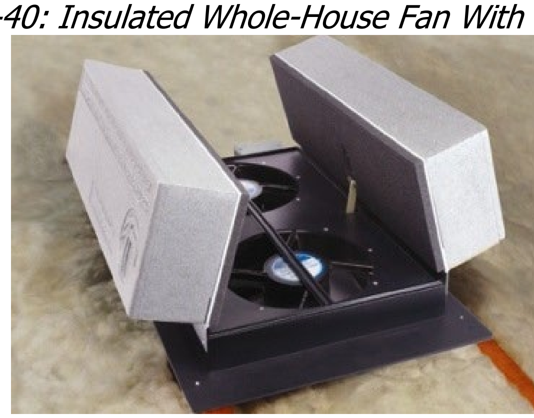
Figure 4-38: Whole-House Fan With Barometric Damper

Source: California Energy Commission

Figure 4-39: Open Barometric Damper With Fan Above

Source: California Energy Commission

Figure *4-40: Insulated Whole-House Fan With Damper Actuation*



Source: California Energy Commission

Figure *4-41*: *Ducted Remote Whole-House Fan*

Source: California Energy Commission

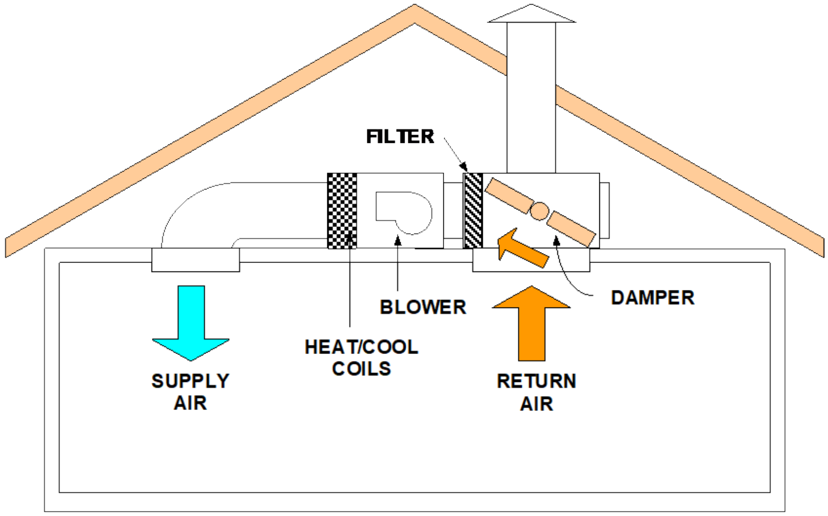
4.7.10.2 **Central Fan Ventilation Cooling Systems**

Another type of ventilation cooling system, the central fan ventilation cooling system (CFVCS) uses an automatically controlled outside air damper and the HVAC system fan or other fan to draw outside air through a large outdoor air vent and distributes the cool outdoor air through the HVAC system ductwork. Warm indoor air is then expelled into the attic through the same damper.

Primary advantages of this system include filtration of outside air, elimination of the need to open windows (improved security), and automatic sensing of the moment when the outdoor air temperature falls below the indoor temperature. A disadvantage of central fan systems is that they typically move less air and consume more energy per CFM as compared to a whole-house fan because of the more restrictive duct systems.

Figure 4-42 shows the airflow path through a CFVCS when the system is not operating to provide ventilation cooling (return air mode). In this mode, the system performs the same as a conventional central space-conditioning system, drawing the return air from the conditioned space, through the heating/cooling coils, then back to the conditioned space.

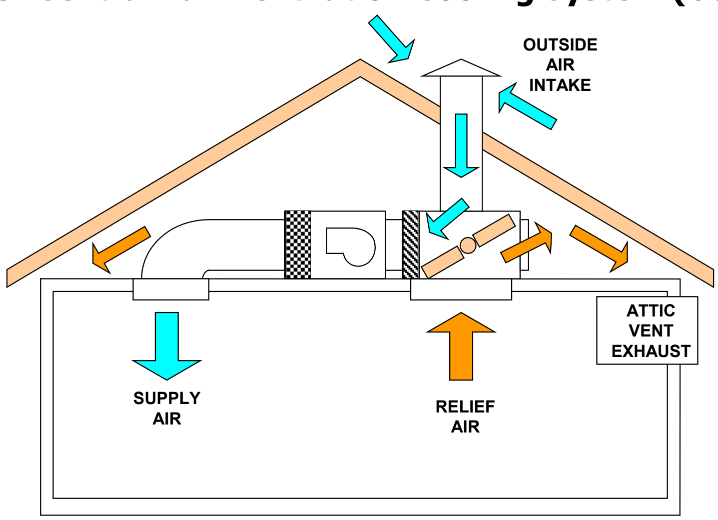
Figure 4-42: Central Fan Ventilation Cooling System (Return Air Mode)



Source: California Energy Commission

Figure 4-43 shows the airflow paths when the system is operating to provide ventilation cooling (outdoor air mode). In this mode, the damper changes position and draws outdoor air through the outdoor air intake vent, through the air handler, and then to the conditioned space. During outdoor air mode, the cooling/heating coils are not operated, and the damper allows indoor air to pass into the attic, then back to outdoors through the attic vents.

Figure 4-43: Central Fan Ventilation Cooling System (Outdoor Air Mode)

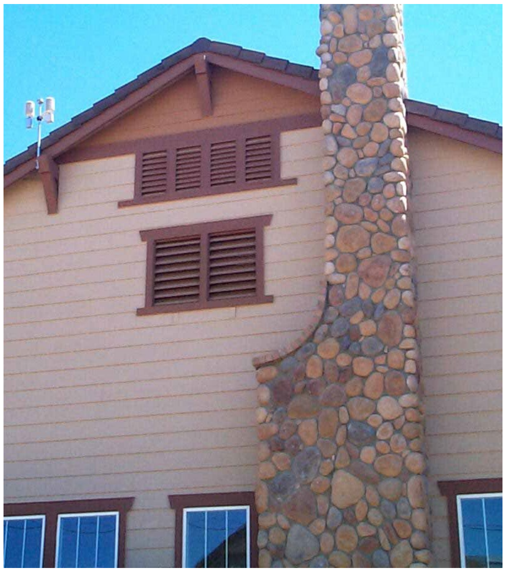


Source: California Energy Commission

Figure 4-44: Sample Rooftop Air Intake

Source: California Energy Commission

Figure 4-45: Sample Gable End Air Intake (Lower Set of Vents)



Source: California Energy Commission

CFVCSs may use a variable-speed motor with a fan-speed control that responds to outdoor temperature conditions and indoor comfort settings, which may improve energy savings compared to fixed-speed CFVCSs.

4.7.10.3 Prescriptive Requirements

Component packages specify a WHF as a prescriptive requirement for single-family newly constructed buildings in Climate Zones 8 through 14. The WHF, or CFVCS, must meet the eligibility criteria specified below to meet the prescriptive requirement.

New dwelling units with a conditioned floor area of 500 square feet and additions of 1,000 ft^2 or less are exempt from the whole-house fan prescriptive requirements.

4.7.10.3.1 Eligibility Criteria for Whole-House Fans

§150.1(c)12

1. Where atmospherically vented combustion appliances or solid-fuel burning appliances are located inside the pressure boundary, the operation of the whole-house fan must be considered in determining the adequacy of providing combustion air and prevention of back-drafting, which may cause toxic combustion products to enter conditioned space of the dwelling.
2. WHFs used to comply with the Energy Code must be listed in the HVI Certified Products Directory.
3. To meet the prescriptive requirement, the installed WHF(s) must have a listed airflow of at least 1.5 CFM/ft^2 of conditioned floor area. The house must have a minimum attic net free vent area to outdoors of one square foot per 750 CFM of installed rated airflow. See Table 4-21 and Table 4-22 for net free ventilation area requirements based on the square footage of the house.
4. Homeowners who have WHFs installed must be provided with a one-page "How to operate your whole house fan" informational sheet.

A. Eligibility Criteria for Central Fan Ventilation Cooling Systems

CFVCS may be approved for use for compliance credits as "fixed-speed" systems or as "variable speed" systems. The Energy Commission must review submittals from manufacturer applicants and determine whether the system meets the qualifying criteria:

When applying for approval for either fixed speed or variable speed systems, the manufacturer must provide documentation to demonstrate the system meets the criteria listed in paragraphs 1, 2, and 3 below

1. CFVCS must meet the applicable duct leakage requirements with the system operating in return air mode (Figure 4-42).
2. CFVCS must be HERS verified for airflow (CFM) and fan efficacy (w/CFM), demonstrating an efficacy of no more than 0.45 watts/CFM for furnaces, 0.58 W/CFM for heat pumps, and 0.62W/CFM for small duct, high velocity systems.
3. In addition to sensing temperature at the thermostat, the CFVCS must have an outdoor temperature sensor to initiate and terminate ventilation cooling operation and a means to detect damper failure.

When applying for approval as a variable speed system, the manufacturer must also provide the documentation described in paragraphs 4, 5, and 6 below.

4. The installed fan motor is a variable-speed motor.

5. The motor is controlled in ventilation cooling mode to vary in a continuous range between full air flow (100 percent) and a minimum airflow of no more than 25 percent of full airflow.
6. The manufacturer must provide written documentation that describes how its control strategy is implemented, how the ventilation cooling fan speed is controlled, and how ventilation cooling rates are determined. The ventilation cooling rate calculation must occur within a 24-hour interval or less to ensure that the system responds in a timely manner to changes in weather patterns.

Table 4-21 shows example conversions for the calculated net free vent area (NFVA) for a range of whole-house fan airflow levels. Instead of using the table, one can calculate the NFVA by dividing the listed CFM by 750.

Table 4-21: Sample NFVA Calculation

CEC Listed Airflow (CFM)	Minimum Attic NFVA (ft2)
2000	2.7
3000	4
4000	5.3
5000	6.7
6000	8
7000	9.3

Source: California Energy Commission

Since attic vents present some level of airflow restriction, use the appropriate screen and louver reduction factor from Table 4-22.

Table *4*-22*:* Attic Vent Airflow Reduction Factors

Vent Type	**Reduction Factor**
¼″ screen (hardware cloth)	0.90
¼″ screen with metal louvers	0.75
¼″ screen with wood louvers	0.25
Insect screen (mesh under ¼″)	0.50
Insect screen with metal louvers	0.50
¼″ screen with wood louvers	0.25

Source: California Energy Commission

Example 4-40

Required vent area = Minimum Attic NFVA (Table 4-18) ÷ Reduction Factor

A 3,000 CFM fan is selected from the Energy Commission Appliance Database. The builder plans to use vents with ¼" screen with metal louvers.

Answer

The minimum required vent area is = 4.0 ÷ 0.90 = 4.4 ft^2

Example 4-41 – Ventilation Cooling

Question:

I am building a 2,350 ft^2 house in Climate Zone 8. Do I need to install a whole-house fan or central fan ventilation system?

Answer:

Yes, if you are complying prescriptively.

No, if you are complying using the performance method and no whole-house fan was modeled.

Whole-house fans are a prescriptive requirement in Climate Zones 8-14, meaning that they are not mandatory, although they define the prescriptive compliance level. If you decide to install a whole-house fan to meet the prescriptive requirement, you should select a fan from the Energy Commission Appliance Database. The prescriptive requirement specifies a minimum airflow of 1.5 CFM/ft^2 (3,525 CFM for the proposed house) and 1 ft^2 of attic net free ventilation area per 750 CFM of airflow (4.7 ft2 for a 3,525 CFM fan).

Example 4-42

Question:

Why do I need to provide attic ventilation area for a whole-house fan?

Answer:

Whole-house fans move a lot of air from inside the dwelling unit, all of which is exhausted to the attic. Without sufficient attic relief to the outdoors, the fan will move less air.

Example 4-43

Question:

What are the advantages and disadvantages of whole-house fans relative to central fan ventilation cooling systems?

Answer:

Whole-house fans are relatively inexpensive; both in first cost and operating cost and are highly effective if used properly in the right climate. They move much more air than central fan systems, which must deliver air through the duct system. Whole-house fans may be noisy, require user operation to open windows, turn on and off, bring in dust and allergens from outside, and potentially reduce home security if windows are left open throughout the night. Central fan systems are more expensive and generally move less air, but provide totally automated operation, independent of whether the occupant is home. Windows can remain shut, and all outdoor air is filtered. Some central fan systems may also be configured to provide ventilation that complies with the whole-dwelling indoor air quality requirements in Section 150.0(o). Review product literature to determine if available products meet the Energy Commission's fresh air ventilation requirements.

Example 4-44

Question:

A two-story home with 2,500 sf of conditioned space and an attic is located in Climate Zone 10. Is a whole-house fan required? Does this affect the number of vents in the attic?

Answer:

Yes, if complying prescriptively. Section 150.1(c)12 requires whole-house fans (WHF) in single-family houses that are in Climate Zones 8-14. These are climate zones that have summer cooling needs but where the home can be efficiently cooled on cool summer evenings by the use of a whole-house fan.

Section 150.1(c)12 also requires that these fans be sized so they provide at least 1.5 cubic feet per minute (CFM) of flow for each square foot of conditioned space in the house. The fans used must be listed in the Energy Commission's Appliance Database at http://appliances.energy.ca.gov/QuickSearch.aspx and the rated CFM listed on the CF2R-MCH-02 form. In addition, the attic must have at least 1 sf of attic vent free area for each 750 CFM of whole-house fan-rated flow.

Thus, for this house with 2,500 sf of conditioned floor area, the minimum total flow rate of whole-house fans installed in the house must be at least:

Min WHF flow rate = Conditioned Floor Area x 1.5 CFM/sf = 2,500 sf x 1.5 CFM/sf = 3,750 CFM.

In this case, the builder has selected two 2,000 CFM whole-house fans. The minimum amount of vent net-free area in the attic is calculated as follows:

Net Free Area = Total WHF CFM / (750 CFM/sf NFA) = (2,000 + 2,000) / 750 = 5.3 sf

4.8 Refrigerant Charge

4.8.1 Refrigerant Charge Verification

This section summarizes the procedures for verifying refrigerant charge for air-conditioning systems as described in RA3.2.

4.8.1.1 **Overview**

A split-system air conditioner undergoes the final assembly at installation. The installation must be verified to ensure proper performance. Important factors that affect performance include the amount of refrigerant in the system (the charge) and the proper functioning of the metering device. Air conditioner energy efficiency suffers if the refrigerant charge is either too low or too high and if the metering device (TXV or EXV) is not functioning properly. In addition to a loss of efficiency and capacity, errors in these areas can lead to premature compressor failure.

To help avoid these problems, the prescriptive standards require that systems be correctly installed. The prescriptive standards also require that they be field-verified in Climate Zones 2 and 8 through 15. Refrigerant charge verification is also required in any climate zone when chosen as a compliance feature using the performance approach.

The requirement to verify the refrigerant charge after installation does not apply to new packaged systems, where the installer certifies the package system came factory-charged and did not alter the system in any way that would affect the refrigerant level; however, airflow and other requirements must still be verified. The prescriptive standards regarding verification of refrigerant charge do apply to altered package systems in Climate Zones 2 and 8 through 15.

Verification of proper refrigerant charge must occur after the HVAC contractor has installed and charged the system in accordance with the manufacturer's specifications. The procedure requires properly calibrated digital refrigerant gauges, thermocouples, and digital thermometers. When multiple systems in the same home require testing, test each system.

In a typical home cooling system, there are two important performance criteria that are relatively easy to verify that there is neither too much nor too little refrigerant in the system. In systems with a fixed-orifice device in the evaporator coil, the number to check is called the *superheat*. In a system with a variable-metering device, the number to check is called the *subcooling*.

Superheat refers to the number of degrees the refrigerant is raised after it evaporates into a gas. This occurs inside the evaporator coil (or *indoor coil*). The correct superheat for a system will vary depending on certain operating conditions. The target superheat for a system must be obtained from a table provided in the RA3.2 protocols or the manufacturer's superheat table. There is an allowed range of several degrees between the measured superheat and the target superheat for a system to pass.

Subcooling refers to the number of degrees the refrigerant is lowered after it condenses into a liquid. This occurs inside the condenser coil (or *outdoor coil*). The manufacturer specifies the correct subcooling for a system. It may vary depending on operating conditions. Like superheat, there is an allowed range of several degrees between the measured subcooling and the target subcooling for a system to pass.

The temperature at which a refrigerant condenses or evaporates is called the *saturation temperature*. Above the saturation temperature, a refrigerant is always a gas. Below the saturation temperature, a refrigerant is always a liquid.

Saturation is when a refrigerant exists as both a liquid and a gas. It always occurs at the same temperature, depending on what the pressure of the refrigerant happens to be. At higher pressures, the saturation temperature goes up and vice versa. This convenient property is what makes refrigeration work.

The saturation temperature can be determined by simply measuring the pressure of a refrigerant and referring to a table, known as a *pressure-temperature* (PT) *table*, for that specific refrigerant. Saturation temperatures are well-documented for all common refrigerants.

Because variable refrigerant metering devices are prone to failure and even more so to improper installation, it is important that the operation of these devices be checked. A metering device maintains a relatively constant superheat over a wide range of operating conditions; therefore, checking the superheat, in addition to the other tests performed, will indicate if the metering device is operating correctly.

Unfortunately, checking superheat and subcooling can be done only under certain indoor and outdoor conditions. This verification procedure, called the Standard Charge Verification Method, is very weather-dependent.

There is another way to verify proper refrigerant charge that is not weather–dependent, and that is by weighing the refrigerant. Called the Weigh-in Charge Verification Method, this approach can be performed only by the installer. It can be verified by the HERS Rater either by simultaneous observation or by using the standard method when conditions permit.

4.8.1.2 Minimum System Airflow Verification for Refrigerant Charge Verification

To have a valid charge test, the system airflow must be verified to be at least 300 CFM/ton for altered systems and 350 CFM/ton for new systems. The procedures for measuring total system airflow are found in RA3.3. They include plenum pressure matching using a fan flow meter, a flow grid, a powered flow hood, and the traditional (nonpowered) flow hood. The airflow verification procedures for refrigerant charge verification no longer include the temperature split method.

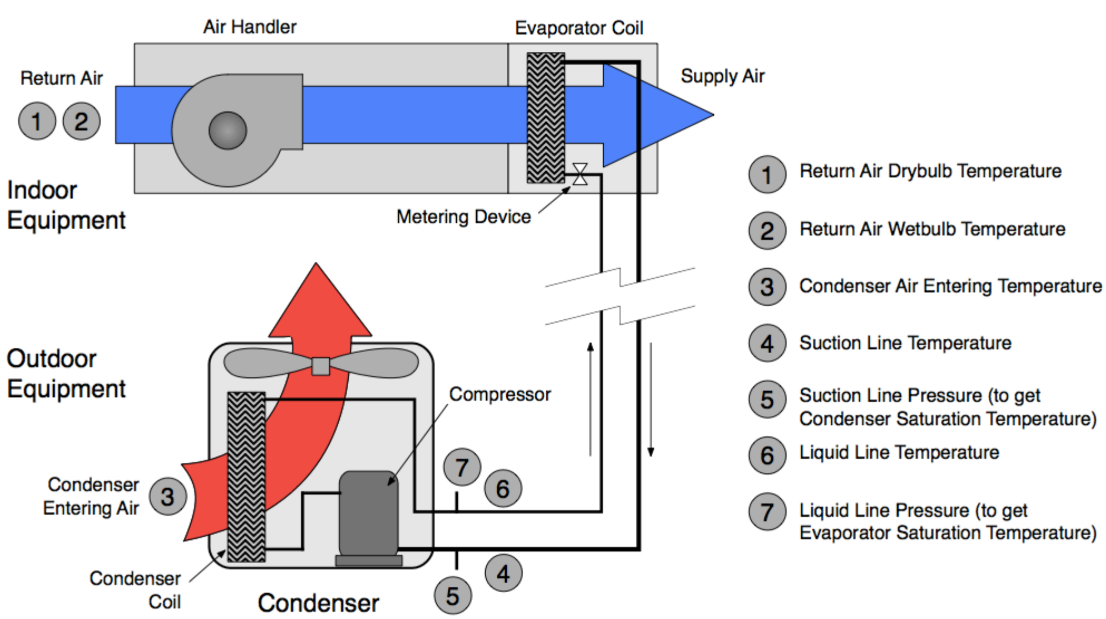
If an altered system does not meet the minimum airflow requirements, remedial steps are required to increase system airflow. More airflow is generally better for systems with air conditioning. Not only does this allow proper refrigerant charge to be verified, but it improves the overall performance of the system. When able to be performed on a system, regardless of the refrigerant charge verification procedure, minimum system airflow must always be verified.

In some alterations, improving airflow may be cost-prohibitive, and there is a process for documenting this (RA3.3.3.1.5). When this option is used, verification by sample groups is not allowed. Minimum airflow is critical to proper air-conditioner operation. Reducing airflow reduces cooling capacity and efficiency. Many systems in California have oversized equipment and undersized ducts. In newly installed duct systems, the minimum airflow requirement is higher because the opportunity exists to design and install a better system. In altered systems, the installer may be required to modify the ducts system to meet the minimum airflow. The minimums of 300 and 350 CFM/ton are lower than the desired airflow for most systems, which is usually 400 CFM/ton and higher.

4.8.1.3 **Standard Charge Verification Procedure (RA3.2.2)**

The first step is to turn on the air-conditioning system and let it run for at least 15 minutes to stabilize temperatures and pressures. While the system is stabilizing, the HERS Rater or the installer may attach the instruments needed to take the measurements.

Figure 4-45: Measurements for Refrigerant Charge and Airflow Tests



Source: California Energy Commission

The following measurements shall be taken by the technician or HERS Rater, when applicable.

1. The return air wet bulb and dry bulb temperatures are measured in the return plenum before the blower at the location labeled "Title 24 – Return Plenum Measurement Access Hole." This hole must be provided by the installer, not the rater (See Points 1 and 2 in Figure 4-45). See Figure RA 3.2-1 for more information on the placement of the measurement access hole (MAH).
2. Moreover, the outdoor air dry bulb temperature is measured at the point where the air enters the outdoor condensing coil. (See Point 3 in Figure 4-45). It is important that this outdoor temperature sensor be shaded from direct sun during the verification procedure.

In addition to the air temperature measurements, four refrigerant properties need to be measured. Two of these measurements are taken near the suction line service valve before the line enters the outdoor unit and are used to check the superheat.

1. The first measurement is the temperature of the refrigerant in the suction line, which is taken by a clamp-on thermocouple or other suitable device insulated from the outdoor air. (See Point 4 in Figure 4-45.)
2. The second measurement determines the saturation temperature of the refrigerant in the evaporator coil. (See Point 5 in Figure 4-45.)The saturation temperature can be determined from the low-side (suction line) pressure and a saturation temperature table for the applicable refrigerant.

To check the subcooling, two more refrigerant properties are required and may be measured near the liquid line service valve at the point where the line exits the outdoor unit.:

1. The liquid refrigerant temperature in the liquid line is measured by a clamp-on thermocouple insulated from the outdoor air. (See Point 6 in Figure 4-45.)
2. The condenser saturation temperature can be determined from the liquid line pressure and a saturation temperature table for the applicable refrigerant. (See Point 7 in Figure 4-45.)

Determination of the condenser saturation temperature and the liquid line temperature is used only for the subcooling verification method on systems with TXV or EXV metering devices.

4.8.1.4 **Superheat Charge Verification Method (RA3.2.2.6.1)**

The *Superheat Charge Verification Method* is used on units with a fixed-orifice refrigerant metering device (not a TXV or EXV).

Airflow verification must be confirmed before starting the Superheat Verification Method.

The *Superheat Verification Method* compares the actual (measured) superheat temperature to a target value from a table. The actual superheat temperature is the measured suction line temperature ($T_{Suction,\ db}$) minus the evaporator saturation temperature ($T_{Evaporator,\ Saturation}$). The target superheat value is read from a table (Table RA3.2-2 or the manufacturer's superheat table).

Only an EPA-certified technician may add or remove refrigerant. Under no circumstances may HERS Raters add or remove refrigerant on systems that they are verifying.

4.8.1.5 **Subcooling Verification Method (RA3.2.2.6.2)**

The *Subcooling Verification Method* is used on units with a variable refrigerant metering device (a TXV or EXV).

Airflow verification must be confirmed before starting the Subcooling Verification Method.

The Subcooling Verification Method compares the actual subcooling temperature to the target value supplied by the manufacturer. The actual subcooling is the condenser saturation temperature ($T_{Condenser,\ Saturation}$) minus the liquid line temperature (T_{Liquid}).

4.8.1.6 **Weigh-In Charging Procedure (RA3.2.3)**

The weigh-in charging procedure charges the system by determining the appropriate weight of refrigerant based on the size of the equipment and refrigerant lines rather than by measuring steady-state performance of the system. Systems using the weigh-in procedure to meet the refrigerant charge verification requirement may not use group sampling procedures for HERS verification compliance.

The weigh-in procedure does not relieve the installer of the responsibility to comply with the required minimum system airflow.

There are two installer options for completing the weigh-in procedure. One involves adjusting the amount of refrigerant supplied by the manufacturer in a new system, as specified by the manufacturer (weigh-in charge adjustment). The other involves evacuating the entire system and recharging it with the correct total amount of refrigerant, by weight (weigh-in total charge).

The weigh-in charge adjustment procedure may be used only when a new factory-charged outdoor unit is being installed and the manufacturer provides adjustment specifications based on evaporator coil size and refrigerant line size and length.

The weigh-in total charge may be used for any weigh-in procedure but still requires manufacturer's adjustment specifications. Only the installer/technician may perform any kind of weigh-in procedure.

4.8.1.7 **Equipment Limitations**

The Energy Code specifically requires verification of refrigerant charge only for air-cooled air conditioners and air-source heat pumps. All other types of systems are not expressly exempt from the refrigerant charge requirements. Certain portions of the requirements may still apply, such as the minimum system airflow requirement. The installer would have to confirm with the manufacturer and the CEC. The installer must adhere strictly to the manufacturer's specifications.

Variable refrigerant flow systems and systems such as some mini-split systems that cannot be verified using the standard charge verification procedure in RA3.2.2 must demonstrate compliance using the weigh-in method. Verification by the HERS Rater can be accomplished only by simultaneous observation of the installer's weigh-in as specified by RA3.2.3.2, and only if use of HERS Rater observation procedure is specified by the Energy Code.

4.8.1.8 **HERS Verification Procedures**

When required by the CF1R, HERS Raters must perform field verification and diagnostic testing of the refrigerant charge, including verification of minimum system airflow and verification of installation of the measurement access hole.

The verification procedures are essentially identical for the rater and the installer except that the tolerances for passing the superheat and subcooling tests are less stringent for the rater's test. This is to allow for some variations in measurements due to instrumentation or test conditions (for example, weather).

The following conditions prohibit verification using sample groups:

1. When the weigh-in method is used
2. When the minimum airflow cannot be met despite reasonable remediation attempts. (See RA3.3.3.1.5).

As always, to be eligible for sampling, the installer must first verify and pass the system. If sampling is not being used, the rater will perform the verification only after the installer has charged the system according to manufacturer's specifications.

4.8.1.9 **Winter Setup Procedures**

Reference Appendix RA1 provides for the approval of special case refrigerant charge verification procedures. These protocols may be used only if the manufacturer has approved use of the procedure for their equipment.

One such procedure is found in RA1.2 Winter Setup for the standard charge verification procedure (winter charge setup). It provides for a modification to the standard charge procedure when temperature conditions do not allow use of the RA3.2.2 standard charge verification procedure.

The winter charge setup allows both installers and HERS Raters to verify the charge when outdoor temperatures are below the manufacturer's allowed temperature, or the outdoor temperature is less than 55°F. The Weigh-in Charging Procedure specified in Section RA3.2.3 may also be used when the outdoor temperatures are below the manufacturer's allowed temperature or below 55°F but may be used only by the installer.

The winter charge setup procedure allows the system to operate in the same range of pressure differences between the low-side pressure and the high-side pressure as occurs during warm outdoor temperatures, by restricting the airflow at the condenser fan outlet. The winter charge setup is used only for units equipped with variable metering devices, which include thermostatic expansion valves (TXV) and electronic expansion valves (EXV) for which the manufacturer specifies subcooling as the means for determining the proper charge for the unit, including units equipped with microchannel heat exchangers. Once this pressure differential is achieved, the variable metering device calculations are conducted in the same way as the variable metering device procedures described in RA3.2.2.6.2. All other applicable requirements of Section RA3.2.2 remain the same and must be completed when using the winter charge setup.

Though not specifically mentioned in the FID protocols in Residential Appendix RA3.4.2, the RA 1.2 winter setup method may be used if applicable. Thus for FID verification, the winter setup method may be used in place of the subcooling method.

4.8.1.10 **Using Weigh-In Charging Procedure at Low Outdoor Temperatures**

When a new HVAC system is installed, the HVAC installer must check the refrigerant charge, and a HERS Rater must verify the correct charge; however, an exception to §150.1(c)7A provides for an alternative third-party HERS verification if the weigh-in method is used when the outdoor temperature is less than 55 degrees F.

Typically, when the weigh-in method is used by the installing contractor, a HERS Rater must perform a charge verification in accordance with the RA3.2. standard charge procedure. However, because the RA3.2.2 procedures cannot be used when the outdoor temperatures are less than 55 degrees, the Energy Code provides the installer with two choices:

1. Use the RA3.2.3.1 Installer Weigh-In Charging Procedure to demonstrate compliance and install an occupant-controlled smart thermostat (OCST).
2. Wait for warmer temperatures then perform the standard charge verification procedure. In this case, the installer must agree to return to correct refrigerant charge if a HERS Rater determines later, when the outside temperature is 55 degrees F or above, that correction is necessary as

described in Residential Appendix RA 2.4.4. The installer must also provide written notice to the homeowner and enforcement agency that the charge has not yet been verified. An example homeowner's notification is shown in Figure 4-46.

Figure 4-46: Example of Notification to Homeowners of Delayed Charged Verification

Note to Homeowner: We're not done yet!

Congratulations on your new Air-Conditioning System! Your new system is more efficient than older systems and it has been installed to industry guidelines, ensuring many years of comfort and efficient service.

One thing you to know, however, is that the installation process is not complete! Because your unit was installed when the outside air temperature too low to fine tune the air conditioner, the unit must be serviced and verified when the weather is warmer.

This requires your cooperation. You need to allow access to the unit for your Installer and/or HERS Rater (verifier) to verify that and the airflow are set correctly. Your project is not considered finished until this verification takes place. If it is not done, **your unit may cost more to operate, may not heat and cool as effectively and may not last as long.**

Source: California Energy Commission

4.9 Compliance and Enforcement

This section describes compliance documentation and field verification requirements related to heating and cooling systems.

4.9.1 Design-Phase Documentation

The initial compliance documentation consists of the certificate of compliance (CF1R). It lists the features that the house needs for compliance with the prescriptive or performance requirements.

For the prescriptive compliance approach, the required features are based on the Prescriptive Component Package, shown in Tables 150.1-A and 150.1-B.

For the performance compliance approach, the required features are based on a set of features that the designer has documented to result in a level of efficiency at least as good as the prescriptive component package for single-family houses and townhouses. The calculations for documenting this are done using the approved performance compliance software at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2019-building-energy-efficiency-2. The calculation approach is described in the *Residential ACM Reference Manual.*

The performance compliance approach provides maximum design flexibility. It also allows compliance credit for special additional features to be quantified.

The CF1R lists special modeling features for which special compliance credit was taken using the performance approach. They require additional visual verification by the enforcement agency to ensure proper installation. Some require field verification and diagnostic testing by a HERS Rater. These will be listed separately on the CF1R under the following headings. For the purposes of this manual, only HVAC-related features are listed below.

Special Features Not Requiring HERS Rater verification:

1. Ducts in a basement
2. Ducts in a crawlspace
3. Ducts in an attic with a radiant barrier
4. Hydronic heating and system design details
5. Gas-fired absorption cooling
6. Zonal control
7. Ductless wall heaters

Special features requiring HERS Rater verification:

1. Duct sealing
2. Verified duct design – for reduced duct surface area and ducts in conditioned space
3. Low-leakage ducts in conditioned space
4. Low-leakage air handlers
5. Verification of return duct design
6. Verification of air filter device design
7. Verification of bypass duct prohibition
8. Refrigerant charge verification
9. Installation of a fault indicator display (FID)
10. Verified system airflow
11. Air handler fan watt draw
12. High energy efficiency ratio (EER)

13. Verified seasonal energy efficiency ratio (SEER)
14. Heating seasonal performance factor (HSPF)
15. Heat pump - rated heating capacity
16. Continuous whole-dwelling unit mechanical ventilation airflow for IAQ
17. Intermittent dwelling unit mechanical ventilation airflow for IAQ
18. Kitchen exhaust fan verification for IAQ (Local Mechanical Exhaust)
19. Whole-house fan (WHF) airflow and fan efficacy
20. Central fan ventilation cooling system (CFVCS)
21. Variable capacity heat pump (VCHP)
22. HRV/ERV fan efficacy

Information summarizing measures requiring field verification and diagnostic testing is presented in Table RA2-1. The field verification and diagnostic testing protocols that must be followed to qualify for compliance credit are described in RA3

Registration of the CF1R with an approved HERS Provider is required. The building owner or the person responsible for the design must submit the CF1R to a HERS Data Registry for retention according to the procedures described in Section 10-103 and RA2. Registration ensures that the project follows the appropriate verification process, provides tracking, and provides electronic access to authentic documentation.

4.9.2 Construction-Phase Documentation

During construction, the general contractor or specialty subcontractors must complete all applicable CF2Rs for the building design special features specified on the CF1R.

Registration of the CF2R is required. The licensed contractor responsible for the installation must submit the CF2R information that applies to the installation to a HERS Provider Data registry using procedures described in Section 10-103 and RA2. CF2R documents corresponding to the list of special features requiring HERS Rater verification in Section 4.9.1 are required.

4.9.3 Field Verification and Diagnostic Testing

When the CF1R and CF2Rsrequire HERS field verification, a HERS Rater must visit the site to perform the tests necessary to complete the applicable heating and cooling system certificates of verification (CF3R). A CF3R is available for each special feature requiring HERS Rater verification given in Section 4.9.1.

Field verification for nonmandatory features is necessary only when performance credit is taken for the measure. Some field verifications are mandatory in all homes unless they are exempted in the Energy Code by specific exceptions.

Registration of the CF3R is required. The HERS Rater must submit the field verification and diagnostic testing information to the HERS Data Registry as described in Chapter 2. For additional details describing HERS verification and the registration procedure, refer to RA2.

2019 EDITION

SIGNIFICANT CHANGES TO THE CALIFORNIA ENERGY CODE

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ICC INTERNATIONAL CODE COUNCIL

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International Code Council

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ISBN: 978-1-955636-12-4 (soft-cover edition)
ISBN: 978-1-955636-13-1 (PDF download)

Cover Design: Julia Lange
Manager of Development: David Walls
Publications Manager: Anne Kerr
Project Editor: Valerie Necka

Errata on various ICC publications may be available at www.iccsafe.org/errata.

First Printing: May 2021

PRINTED IN THE USA

T026502

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Preface

The purpose of *Significant Changes to the California Energy Code Code, 2019 Edition*, is to familiarize energy code professionals, building officials, fire officials, plans examiners, inspectors, design professionals, contractors, and others in the building construction industry with many of the important changes in the 2019 *California Energy Code* (CEC). This publication is designed to assist code users in identifying the specific code changes that have occurred and understanding the reasons behind the changes. It is also a valuable resource for jurisdictions in their code-adoption process.

Only a portion of the code changes to the CEC are discussed in this book. The changes selected were identified for a number of reasons, including their frequency of application, special significance, or change in application. However, the importance of the changes not included is not to be diminished. Further information on California code changes can be found in the *California Significant Code Change series,* available from the International Code Council® (ICC®). This resource series provides the published documentation for each successful code change contained in the 2019 California Building, Fire, and Residential Codes.

Significant Changes to the California Energy Code (CEC), 2019 Edition, is organized into nine parts, each representing a distinct grouping of code topics. It is arranged to follow the general layout of the CEC, including code sections and section number format. The table of contents, in addition to providing guidance in the use of this publication, allows for a quick identification of those significant code changes that occur in the 2019 CEC.

Throughout the book, each change is accompanied by a photograph or an illustration to assist in and enhance the reader's understanding of the specific change. A summary and a discussion of the significance of the change are also provided. Each code change is identified by type, be it an addition, modification, clarification, or deletion.

The code change itself is presented in a legislative format similar to the style utilized for code-change proposals. Deleted code language is shown with a strikethrough, whereas new code text is indicated by underlining. As a result, the actual 2019 code language is provided, as well as a comparison with the 2016 CEC language, so the user can easily determine changes to the specific code text.

As with any code-change text, *Significant Changes to the California Energy Code, 2019 Edition*, is best used as a companion to the 2019 CEC. Because only a limited discussion of each change is provided, the code itself should always be referenced in order to gain a more comprehensive understanding of the code change and its application.

The commentary and opinions set forth in this text are those of the authors and do not necessarily represent the official position of ICC. In many cases, the explanatory material is derived from the reasoning expressed by code-change proposals.

Comments concerning this publication are encouraged and may be directed to ICC at significantchanges@iccsafe.org.

About the *California Energy Code*

Building officials, design professionals, contractors and others involved in the field of building construction recognize the need for modern, up-to-date building energy codes addressing the design and installation of building systems through both prescriptive and performance requirements. The *California Energy Code* (CEC), 2019 Edition, is intended to meet these needs for residential and commercial buildings through the development and adoption of Part 6 of the California Building Standards Code that safeguard the public health, the environment, and safety in all communities, large and small. The CEC is kept up to date through California's code-development process. The provisions of the 2016 edition, along with those code changes approved through 2019, make up the 2019 edition.

The CEC is Part 6 of the California Building Standards Code, Title 24 and is published by ICC. This comprehensive code establishes minimum regulations for residential and commercial building systems by means of prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new building designs. The CEC is a comprehensive code containing provisions for building energy conservation and efficiency and is applicable to buildings throughout California.

Acknowledgments

Grateful appreciation is due to many ICC staff members for their generous assistance in the preparation of this publication, and to the following:

Payam Bozorgchami, P.E.	Bill Pennington	Mazi Shirakh, P.E.
Peter Strait	Todd Ferris	Larry Froess, P.E.
Simon Lee, P.E.	Jeff Miller, P.E.	Ronald Balneg
Dee Anne Ross	Michael Shewmaker	Alexis Smith
Danny Tam	RJ Wichert	Thao Chau
Allen Wong	Paula David	Jose Perez
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Elizabeth Ferris	Hamed Amouzgar	

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About the California Energy Commission

The California Energy Commission is the state's primary energy policy and planning agency. It has seven core responsibilities: advancing state energy policy, encouraging energy efficiency, certifying thermal power plants, investing in energy innovation, developing renewable energy, transforming transportation, and preparing for energy emergencies. Established in 1975 by the Warren-Alquist Act to respond to the energy crisis of the early 1970s, the agency's research, programs and policies remain crucial today as the state plans for 100-percent clean energy and carbon neutrality by midcentury.

About CALBO

California Building Officials is a nonprofit corporation dedicated to promoting public health and safety in building construction through responsible legislation, education, and building code development. CALBO was founded in 1962 to promote and further the profession of the local California Building Official. With time and achievement, the organization has become the advocate and representative of not only the local California Building Official, but of local building departments, local government entities, and public safety and code enforcement officials.

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About the International Code Council®

The International Code Council is a nonprofit association that provides a wide range of building safety solutions including product evaluation, accreditation, certification, codification and training. It develops model codes and standards used worldwide to construct safe, sustainable, affordable and resilient structures. ICC Evaluation Service (ICC-ES) is the industry leader in performing technical evaluations for code compliance, fostering safe and sustainable design and construction.

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PART 1

All Occupancies—General Provisions

Subchapter 1

Subchapter 1 is comprised of three sections: 100.0, 100.1, and 100.2. Section 100.0 addresses the general provisions of the *California Energy Code*. It defines which buildings are covered, spaces of buildings that are regulated, and how the sections apply to different types of construction. Table 100.0-A summarizes which sections of the Energy Code apply based on the occupancy of the building, and type of construction, whether newly constructed, addition, or alteration.

Section 100.1 establishes definitions for terms used within the Energy Code. If a term used in the Energy Code is not defined in this section, the Energy Code defers to Parts 1 through 5 of the California Code of Regulations. If no definition for a term exists in Parts 1 through 6, the Energy Code defers to *Webster's Third New International Dictionary of the English Language, Unabridged* I1961 edition, through 2002 addenda), unless the context requires otherwise. This section also identifies California's 16 building climate zones in Figure 100.0-A.

Section 100.2 summarizes the calculation of Time Dependent Valuation (TDV) energy. TDV energy is used to compare proposed buildings to buildings of the same geometry, orientation, and location, that meet all mandatory and prescriptive requirements of the Energy Code. This comparison of energy use is how the performance approach determines the compliance of a building with the Energy Code's requirements. TDV energy accounts for fluctuations in energy costs and assigns multipliers for each hour of the year, by energy type (electricity, natural gas, or propane), by climate zone, and by building type. ■

100.0
Scope

100.0(a)
Buildings Covered

100.0(e)
Sections Applicable to Particular Buildings

100.1
Definitions and Rules of Construction

100.1(b)
Definitions

100.0(a)

Buildings Covered

CHANGE TYPE: Addition

CHANGE SUMMARY: Buildings that are Occupancy Group I-1 and I-2 are now covered by the 2019 Energy Code, and the code language was simplified.

2019 CODE:

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

1. That are of Occupancy Group A, B, E, F, H, <u>I,</u> 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 ~~by mechanical heating or mechanical cooling,~~ or process spaces~~;~~ <u>.</u> ~~or~~
   ~~C. Low-rise residential buildings that are heated with a non-mechanical heating system.~~

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.

<u>**EXCEPTION 3 to Section 100.0(a):** Buildings in Occupancy Group I-3 and I-4</u>.

CHANGE SIGNIFICANCE: Section 100.0(a) has expanded the scope of the Energy Code to now include some buildings that are of Occupancy Group I. Requirements for Occupancy Group I buildings have been excluded from the scope of the Energy Code since 1982. For a description of buildings that are categorized as Occupancy Group I (Institutional), see Section 308 of the *California Building Code* (Title 24, Part 2).

Exception 3 to Section 100.0(a) was added to exclude Occupancy Groups I-3 and I-4 from the scope. Staff found that the analysis conducted for prior standards are not as readily applicable to I-3 and I-4 occupancies. This Exception is therefore necessary to prevent applying existing standards to these occupancies ahead of additional analysis.

Section 100.0(a)3B was modified to simplify the description of buildings regulated by the Energy Code. The definition of "conditioned space" already uses the terms mechanical heating, mechanical cooling, and wood heating, with wood heating being nonmechanical heating. This change clarifies without materially altering the requirements, and is necessary to improve clarity and consistency.

Similarly, Section 100.0(a)3C was also modified to simplify the description of buildings regulated by the Energy Code. The definition of conditioned space already uses the term "wood heating." This change clarifies without materially altering the requirements and is necessary to improve clarity and consistency.

International Code Council®

Healthcare Facilities – Healthcare facilities are now regulated by the Energy Code. Specifically, Occupancy Groups I-1 and I-2 have been added to the scope of the Energy Code.

100.0(e)

Sections Applicable to Particular Buildings

CHANGE TYPE: Modification

CHANGE SUMMARY: An exception to the low-rise residential prescriptive and performance requirements was removed.

2019 CODE:

(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).

[…]

2. **Newly constructed buildings.**

   […]

   D. **Low-rise residential buildings.**

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

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

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

   b. Either:

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

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

   EXCEPTION ~~1~~ 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.

   ~~**EXCEPTION 2 to Section 100.0(e)2Diib:** Low-rise residential buildings that are heated with a wood heater or another nonmechanical heating system and that use no energy obtained from depletable sources for lighting or water heating.~~

   […]

CHANGE SIGNIFICANCE: Exception 2 to Section 100.0(e)2Diib was modified to eliminate a conflict with Section 100.0(a)3C, in that a low-rise residential building heated with nonmechanical heat are under the scope of the Energy Code. Also, with the prescriptive requirement for photovoltaic panels, this exception could have been a loophole for low-rise residential buildings to not have to comply those requirements. This change is necessary to eliminate that potential loophole. More on the prescriptive photovoltaic system requirements can be found in Section 150.1(c)14 of the 2019 Energy Code.

100.1(b)

Definitions – Conditioned Spaces

CHANGE TYPE: Clarification

CHANGE SUMMARY: The definitions related to "Conditioned Space" were reworded for clarity.

2019 CODE:

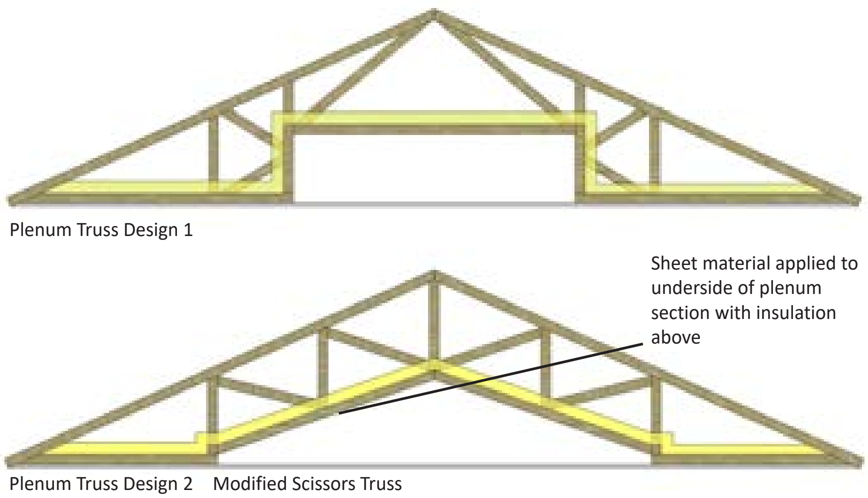
CONDITIONED SPACE is an enclosed space within a building that is ~~either~~ directly conditioned or indirectly conditioned.

CONDITIONED SPACE, DIRECTLY is an enclosed space that is provided with wood heating, ~~is provided with~~ mechanical heating that has a capacity exceeding 10 Btu/hr-ft^2, or ~~is provided with~~ mechanical cooling that has a capacity exceeding 5 Btu/hr-ft^2, ~~unless the space-conditioning system is designed for process space or process load~~. Directly conditioned space does not include process space. (See ~~"process load" and~~ "process space.")

CONDITIONED SPACE, INDIRECTLY is enclosed space~~, including, but not limited to, unconditioned volume in atria~~, that (1) is not directly conditioned space; and (2) either (a) has a thermal transmittance area product (UA) to directly conditioned space exceeding that to the outdoors or to unconditioned space and does not have fixed vents or openings to the outdoors or to unconditioned space, or (b) is a space through which air from directly conditioned spaces is transferred at a rate exceeding three air changes per hour.

CHANGE SIGNIFICANCE: The purpose of the changes to the definitions related to conditioned space is to remove unnecessary language and improve phrasing. Spaces that are conditioned and kept between and including 55 and 90 degrees are subject to all applicable requirements of the Energy Code. Whether or not that space conditioning system is for a process or for human comfort does not change this. Commercial plant growth facilities typically fall into this category. While the space conditioning systems that serve these areas are not for human comfort, this space is not considered "process space," and thus is subject to all applicable requirements for conditioned spaces.

The language excluding "process spaces" was added to the definition of "conditioned space, directly" to explicitly omit spaces with space heating or cooling that are kept below 55 degrees, or above 90 degrees. See the definition for "process space" for more on how these spaces are classified. These changes clarify without materially altering the requirements of the Energy Code.



Indirectly Conditioned Attic Spaces – The spaces below the yellow insulation but above the ceiling line are considered indirectly conditioned spaces.
Source: California Energy Commission, 2019 Residential Compliance Manual

100.1(b)

Definitions – Door

CHANGE TYPE: Modification

CHANGE SUMMARY: The threshold for when a door is considered a glazed door has been reduced from 50% glazing to 25%.

2019 CODE:

DOOR is an operable opening in the building envelope, including swinging and roll-up doors, fire doors, pet doors and access hatches with less than ~~50~~25 percent glazed area. When that operable opening has ~~50~~25 percent or more glazed area it is a glazed door. See Fenestration: Glazed Door.

CHANGE SIGNIFICANCE: The purpose of the changes made to this definition is to reduce the threshold of glazed doors from 50% glazing to 25%. This change was made to align the Energy Code's definition with the National Fenestration Rating Council's (NFRC) definition. As a result, more doors will fall under the definition of a "glazed door," and thus will be subject to *U*-factor and solar heat gain coefficient (SHGC) requirements.

Getty Images

Entrance Door with 25% or More Glazing – Doors with 25% or more glazing are now considered glazed doors under the 2019 Energy Code. This is a change from the 50% threshold of the 2016 Energy Code.

100.1(b)

Definitions – Energy Design Rating

CHANGE TYPE: Addition

CHANGE SUMMARY: The 2019 Energy Code has changed how performance compliance is measured for newly constructed low-rise residential buildings, and these definitions were added for clarification and understanding of the new terms.

2019 CODE:

ENERGY DESIGN RATING (EDR) is a way to express the energy consumption of a building as a rating score index where a score of 100 represents the energy consumption of the building built to the specifications of the Residential Energy Services (RESNET) reference home characterization of the 2006 *International Energy Conservation Code* (IECC) with Title 24, Part 6 modeling assumptions, and a score of 0 (zero) represents a building that has zero net energy consumption. The EDR is calculated using Commission-approved compliance software as specified by the Alternative Calculation Method Approval Manual.

ENERGY DESIGN RATING, ENERGY EFFICIENCY is an Energy Design Rating based on the TDV energy consumption of a building that results from the building's energy efficiency characteristics, calculated using Commission-approved compliance software as specified by the Alternative Calculation Methods Approval Manual.

ENERGY DESIGN RATING, SOLAR ELECTRIC GENERATION AND DEMAND FLEXIBILITY is the reduction in TDV energy consumption of a building expressed in terms of an Energy Design Rating reduction that results from the combination of the building's solar electric generation system and demand flexibility measures.

ENERGY DESIGN RATING, TOTAL is the total Energy Design Rating for the building that is determined by subtracting the Solar Electric Generation System and Demand Flexibility Energy Design Rating from the Energy Efficiency Energy Design Rating.

CHANGE SIGNIFICANCE: The 2019 Energy Code has changed how compliance for newly constructed low-rise residential buildings via the performance approach is measured. These buildings now must comply with maximum Energy Design Rating scores. The purpose of adding these definitions is to clarify the meaning of these terms.

The EDR score enables a comprehensive focus that maximizes the ability for newly constructed buildings to be designed and built to be harmonized with California's electricity grid, consistent with the policies of the Commission's sister agencies, CALISO, CPUC and ARB, to contribute to achievement of California's climate change goals at lowest cost. For the first time this EDR metric is incorporated into the Energy Code for newly constructed, low-rise buildings.

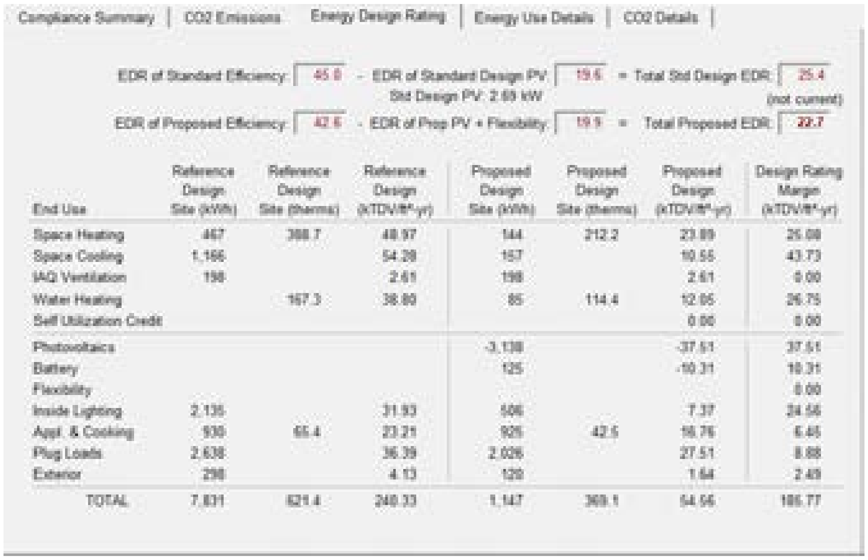
An EDR score of 100 represents a building that consumes the amount of energy that a building built to the 2006 *International Energy Conservation Code* would have consumed. A score of 0 represents a building that produces at least the same amount of energy it consumes over one year, making it a zero net energy building.

For compliance with the 2019 Energy Code, two EDR scores must be met independently:

1. Efficiency EDR, which represents that EDR score of 100, minus energy savings for space heating, cooling, ventilation, water heating, plus a limited credit for battery, and
2. Total EDR, which represents the Efficiency EDR minus a compliance credit for a photovoltaic system (PV), battery, and other demand flexibility measures if modeled.

The Efficiency EDR score will generally be in the range of 41–48 and will vary by climate zone and building size. Once PV is added into the equation, the Total EDR score will generally be in the range of 15–27.

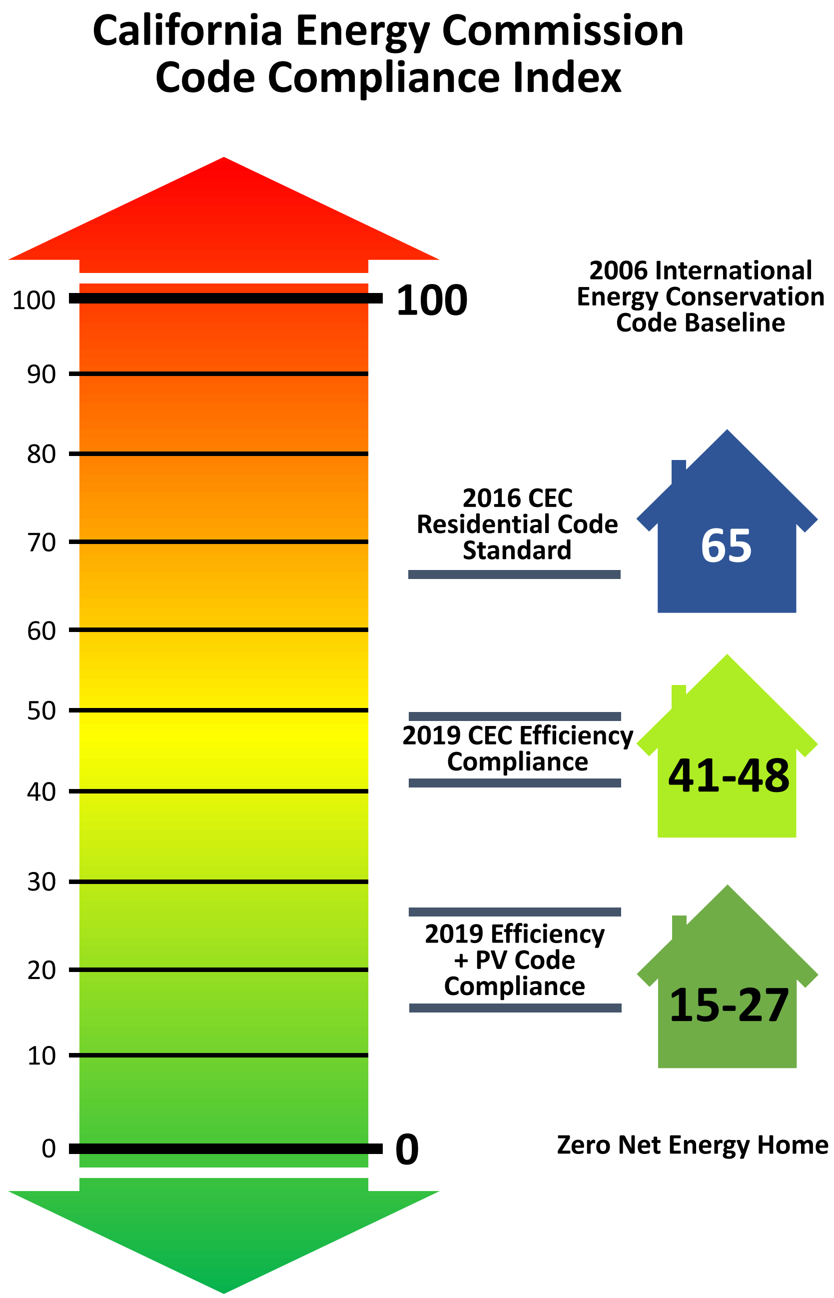
For the first time, the Energy Code is also recognizing the installation of a battery system, and demand flexibility measures. These options can assist with achieving the maximum EDR scores for the buildings they're designed in.


Compliance Summary | CO2 Emissions | Energy Design Rating | Energy Use Details | CO2 Details

EDR of Standard Efficiency: 45.0 - EDR of Standard Design PV: 19.6 = Total Std Design EDR: 25.4
Std Design PV: 2.69 kW (not current)
EDR of Proposed Efficiency: 42.6 - EDR of Prop PV + Flexibility: 19.9 = Total Proposed EDR: 22.7

End Use	Reference Design Site (kWh)	Reference Design Site (therms)	Reference Design (kTDV/ft²-yr)	Proposed Design Site (kWh)	Proposed Design Site (therms)	Proposed Design (kTDV/ft²-yr)	Design Rating Margin (kTDV/ft²-yr)
Space Heating	467	388.7	48.97	144	212.2	23.89	25.08
Space Cooling	1,166		54.28	157		10.55	43.73
IAQ Ventilation	198		2.61	198		2.61	0.00
Water Heating		167.3	38.80	85	114.4	12.05	26.75
Self Utilization Credit						0.00	0.00
Photovoltaics				-3,138		-37.51	37.51
Battery				125		-10.31	10.31
Flexibility							0.00
Inside Lighting	2,135		31.93	506		7.37	24.56
Appl. & Cooking	930	65.4	23.21	925	42.5	16.76	6.45
Plug Loads	2,638		36.39	2,026		27.51	8.88
Exterior	298		4.13	120		1.64	2.49
TOTAL	7,831	621.4	240.33	1,147	369.1	54.56	186.77

Example Energy Design Rating (EDR) Score: Under the 2019 Energy Code, low-rise residential buildings must now comply with two scores: a maximum efficiency EDR, and a maximum total EDR.
Source: California Energy Commission

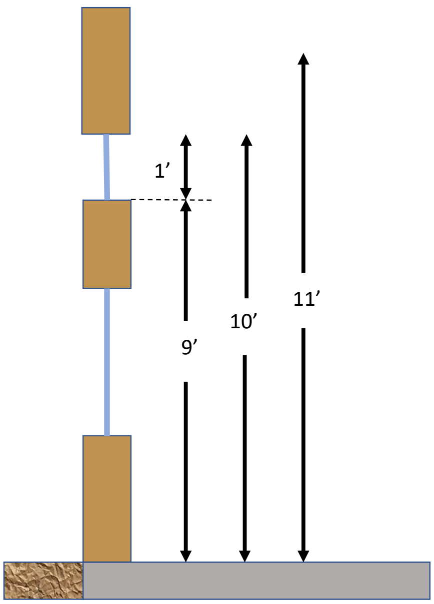


Energy Design Rating (EDR), as defined by the California Energy Commission, is an alternate way to express the energy performance of a building using a scoring system where 100 represents the energy performance of a Residential Energy Services (RESNET) reference home characterization of the 2006 IECC with California modeling assumptions. A score of 0 represents the energy performance of a building that combines high levels of energy efficiency with renewable generation to "zero out" its TDV energy.

California's Energy Design Rating Sample Scale – An EDR score of 100 represents a low-rise residential building built to the 2006 *International Energy Conservation Code*. A low-rise residential building built to the 2019 Energy Code, including the new photovoltaic system requirements, will generally have an EDR score between 15 and 27.
Source: California Energy Commission

100.1(b)

Definitions – Fenestration



Clerestory – To qualify for a lighting power adjustment factor, clerestory fenestration must meet the requirements of Section 140.6(d)1.
Source: California Energy Commission

CHANGE TYPE: Addition and Clarification

CHANGE SUMMARY: Definitions were added for different fenestration types, and fenestration definitions were altered for clarity.

2019 CODE:

FENESTRATION: Includes the following:

[…]

~~**ALTERATION** is any change to an existing building's exterior fenestration product that is not a repair (see Fenestration Repair) that:~~

~~i. Replaces existing fenestration in an existing wall or roof with no net area added; or~~

~~ii. Replaces existing fenestration and adds new net area in the existing wall or roof; or~~

~~iii. Adds a new window that increases the net fenestration area to an existing wall or roof.~~

[…]

CLERESTORY is fenestration installed above a roofline greater than or equal to 60° from the horizontal, or any portion of exterior vertical glazing greater than eight feet per floor above the finished floor of a space.

[…]

FENESTRATION ALTERATION is any change to an existing building's exterior fenestration product that is not a repair (see "fenestration repair") that:

i. Replaces existing fenestration in an existing wall or roof with no net area added; or

ii. Replaces existing fenestration and adds new net area in the existing wall or roof; or

iii. Adds a new window that increases the net fenestration area to an existing wall or roof.

FENESTRATION AREA is the rough opening area of any fenestration product. ~~for windows is the total window rough opening area which includes the fenestration, fenestration frame components in the exterior walls and roofs.~~

FENESTRATION PRODUCT is any transparent or translucent material plus any sash, frame, mullions and dividers, in the facade of a building, including, but not limited to, windows, ~~sliding glass doors~~, ~~french~~glazed doors, skylights, curtain walls, dynamic glazing, garden windows and glass block.

[…]

GLAZED DOOR is an exterior door having a glazed area of ~~50~~25 percent or greater of the area of the door. Glazed doors shall meet fenestration product requirements. See "door".

[…]

HORIZONTAL SLATS, when referring to a daylighting device, is a set of adjacent surfaces located directly adjacent to vertical fenestration, oriented horizontally and projecting horizontally from its interior or exterior vertical surface.

LIGHT SHELF is an adjacent, opaque surfaced daylighting device located at the sill of clerestory glazing, oriented horizontally and projecting horizontally from an interior or exterior vertical surface.

[…]

SKYLIGHT ROOF RATIO (SRR) is the ratio of the skylight area to the gross exterior roof area.

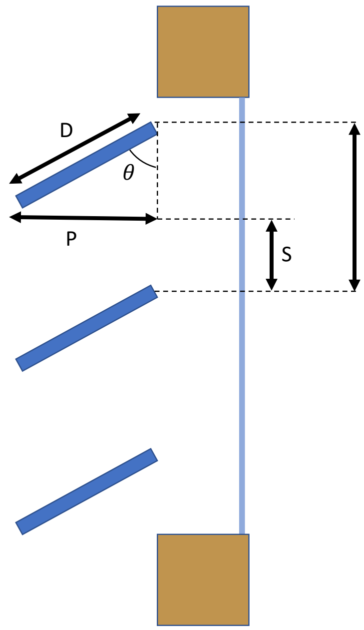
[…]

VERTICAL FENESTRATION is all fenestration other than skylights and doors.

VISIBLE REFLECTANCE is the reflectance of light at wavelengths from 410 to 722 namometers.

[…]

WINDOW HEAD HEIGHT is the height from the floor to the top of the ~~window~~vertical fenestration.



Horizontal Slats – To qualify for a lighting power adjustment factor, horizontal slats must meet the requirements of Section 140.6(d)2.
Source: California Energy Commission

CHANGE SIGNIFICANCE: Clerestory Glazing – The purpose of adding this definition is to include a key term consistent with the proposed addition of clerestory glazing as a power adjustment factor in Section 140.6. This change is necessary to ensure clarity and specificity where this new measure is proposed.

Glazed Door – The purpose of the changes made to this definition is to reduce the threshold for glazed doors from 50% to 25%. This change is necessary to provide clarity and better align with the NFRC definitions.

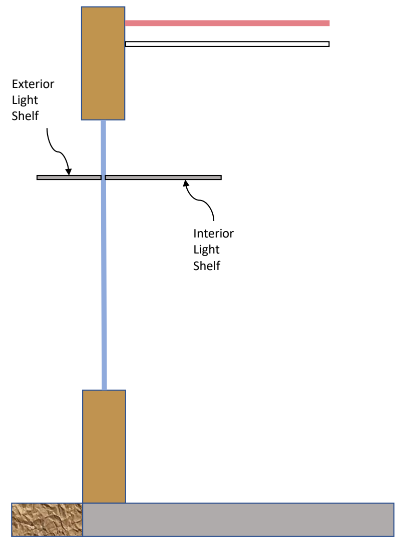
Fenestration Alteration – The purpose of adding this definition is to move and clarify definition language and remove redundant definitions. The term "alteration" is defined generally, and was also defined specifically in relation to fenestration, which made it appear that the term "alteration" had two definitions in Section 100.1. This addition provides that same definitional language as defining the term "fenestration alteration." This change clarifies without materially altering the requirements of the Energy Code.

Fenestration Area – The purpose of the changes made to this definition is to reduce redundancy and provide clarity. This change is necessary to eliminate the confusion caused by having two definitions for fenestration area (one for nonresidential and one for low-rise residential) and to use simpler and more comprehensive language.

Horizontal Slats – The purpose of adding this definition is to include a key term consistent with the proposed addition of horizontal slats as a power adjustment factor in Section 140.6. This change is necessary to ensure clarity and specificity where this new measure is proposed.

Light Shelf – The purpose of adding this definition is to include a key term consistent with the proposed addition of light shelves as a power adjustment factor in Section 140.6. This change is necessary to ensure clarity and specificity where this new measure is proposed.

Skylight Roof Ratio (SRR) – The purpose of adding this definition is to define the elements that are used to calculate the skylight roof ratio, and to provide support for use of an acronym in place of the full term.



Lighting Shelves – To qualify for a lighting power adjustment factor, lighting shelves must meet the requirements of Section 140.6(d)2.
Source: California Energy Commission

This change is necessary to support and provide clarity to the provisions of the Energy Code that relate to skylights.

Vertical Fenestration – The purpose of adding this definition is to create an inclusive term for all windows and other building penetrations and openings that act like windows, and to clarify that the use of the term is intended to exclude skylights (which are not typically installed vertically) and doors (which are subject to separate requirements). This change is necessary to clearly categorize the types of fenestration that are subject to the requirements of the Energy Code.

Window Head Height – The purpose of the change to this definition is to use the new term "vertical fenestration" in order to ensure appropriate application of the window requirements. This change clarifies without materially altering the requirements of the Energy Code.

100.1(b)

Definitions – Habitable Areas

CHANGE TYPE: Clarification

CHANGE SUMMARY: Definitions for "Habitable Space" and "Habitable Story" were updated for clarity.

2019 CODE:

HABITABLE SPACE is space in a building for living, sleeping, eating or cooking, excluding ~~B~~bathrooms, toilets, hallways, storage areas, closets, ~~or~~ utility rooms and similar areas ~~are not considered habitable spaces~~. (See also "occupiable space".)

HABITABLE STORY is a story that contains habitable space ~~in which humans may work or live in reasonable comfort,~~ and that has at least 50 percent of its volume above grade.

CHANGE SIGNIFICANCE: The purpose of the changes to these definitions is to simplify phrasing, ensure consistency between the definitions, and create consistency between these terms and with the terms relating to occupancy. For residential buildings, only habitable stories count towards the 3-story delineation. This change clarifies without materially altering the requirements of the Energy Code.

100.1(b)

Definitions – Healthcare Facility

CHANGE TYPE: Addition

CHANGE SUMMARY: The scope of the Energy Code has expanded to include Occupancy Group I-1 and I-2, and for this reason, the definition of a “Healthcare Facility” was added.

2019 CODE:

HEALTHCARE FACILITY is any building or portion thereof licensed pursuant to California Health and Safety Code Division 2, Chapter 1, §1204 or Chapter 2, §1250.

CHANGE SIGNIFICANCE: The purpose of adding this definition is to specifically and accurately define when a building or space can be considered a healthcare facility. It is necessary because the scope of the code has expanded to include Occupancy Groups I-1 and I-2, and many of these facilities require a number of special exceptions in order to protect health and safety. The definition allows the Energy Code to defer to the California Department of Public Health, which issues the specified licenses, with respect to which facilities should be eligible for exceptions. This definition was developed under close coordination with the Office of Statewide Health Planning and Development (OSHPD) and the healthcare industry.

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Healthcare Facility – Occupancy Groups I-1 and I-2, including healthcare facilities, have been added to the scope of the Energy Code.

CHANGE TYPE: Addition, Clarification, and Modification

100.1(b)

Definitions – Lighting

CHANGE SUMMARY: Definitions to different terms related to lighting were added and altered for clarity and consistency with other sections of the Energy Code.

2019 CODE:

LIGHTING definitions:

[…]

Compact Fluorescent Lamp is a single-ended fluorescent lamp ~~less than nine inches maximum overall length~~ with a T5 or smaller diameter glass tube that is folded, bent, or bridged.

[…]

Lamp is an electrical appliance that produces optical radiation for the purpose of visual illumination, designed with a base to provide an electrical connection between the lamp and a luminaire, ~~designed with a base to provide an electrical connection between the lamp and a luminaire~~, and designed to be installed into a luminaire. A lamp is not a luminaire and is not an LED retrofit kit ~~by means of a lampholder integral to the luminaire~~.

[…]

LED Retrofit Kit is a solid state lighting product intended to replace existing light sources and systems, including incandescent and fluorescent light sources, in previously installed luminaires that already comply with safety standards. These kits replace the existing light source and related electrical components, and are classified or certified to UL 1598C. They may employ an ANSI standard lamp base, either integral or connected to the retrofit by wire leads. LED retrofit kit does not include self-ballasted lamps.

Non-integrated LED lamp is an assembly composed of a light emitting diode (LED) array (module) or LED packages (components), and an ANSI standard base. The device is intended to connect to the LED driver of an LED luminaire through an ANSI standard lamp-holder (socket). The device cannot be connected directly to the branch circuit. ~~an assembly comprised of an LED array (module) or LED packages (components) and ANSI standard base. The device is intended to connect to the LED driver of an LED luminaire through an ANSI standard lamp-holder (socket). The device cannot be connected to the branch circuit~~ (ANSI/IES RP-16-17~~10~~).

Integrated LED lamp is an integrated assembly composed of light emitting diode (LED) packages (components) or LED arrays (modules), as well as an LED driver, an ANSI standard base, and other optical, thermal, mechanical and electrical components. The device is intended to connect directly to the branch circuit through a corresponding ANSI standard lamp-holder (socket). ~~an integrated assembly comprised of LED packages (components) or LED arrays (modules), LED driver, ANSI standard base and other optical, thermal,~~

~~mechanical and electrical components. The device is intended to connect directly to the branch circuit via a corresponding ANSI standard lamp-holder (socket)~~ (ANSI/IES RP-16-17~~10~~).

[…]

Narrow Band Spectrum is a limited range of wavelengths (nm) concentric to a dominant peak wavelength in the visible spectrum. The limited range of wavelength shall be within 20 nm on either side of the peak wavelength at 50 percent of the peak wavelength's relative spectral power, and within 75 nm on either side of the peak wavelength at 10 percent of the peak wavelength's relative spectral power.

[…]

Solid State Lighting (SSL) is a family of light sources that includes: semiconductor light emitting diodes (LEDs); and organic light emitting diodes (OLEDs).

Driver, when used in relation to solid state lighting, is a device that uses semiconductors to control and supply dc power for LED starting and operation.

[…]

CHANGE SIGNIFICANCE: Compact Fluorescent Lamp – The purpose of the change to this definition is to align with the definition in the Title 20 Appliance Efficiency Regulations. This change is necessary to create consistency between applicable regulations.

Lamp – The purpose of the change to this definition is to provide a clearer distinction between types of lighting. This change clarifies without materially altering the requirements of the Energy Code.

LED Retrofit Kit – The purpose of adding this definition is to provide clarification for a class of products that exist between removable lamps and fully integrated luminaires. These products are becoming increasingly more common, and defining this term is necessary to provide clear direction to manufacturers and installers of these products regarding the applicability of the requirements of the Energy Code.

Non-integrated LED lamp – The purpose of the change to this definition is to update its verbiage consistent with a general update to the latest version of ANSI/IES RP-16. This change is necessary to ensure consistency with current ANSI and IES lighting standards.

Integrated LED lamp – The purpose of the change to this definition is to update its verbiage consistent with a general update to the latest version of ANSI/IES RP-16. This change is necessary to ensure consistency with current ANSI and IES lighting standards.

Narrow Band Spectrum – The purpose of adding this definition is to recognize a specific class of lighting products with distinct features. This change is necessary to facilitate consideration of requirements that account for, or are tailored to, this specific subset of lighting products.

Ornamental Lighting – The purpose of the change to this definition is to change a wattage value consistent with proposed revisions to later section language that propose wattage values consistent with typical LED performance.

Solid State Lighting (SSL) – The purpose of adding this definition is to clarify that solid state lighting includes both LEDs and OLEDs, and is not limited solely to LED lighting. This change clarifies without materially altering the requirements of the Energy Code.

Driver – The purpose of adding this definition is to specify the functions of circuitry that define it as a driver and separate it from other functions that the same circuitry may also perform. This change is necessary as there is not always a clear physical break or boundary between a driver and other circuitry.

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LED Retrofit Kit – An LED retrofit kit is a solid state lighting product intended to replace existing light sources and systems in previously installed luminaires that already comply with safety standards, as defined in Section 100.1(b) of the 2019 Energy Code.

100.1(b)

Definitions – Low-rise Residential Building

CHANGE TYPE: Clarification

CHANGE SUMMARY: The term "habitable" was added to the language related to R-2 multifamily buildings under the definition of a "low-rise residential building" for clarity and consistency.

2019 CODE:

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

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

R-3, single family; or

U-building, located on a residential site.

CHANGE SIGNIFICANCE: The purpose of the changes to this definition is to correct punctuation and to add the word "habitable" for consistency with the definition of a "high-rise residential building." This change clarifies without materially altering the requirements of the Energy Code.

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High-Rise Residential Buildings – Multifamily buildings of Occupancy Group R-2 (as defined in the *California Building Code*) with 4 or more habitable stories are defined as high-rise residential buildings.

100.1(b)

Definitions – Occupancy

CHANGE TYPE: Addition and Clarification

CHANGE SUMMARY: Definitions related to occupancy were added, and occupiable space was altered for clarity.

2019 CODE:

OCCUPANCY is the purpose for which a building or part thereof is used or intended to be used.

OCCUPANCY, HUMAN is any occupancy that is intended primarily for human activities.

OCCUPANCY GROUP is a classification of occupancy defined in Chapter 3 of the CBC (Title 24, Part 2).

OCCUPANCY TYPE is a description of occupancy than is more specific than occupancy group and that relates to determining the amount of lighting, ventilation, or other services needed for that portion of the building.

OCCUPIABLE SPACE is any enclosed space that is~~inside the pressure boundary and~~ intended for human ~~activities~~occupancy, including~~, but not limited to,~~ all habitable spaces as well as~~,~~ bathrooms, toilets, closets, halls, storage and utility areas, ~~and~~ laundry areas, and similar areas.~~.~~ (See also “habitable space”.)

CHANGE SIGNIFICANCE: Occupancy: Occupancy Human, Occupancy Group, Occupancy Type – The purpose of adding these definitions is to ensure that the terms that use the word “occupancy” have a consistent meaning where found in the Energy Code, that there is internal consistency among these terms, and that their meaning is also consistent with their use in the other Parts of Title 24. This change is necessary to eliminate a risk of ambiguity or inconsistency in either the use or meaning of these terms.

Occupiable Space – The purpose of the change to this definition is to harmonize it with the definitions for human occupancy and habitable space, and to more clearly express the distinction between “occupiable” and “habitable” space. This change clarifies without materially altering the requirements of the Energy Code.

100.1(b)

Definitions – Overhangs

CHANGE TYPE: Modification

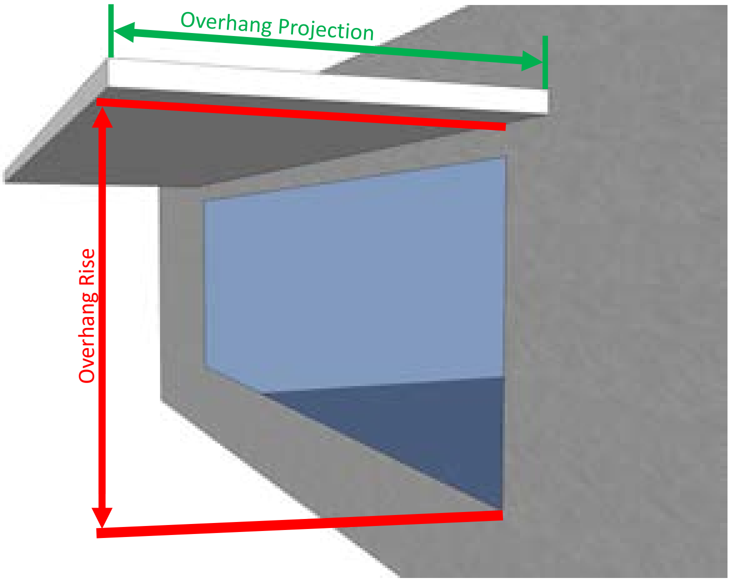
CHANGE SUMMARY: Terms related to overhangs were renamed, and their definitions were altered for clarity.

2019 CODE:

~~**OVERHANG OFFSET** is the vertical distance from the edge of exposed exterior glazing at the head of a window to the overhang.~~

<u>**OVERHANG RISE** is the vertical distance between the projected edge of an overhang and the sill of the vertical fenestration below it.</u>

CHANGE SIGNIFICANCE: The term "overhang offset" has been changed to "overhang rise." The purpose of changing this term is to include a key term consistent with the clarification of automatic daylighting control requirements for the areas adjacent to vertical glazing below an overhang. This change clarifies without materially altering the requirements of the Energy Code.



Overhang Rise – The "overhang rise" is depicted by the red arrow. It is the vertical distance between the projected edge of an overhang and the window sill below. Source: California Energy Commission

100.1(b)

Definitions – Proposed Design Building

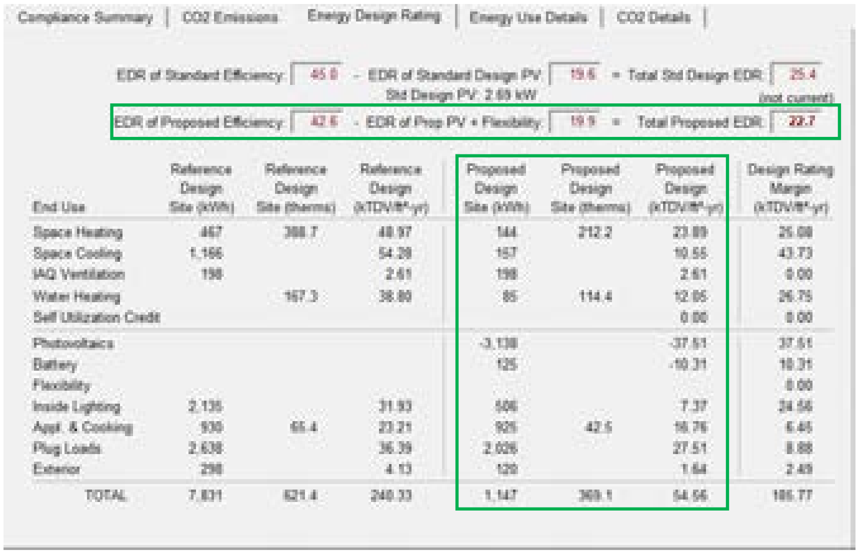
CHANGE TYPE: Modification and Clarification

CHANGE SUMMARY: The term "proposed design building energy use" was modified to remove "energy use," and the definition was simplified for clarity.

2019 CODE:

PROPOSED DESIGN BUILDING ~~ENERGY USE~~ is a building that is simulated by Commission-approved compliance software to determine the energy consumption resulting from all of the characteristics and energy consuming features that are actually proposed for a building, as specified by the ~~predicted energy use of proposed building derived from application of the building energy use modeling rules described in the~~ Alternative Calculation Method (ACM) Approval Manual.

CHANGE SIGNIFICANCE: The purpose of the change to this definition is to rename the term and make the definition clearer and more straightforward while also shortening the defined phrase. This change clarifies without materially altering the requirements of the Energy Code.


Compliance Summary | CO2 Emissions | Energy Design Rating | Energy Use Details | CO2 Details

EDR of Standard Efficiency: 45.0 - EDR of Standard Design PV: 19.6 = Total Std Design EDR: 25.4
Std Design PV: 2.69 kW (not current)
EDR of Proposed Efficiency: 42.6 - EDR of Prop PV + Flexibility: 19.9 = Total Proposed EDR: 22.7

End Use	Reference Design Site (kWh)	Reference Design Site (therms)	Reference Design (kTDV/ft²-yr)	Proposed Design Site (kWh)	Proposed Design Site (therms)	Proposed Design (kTDV/ft²-yr)	Design Rating Margin (kTDV/ft²-yr)
Space Heating	467	388.7	48.97	144	212.2	23.89	25.08
Space Cooling	1,166		54.28	157		10.55	43.73
IAQ Ventilation	198		2.61	198		2.61	0.00
Water Heating		167.3	38.80	85	114.4	12.05	26.75
Self Utilization Credit						0.00	0.00
Photovoltaics				-3,138		-37.51	37.51
Battery				125		-10.31	10.31
Flexibility							0.00
Inside Lighting	2,135		31.93	506		7.37	24.56
Appl. & Cooking	930	65.4	23.21	925	42.5	16.76	6.45
Plug Loads	2,638		36.39	2,026		27.51	8.88
Exterior	298		4.13	120		1.64	2.49
TOTAL	7,831	621.4	240.33	1,147	369.1	54.56	185.77

Residential Proposed Design – Outlined in green, the proposed design shows the energy use of the residential building as designed.
Source: California Energy Commission, CBECC-Res Computer Modeling Program

Energy Use Summary | Unmet Load Hours

End Use	Standard Design Site (MWh)	Standard Design Site (MBtu)	Standard Design TDV (kBtu/ft²-yr)	Proposed Design Site (MWh)	Proposed Design Site (MBtu)	Proposed Design TDV (kBtu/ft²-yr)	Compliance TDV Margin (kBtu/ft²-yr)
Space Heating	--	1,961.6	16.71	--	1,961.6	16.71	--
Space Cooling	301.4	--	67.13	301.4	--	67.13	--
Indoor Fans	231.2	--	30.49	231.2	--	30.49	--
Heat Rejection	--	--	--	--	--	--	--
Pumps & Misc	--	--	--	--	--	--	--
Domestic Hot Water	138.3	--	16.82	138.3	--	16.82	--
Indoor Lighting	533.2	--	68.35	533.2	--	68.35	--
COMPLIANCE TOTAL	1,204.1	1,961.6	199.50	1,204.1	1,961.6	199.50	--
Receptacle	683.0	--	85.38	683.0	--	85.38	- %
Process	--	--	--	--	--	--	
Other Ltg	--	--	--	--	--	--	Result:
Process Motors	1.8	--	0.23	1.8	--	0.23	**PASS**
Photovoltaics	--	--	--	--	--	--	(not current)
Battery	--	--	--	--	--	--	
TOTAL	1,888.9	1,961.6	285.11	1,888.9	1,961.6	285.11	

Generation Coincident Peak Demand (kW): Standard Design: 571.6 Proposed Design: 571.6 Reduction: 0.0

Nonresidential Proposed Design – Outlined in green, the proposed design shows the energy use of the nonresidential building as designed.
Source: California Energy Commission, CBECC-Com Computer Modeling Program

100.1(b)

Definitions – Daylit Zones

CHANGE TYPE: Modification

CHANGE SUMMARY: Sidelit and skylit daylit zone definitions were moved from Section 130.1(d) to the definitions section, Section 100.1(b) of the Energy Code.

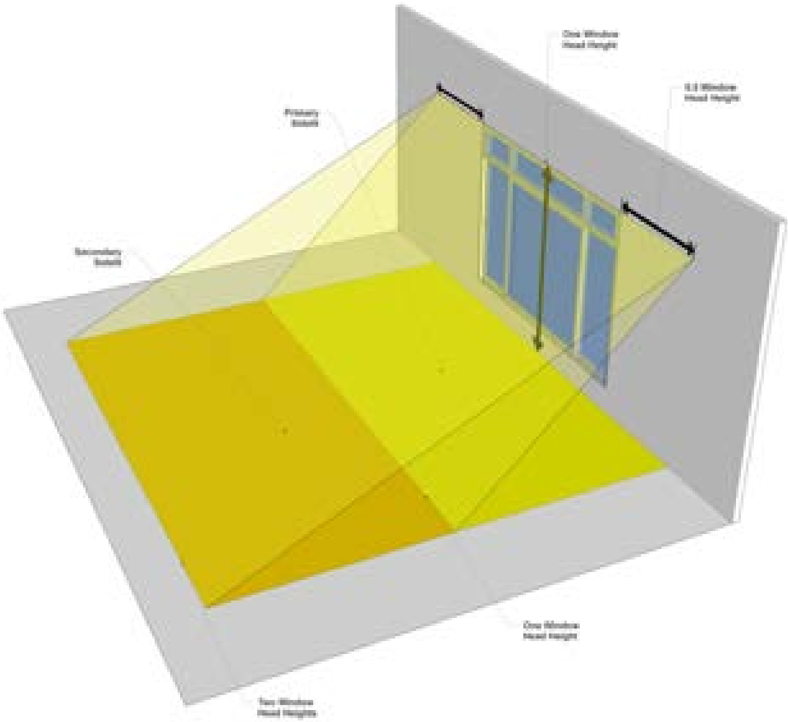
2019 CODE:

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

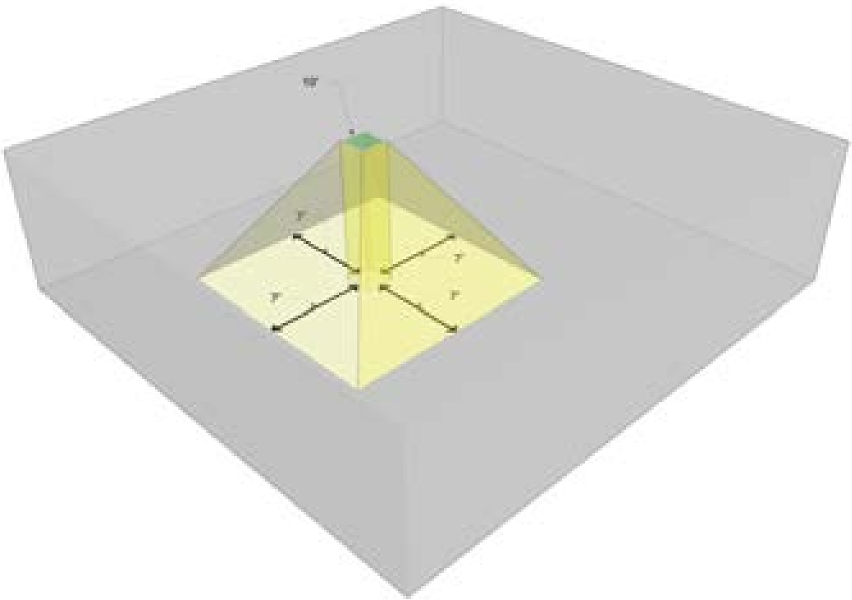
SIDELIT DAYLIT ZONE, SECONDARY is the area in plan view directly adjacent to each vertical glazing, two window head heights deep into the area, and window width plus 0.5 times window head height wide on each side of the rough opening of the window, minus any area on a plan beyond a permanent obstruction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

SKYLIT DAYLIT ZONE is the rough area in plan view under each skylight, plus 0.7 times the average ceiling height in each direction from the edge of the rough opening of the skylight, minus any area on a plan beyond a permanent obstruction that is taller than one-half of the distance from the floor to the bottom of the skylight. The bottom of the skylight is measured from the bottom of the skylight well for skylights having wells, or the bottom of the skylight if no skylight well exists. For the purpose of determining the skylit daylit zone, the geometric shape of the skylit daylit zone shall be identical to the plan view geometric shape of the rough opening of the skylight; for example, for a rectangular skylight the skylit daylit zone plan area shall be rectangular, and for a circular skylight the skylit daylit zone plan area shall be circular. For skylight located in an atrium, the skylit daylit zone shall include the floor area directly under the atrium, and the area of the top floor that is directly under the skylight, plus 0.7 times the average ceiling height of the top floor, in each direction from the edge of the rough opening of the skylight, minus any area on a plan beyond a permanent obstruction that is taller than one-half of the distance from the top floor to the bottom of the skylight.

CHANGE SIGNIFICANCE: The purpose of these changes is to move definitions previously located in Section 130.1(d) into the definition section, Section 100.1(b), consistent with the rest of the Energy Code. These changes do not materially alter the requirements of the Energy Code.



Sidelit Daylit Zones – The sidelit daylit zones extend one and two window head heights into the room, and their width is the width of the window plus ½ the window head height in each direction.
Source: California Energy Commission



Skylit Daylit Zones – Skylit daylit zones are determined by projecting the skylight to the floor, and then projecting that pattern in each direction a length of 0.7 times the ceiling height. In this example, the ceiling height is 10 feet, and the pattern is extended 7 feet in all directions.
Source: California Energy Commission

100.1(b)

Definitions – Photovoltaic System

CHANGE TYPE: Addition

CHANGE SUMMARY: The 2019 Energy Code has added requirements for solar electric generation systems, or photovoltaic (PV) systems, and these terms were defined for clarity.

2019 CODE:

SOLAR ELECTRIC GENERATION SYSTEM or **PHOTOVOLTAIC SYSTEM** is the complete set of all components for converting sunlight into electricity through the photovoltaic process, including the array of panels, inverter(s) and the balance of system components required to enable the system to effectively deliver power to reduce a building's consumption of electricity from the utility grid.

CHANGE SIGNIFICANCE: The purpose of adding this definition is to clearly state the scope of equipment referred to when these terms are used. This addition is necessary to ensure clarity and specificity for the new PV system requirements for newly constructed low-rise residential buildings.

Getty Images

Residential Home with a PV System Installed – The 2019 Energy Code now requires PV systems to be installed on newly constructed low-rise residential buildings. More on this can be found in Section 150.1(c)14 of the Energy Code.

100.1(b)

Definitions – Standard Design Building

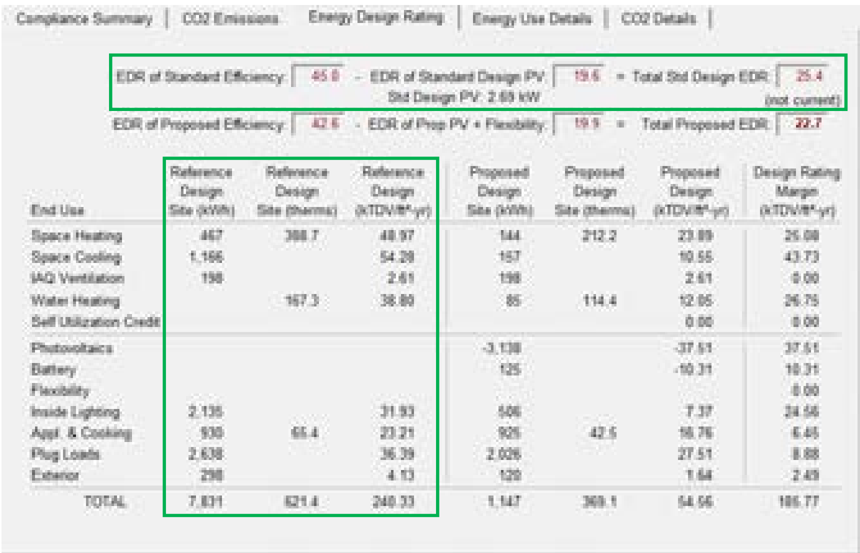
CHANGE TYPE: Clarification

CHANGE SUMMARY: The definition of "standard design building" has been updated for clarity.

2019 CODE:

STANDARD DESIGN BUILDING is a building that is automatically simulated by Commission-approved compliance software to establish the Energy Budget that is the maximum energy consumption allowed by a Proposed Design Building to comply ~~complies~~ with the ~~mandatory and prescriptive requirements in the~~ Title 24 Building Energy Efficiency Standards ~~by using the building energy modeling rules described in the Alternative Calculation Method (ACM) Reference Manual~~. The Standard Design building is simulated using the same location and having the same characteristics of the Proposed Design building, but assuming minimal compliance with the mandatory and prescriptive requirements that are applicable to the proposed building, as specified by the Alternative Calculation Methods Approval Manual.

CHANGE SIGNIFICANCE: The purpose of the change to this definition is to harmonize its language with clarifying changes proposed for the definition of "proposed design building." This change clarifies without materially altering the requirements of the Energy Code.



Compliance Summary | CO2 Emissions | Energy Design Rating | Energy Use Details | CO2 Details |

EDR of Standard Efficiency: 45.0 - EDR of Standard Design PV: 19.6 = Total Std Design EDR: 25.4
Std Design PV: 2.69 kW (not current)
EDR of Proposed Efficiency: 42.6 - EDR of Prop PV + Flexibility: 19.9 = Total Proposed EDR: 22.7

End Use	Reference Design Site (kWh)	Reference Design Site (therms)	Reference Design (kTDV/ft²-yr)	Proposed Design Site (kWh)	Proposed Design Site (therms)	Proposed Design (kTDV/ft²-yr)	Design Rating Margin (kTDV/ft²-yr)
Space Heating	467	388.7	48.97	144	212.2	23.89	25.08
Space Cooling	1,166		54.28	157		10.55	43.73
IAQ Ventilation	198		2.61	198		2.61	0.00
Water Heating		167.3	38.80	85	114.4	12.05	26.75
Self Utilization Credit						0.00	0.00
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Flexibility							0.00
Inside Lighting	2,135		31.93	506		7.37	24.56
Appl. & Cooking	930	65.4	23.21	925	42.5	16.76	6.45
Plug Loads	2,638		36.39	2,026		27.51	8.88
Exterior	298		4.13	120		1.64	2.49
TOTAL	7,831	621.4	240.33	1,147	369.1	54.56	185.77

Residential Standard Design – The standard design in green shows the energy consumption that this low-rise residential building will be measured against
Source: California Energy Commission, CBECC-Res Computer Modeling Program

Energy Use Summary | Unmet Load Hours

End Use	Standard Design Site (MWh)	Standard Design Site (MBtu)	Standard Design TDV (kBtu/ft²-yr)	Proposed Design Site (MWh)	Proposed Design Site (MBtu)	Proposed Design TDV (kBtu/ft²-yr)	Compliance TDV Margin (kBtu/ft²-yr)
Space Heating	--	1,961.6	16.71	--	1,961.6	16.71	--
Space Cooling	301.4	--	67.13	301.4	--	67.13	--
Indoor Fans	231.2	--	30.49	231.2	--	30.49	--
Heat Rejection	--	--	--	--	--	--	--
Pumps & Misc.	--	--	--	--	--	--	--
Domestic Hot Water	138.3	--	16.82	138.3	--	16.82	--
Indoor Lighting	533.2	--	68.35	533.2	--	68.35	--
COMPLIANCE TOTAL	1,204.1	1,961.6	199.50	1,204.1	1,961.6	199.50	--
Receptacle	683.0	--	85.38	683.0	--	85.38	- %
Process	--	--	--	--	--	--	
Other Ltg	--	--	--	--	--	--	Result:
Process Motors	1.8	--	0.23	1.8	--	0.23	**PASS**
Photovoltaics	--	--	--	--	--	--	(not current)
Battery	--	--	--	--	--	--	
TOTAL	1,888.9	1,961.6	285.11	1,888.9	1,961.6	285.11	

Generation Coincident Peak Demand (kW): Standard Design: 571.6 Proposed Design: 571.6 Reduction: 0.0

Nonresidential Standard Design – The standard design in green shows the energy consumption that this nonresidential building will be measured against.
Source: California Energy Commission, CBECC-Com Computer Modeling Program

PART 2

All Occupancies—Mandatory Requirements for the Manufacture, Construction and Installation of Systems, Equipment, and Building Components

Subchapter 2

Subchapter 2 identifies mandatory requirements that are applicable to all buildings regulated by the Energy Code (low-rise residential, high-rise residential, nonresidential, and hotel/motel buildings). This subchapter spans from Section 110.0 through 110.12. Requirements listed in these sections are mandatory and cannot be traded away via the performance approach. ■

110.3

Mandatory Requirements for Service Water Heating Systems and Equipment

110.3(c)

Installation

110.5

Natural Gas Central Furnaces, Cooking Equipment, Pool and Spa Heaters, and Fireplaces: Pilot Lights Prohibited

110.6

Fenestration Products and Exterior Doors

110.6(a)

Certification of Fenestration Products and Exterior Doors other than Field-Fabricated

110.9

Mandatory Requirements for Lighting Controls

110.9(a)

General

110.9(b)

All Lighting Controls

110.9(b)1

Time Switch Lighting Controls

110.9(b)2

Daylighting Controls

110.9(b)3

Dimmers

110.9(b)4

Occupant Sensing Controls

110.9(B)5

Part-Night Outdoor Lighting Controls

110.9(b)6 and 7

Sensors Used to Detect Occupants; Indicator Lights

110.9(c)

Track Lighting Integral Current Limiter

110.9(d)

Track Lighting Supplementary Overcurrent Protection Panel

110.9(e) and (f)

JA8 High Efficacy Light Sources, and Ballasts for Residential Recessed Luminaires

110.10

Mandatory Requirements for Solar Ready Buildings

110.10(a)

Covered Occupancies

110.12

Mandatory Requirements for Demand Management

110.12(a)

Covered Occupancies

110.3

Mandatory Requirements for Service Water Heating Systems and Equipment

CHANGE TYPE: Addition

CHANGE SUMMARY: A reference to the portion of the plumbing code that applies to healthcare facilities has been added to this section.

2019 CODE:

(a) **Certification by Manufacturers.** Any service water-heating system or equipment may be installed only if the manufacturer has certified that the system or equipment complies with all of the requirements of this subsection for that system or equipment.

1. **Temperature controls for service water heating systems.** Service water-heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use as listed in Table 3, Chapter 50 of the ASHRAE Handbook, HVAC Applications Volume or Table 613.1 of the *California Plumbing Code* for healthcare facilities.

   EXCEPTION to Section 110.3(a)1: Residential occupancies.

CHANGE SIGNIFICANCE: Healthcare facilities are included in the scope of the Energy Code for the first time. To accommodate their unique needs for health and safety, they are exempt from some energy code provisions, or have separate or alternative requirements.

The addition to this section is an acknowledgement that healthcare facilities need higher water temperatures than other nonresidential buildings for certain applications. They must use the highest acceptable temperature settings specified in Table 613.1 of the *California Plumbing Code* when necessary. Alternatively, they may realize additional energy savings with temperature control settings in Table 3 in Chapter 50 of the ASHRAE HVAC Applications Handbook, depending on the service application.

The temperature control requirements for all other nonresidential service water heating systems continue to be specified in the 2015 ASHRAE HVAC Applications Handbook.

TABLE 613.1 of the California Plumbing Code [OSHPD 1, 1R, 2, 3, 4 & 5] Hot Water Use

	CLINICAL	DIETARY[1]	LAUNDRY[2]
Liter/Hour/Bed	*11.9*	*7.2*	*7.6*
Gallons/Hour/Bed	*3*	*2*	*2*
Temperature °C	*41-49.0*	*49.0*	*71.0*
Temperature °F	*105-120.0*	*120*	*160.0*

1 Rinse water temperature at automatic dishwashing equipment and pot sinks shall be 180°F (82°C).

Exception: *The rinse water supply to pot rinse sinks may be deleted if a method of chemical disinfection using a three-compartment sink is proposed.*

2 The required temperature of 160°F (71°C) in the laundry is that measure in the washing machine and shall be supplied so that the temperature may be maintained over the entire wash and rinse period.

Exception: *A lower water temperature of 140°F (60°C) may be utilized, provided linens are subsequently passed through a tumbler dryer at 180°F (82°C) or a flatwork ironer at 300°F (149°C).*

110.3(c)
Installation

CHANGE TYPE: Addition

CHANGE SUMMARY: Exceptions were added for service water heating systems in healthcare facilities.

2019 CODE:

(c) **Installation.** Any service water-heating system or equipment may be installed only if the system or equipment complies with all of the applicable requirements of this subsection for the system or equipment.

1. **Outlet temperature controls.** On systems that have a total capacity greater than 167,000 Btu/hr, outlets that require higher than service water temperatures as listed in the ASHRAE Handbook, Applications Volume, shall have separate remote heaters, heat exchangers, or boosters to supply the outlet with the higher temperature.

   EXCEPTION to Section 110.3(c)1: Systems covered by *California Plumbing Code* Section 613.0 shall instead follow the requirements of that section.

2. **Controls for hot water distribution systems.** Service hot water systems with circulating pumps or with electrical heat trace systems shall be capable of automatically turning off the system.

   EXCEPTION to Section 110.3(c)2: Systems serving healthcare facilities.

~~3. **Temperature controls for public lavatories.** The controls shall limit the outlet temperature at the fixtures to 110°F.~~

[…]

~~6~~5. **Service water heaters in state buildings.** Any newly constructed building constructed by the State shall derive its service water heating from a system that provides at least 60 percent of the energy needed for service water heating from site solar energy or recovered energy, per the statutory requirement of California Public Resources Code Section 25498.

   EXCEPTION to Section 110.3(c)~~6~~5: Buildings for which the state architect determines that service water heating from site solar energy or recovered energy is economically or physically infeasible. […]

CHANGE SIGNIFICANCE: The service water heating system installation requirements in Section 110.3(c) are mandatory for residential and nonresidential buildings, with some exceptions for healthcare facilities. The system or equipment must comply with measures for outlet temperature controls, hot water distribution system controls, insulation, recirculation loops, State of California government buildings, and isolation valves.

Now that healthcare facilities are within the scope of the Energy Code, Section 110.3(c)1 has a new exception to the requirements for outlet temperature controls to harmonize with the California's Plumbing Code. Service water heating systems covered by *California Plumbing Code* Section 613.0 must instead follow those requirements. This change prevents a conflict between the Plumbing Code and the Energy Code.

The exception to Section 110.3(c)2 exempts licensed healthcare facilities from requirements for water distribution systems controls. Service hot water systems with circulating pumps or with electrical heat trace systems must be capable of automatically turning off the system. This exception is necessary because this section has the potential to interfere with the primary health and safety responsibilities of healthcare facilities. Infection control requires sustained higher temperatures in distribution lines than in other buildings. In addition, the measure may not be cost effective for healthcare facilities because they operate continuously. In future code cycles, more detailed analysis may result in this exception's revision or removal.

Section 110.3(c)3 covering temperature controls in public lavatories has been removed from the Energy Code. The *California Plumbing Code* specifies the minimum output temperature for public lavatories, and this section duplicated the requirement. During the 2019 Energy Code rulemaking process, the initial draft regulations proposed a revision to harmonize the water temperature specifications with *California Plumbing Code* Section 407.3, but in the final version adopted by the Energy Commission, all of Section 110.3(c)3 was deleted to increase clarity, and to streamline the code. The remaining subsections have been re-numbered, so the 2019 version of Section 110.3(c)3 now addresses insulation.

The minor change to Section 110.3(c)5 is a clarification. Newly constructed State of California government buildings have unique requirements designed to meet energy efficiency goals. At least 60% of the energy needed for service water heating systems must come from site solar energy or recovered energy. New language has been added that references the California Public Resources Code to inform the reader that Section 110.3(c)5 is statutory in nature.

110.5

Natural Gas Central Furnaces, Cooking Equipment, Pool and Spa Heaters, and Fireplaces: Pilot Lights Prohibited

CHANGE TYPE: Addition

CHANGE SUMMARY: Continuously burning pilot lights are now prohibited for indoor and outdoor fireplaces serving buildings covered by the Energy Code.

2019 CODE:

Any natural gas system or equipment listed below may be installed only if it does not have a continuously burning pilot light:

(a) Fan-type central furnaces.

(b) Household cooking appliances.

EXCEPTION to Section 110.5(b): Household cooking appliances without an electrical supply voltage connection and in which each pilot consumes less than 150 Btu/hr.

(c) Pool heaters.

(d) Spa heaters.

<u>(e) Indoor and outdoor fireplaces.</u>

[…]

CHANGE SIGNIFICANCE: Fireplaces have been added to the list of equipment that cannot have continuously burning pilot lights. Previously, only indoor fireplaces installed in low-rise residential buildings were regulated in this way. This limitation has been expanded to apply to all buildings covered by the Energy Code. This mandatory measure reduces uneconomic and inefficient energy consumption. Note that intermittent pilot lights, meaning pilot lights that are on while the fireplace is in use and off while the fireplace is not in use, are allowed by the Energy Code.

110.6(a)

Certification of Fenestration Products and Exterior Door other than Field-Fabricated

TYPE: Modification and Clarification

CHANGE SUMMARY: Exterior doors that are not field fabricated now must meet *U*-factor and labeling requirements, and the threshold for using an exception to calculate default *U*-factor, Solar Heat Gain Coefficient (SHGC), and Visible Transmittance (VT) values, was lowered.

2019 CODE:

(a) **Certification of Fenestration Products and Exterior Doors other than Field-fabricated.** Any fenestration product and exterior door, other than field-fabricated fenestration products and field-fabricated exterior doors, may be installed only if the manufacturer has certified to the Commission, or if an independent certifying organization approved by the Commission has certified that the product complies with all of the applicable requirements of this subsection.

1. **Air leakage.** Manufactured fenestration products and exterior doors shall have air infiltration rates not exceeding 0.3 cfm/ft^2 of window area, 0.3 cfm/ft^2 of door area for residential doors, 0.3 cfm/ft^2 of door area for nonresidential single doors (swinging and sliding), and 1.0 cfm/ft^2 for nonresidential double doors (swinging), when tested according to NFRC-400 or ASTM E283 at a pressure differential of 75 pascals (or 1.57 pounds/ft^2), incorporated herein by reference.

   NOTES TO SECTION 110.6(a)1:

   Pet doors must meet 0.3 cfm/ft^2 when tested according to ASTM E283 at 75 pascals (or 1.57 pounds/ft^2). AAMA/WDMA/CSA 101/I.S.2/A440-2011 specification is equivalent to ASTM E283 at a pressure differential of 75 pascals (or 1.57 pounds/ft^2) and satisfies the air leakage certification requirements of this section.

   EXCEPTION to Section 110.6(a)1: Field-fabricated fenestration and field-fabricated exterior doors.

2. **U-factor.** The fenestration product and exterior door's *U*-factor shall be rated in accordance with NFRC 100, or use the applicable default U-factor set forth in TABLE 110.6-A.

   EXCEPTION 1 to Section 110.6(a)2: If the fenestration product is a skylight or a vertical site-built fenestration product in a building covered by the nonresidential standards with less than ~~1,000~~200 square feet of site-built fenestration, the default U-factor may be calculated as set forth in Reference Nonresidential Appendix NA6.

   EXCEPTION 2 to Section 110.6(a)2: If the fenestration product is an alteration consisting of any area replacement of glass in a skylight product or in a vertical site-built fenestration product, in a building covered by the nonresidential standards, the default U-factor may be calculated as set forth in Reference Nonresidential Appendix NA6.

3. **Solar Heat Gain Coefficient (SHGC).** The fenestration product's SHGC shall be rated in accordance with NFRC 200, or use the applicable default SHGC set forth in TABLE 110.6-B.

EXCEPTION 1 to Section 110.6(a)3: If the fenestration product is a skylight or a vertical site-built fenestration product in a building covered by the nonresidential standards with less than ~~1,000~~200 square feet of site-built fenestration, the default SHGC may be calculated as set forth in Reference Nonresidential Appendix NA6.

EXCEPTION 2 to Section 110.6(a)3: If the fenestration product is an alteration consisting of any area replacement of glass in a skylight product or in a vertical site-built fenestration product, in a building covered by the nonresidential standards, the default SHGC may be calculated as set forth in Reference Nonresidential Appendix NA6.

4. **Visible Transmittance (VT).** The fenestration product's VT shall be rated in accordance with NFRC 200 or ASTM E972, for tubular ~~skylights~~ daylighting devices VT shall be rated using NFRC 203.

EXCEPTION 1 to Section 110.6(a)4: If the fenestration product is a skylight or a vertical site-built fenestration product in a building covered by the nonresidential standards with less than ~~1,000~~200 square feet of site-built fenestration, the default VT may be calculated as set forth in Reference Nonresidential Appendix NA6.

EXCEPTION 2 to Section 110.6(a)4: If the fenestration product is an alteration consisting of any area; replacement of glass in a skylight product or in a vertical site-built fenestration product in a building covered by the nonresidential standards, the default VT may be calculated as set forth in Reference Nonresidential Appendix NA6.

5. **Labeling.** Fenestration products and exterior doors shall:
   A. Have a temporary label for manufactured fenestration products and exterior doors or a label certificate when the Component Modeling Approach (CMA) is used and for site-built fenestration meeting the requirements of Section 10-111(a)1. The temporary label shall not be removed before inspection by the enforcement agency; and
   B. Have a permanent label or a label certificate when the Component Modeling Approach (CMA) is used and for site-built fenestration meeting the requirements of Section 10-111(a)2 if the product is rated using NFRC procedures.

[…]

CHANGE SIGNIFICANCE: Installed fenestration products that are not field-fabricated must be certified to the National Fenestration Rating Council (NFRC) showing they comply with the Energy Code. They must meet *U*-factor, SHGC, air leakage, VT and labeling specifications. Certified products meet or exceed the applicable requirements of Section 110.6(a).

The labeling requirements make it easier to identify certified products. The product manufacturer is responsible for the certification label, or they can an NFRC label.

In Section 110.6(a)2 and 5, the term "exterior doors" has been added to clarify that these products must comply with *U*-factor specifications and labeling requirements. This is stated at the beginning of subsection (a), but was not restated in (a)2 and (a)5 in previous code cycles.

In Section 110.6(a)2, 3, and 4, the allowable square footage to use the exception square footage thresholds has been reduced. The exceptions now apply for nonresidential buildings with less than 200 square feet of site-built fenestration. The area threshold was formerly 1,000 square feet. Site-built fenestration not exceeding this new limit can use the calculations found in Reference Nonresidential Appendix NA6 to determine alternate default *U*-factor, SHGC, and VT values.

Section 110.6(a)4 specifies visual transmittance allowances. The 2019 Energy Code now uses the term "tubular daylighting device" to describe the devices subject to the VT specifications. Formerly called "tubular skylight," the new term more accurately characterizes these devices, given the variety of daylighting products available on the market. The change also resolves a conflict with the definition of the term "skylight."

Sample NFRC Label
Source: National Fenestration Rating Council

CHANGE TYPE: Modification

CHANGE SUMMARY: Requirements for different types of lighting control components, systems, and light sources have been consolidated, and language was relocated.

110.9(a)

Mandatory Requirements for Lighting Controls; General

2019 CODE:

(a) **All lighting control devices and systems~~,~~ ~~ballasts,~~ and ~~luminaires~~ all light sources** subject to the requirements of Section 110.9 shall meet the following requirements:

1. Shall be installed only if the lighting control ~~device or system, ballast,~~ or ~~luminaire~~ light source complies with all of the applicable requirements of Section 110.9.
2. Lighting controls may be individual devices ~~(Self Contained Lighting Control)~~ or systems ~~(Lighting Control Systems)~~ consisting of two or more components.
3. ~~Self Contained Lighting Controls, as defined in Section 100.1, shall be certified by the Manufacturer as required by the Title 20 Appliance Efficiency Regulations.~~
4. ~~Lighting Control Systems, as defined in Section 100.1, shall be a fully functional lighting control system complying with the applicable requirements in Section 110.9(b), and~~ Shall meet the Lighting Control Installation requirements in Section 130.4.
5. ~~If indicator lights are integral to a lighting control system, they shall consume no more than one watt of power per indicator light.~~

CHANGE SIGNIFICANCE: Advances in lighting control technology helped simplify Section 110.9. Measures now apply to "lighting controls" and "light sources" instead of the various control system components and systems that were specified in the 2016 Energy Code.

Another simplification is the removal of Section 110.9(a)3. It is no longer necessary for manufacturers to certify lighting controls to the Title 20 Modernized Appliance Efficiency Database System (MAEDbS). Lighting control technology and installation best practices have improved, thus diminishing the value of manufacturer certification. For example, nonresidential lighting controls undergo acceptance testing to confirm correct installation, configuration, and operation, while residential controls are digital devices that are increasingly reliable and user-friendly.

The lighting control measures in Section 110.9 continue to apply to indoor and outdoor signs. This has been clarified by adding Section 110.9 to the other mandatory measures for signs in Table 100.0-A.

110.9(b)1

All Lighting Controls, Time Switch Lighting Controls

CHANGE TYPE: Modification

CHANGE SUMMARY: Time-switch lighting controls will no longer require manufacturer certification, though devices must still comply with specified requirements which have been relocated from the Appliance Efficiency Regulations to this section.

2019 CODE:

(b) All ~~Installed~~ Lighting Controls. ~~Systems~~ Lighting controls listed in Section 110.9(b) shall comply with the requirements listed below; and all components of the system considered together as installed shall meet all applicable requirements for the application for which they are installed as required in Sections 130.0 through 130.5, Sections 140.6 through 140.8, Section 141.0, and Section 150.0(k).

1. **Time-Switch Lighting Controls.** All controls that provide time-switch functionality, including all automatic and astronomical time-switch controls, shall have program backup capabilities that prevent the loss of the device's schedule for at least 7 days, and the device's date and time for at least 72 hours if power is interrupted. In addition:

   A. **~~Automatic~~ Time-Switch Controls** installed in nonresidential buildings shall ~~meet all requirements for Automatic Time Switch Control devices in the Title 20 Appliance Efficiency Regulations.~~

      i. For each connected load, be capable of providing manual override to each connected load and of resuming normally scheduled operation after a manual override is initiated within 2 hours; and

      ii. Provide an automatic holiday shutoff feature that turns off all connected loads for at least 24 hours and then resumes normally scheduled operation.

   B. **Astronomical Time-Switch Controls** shall: ~~meet all requirements for Astronomical Time-Switch Control devices in the Title 20 Appliance Efficiency Regulations.~~

      i. Have sunrise and sunset prediction accuracy within plus-or-minus 15 minutes and timekeeping accuracy within 5 minutes per year;

      ii. Be capable of displaying date, current time, sunrise time, sunset time, and switching times for each step during programming;

      iii. Be capable of automatically adjusting for daylight savings time; and

      iv. Have the ability to independently offset the on and off for each channel by at least 90 minutes before and after sunrise or sunset.

   C. **MultiLevel ~~Astronomical~~ Time-Switch Controls,** ~~in addition to meeting all of the requirements for Astronomical Time-Switch Controls~~, shall include at least ~~2~~two separately programmable steps per zone.

D. **~~Outdoor Astronomical~~ Time-Switch Controls i<u>nstalled outdoors,</u>** ~~in addition to meeting all of the requirements for Astronomical Time-Switch Controls~~, shall have setback functions that allow the lighting on each controlled channel to be switched or dimmed to lower levels. The set back functions shall be capable of being programmed by the user for at least one specific time of day.

CHANGE SIGNIFICANCE: The purpose of the changes in this section are to relocate lighting control device specifications present in the Appliance Efficiency Regulations to this section of the Energy Code. Previously, the Energy Code referred to the Appliance Efficiency Regulations for lighting control device requirements. This was done to facilitate manufacturer product certification. However, the Appliance Efficiency Regulations can be updated outside of the Building Code's triennial cycle, causing inconsistencies with Section 110.9. Relocating this language back into Section 110.9 is necessary to prevent out-of-cycle changes to the requirements of the Energy Code, and to facilitate reconsideration of manufacturer certification requirements.

The time-switch lighting control requirements were relocated from the Appliance Efficiency Regulations to Section 110.9(b)1. There are no substantive changes to these requirements.

110.9(b)2

All Lighting Controls, Daylighting Controls

CHANGE TYPE: Modification

CHANGE SUMMARY: Daylighting controls no longer require manufacturer certification, however devices must still comply with specified requirements which have been relocated from the Appliance Efficiency Regulations to this section.

2019 CODE:

(b) **All ~~Installed~~ Lighting Controls.** ~~**Systems**~~ Lighting controls listed in Section 110.9(b) shall comply with the requirements listed below; and all components of the system considered together as installed shall meet all applicable requirements for the application for which they are installed as required in Sections 130.0 through 130.5, Sections 140.6 through 140.8, Section 141.0, and Section 150.0(k).

[…]

2. Daylighting Controls. Controls that provide automatic daylighting functionality shall:

A. Automatically return to its most recent time delay settings within 60 minutes of the last received input when left in calibration mode;

B. Have a set point control that easily distinguishes settings to within 10 percent of full scale adjustment;

C. Provide a linear response within 5 percent accuracy over the range of illuminance measured by the light sensor; and

D. Be capable of being calibrated in a manner that the person initiating the calibration is remote from the sensor during calibration to avoid influencing calibration accuracy, for example by having a light sensor that is physically separated from where the calibration adjustments are made.

~~A. **Automatic Daylight Controls** shall meet all requirements for Automatic Daylight Control devices in the Title 20 Appliance Efficiency Regulations.~~

~~B. **Photo Controls** shall meet all requirements for Photo Control devices in the Title 20 Appliance Efficiency Regulations.~~

CHANGE SIGNIFICANCE: The purpose of the changes in this section are to relocate lighting control device specifications present in the Appliance Efficiency Regulations to this section of the Energy Code. Previously, the Energy Code referred to the Appliance Efficiency Regulations for lighting control device requirements. This was done to facilitate manufacturer product certification. However, the Appliance Efficiency Regulations can be updated outside of the Building Code's triennial cycle, causing inconsistencies with Section 110.9. Relocating this language back into Section 110.9 is necessary to prevent out-of-cycle changes to the requirements of the Energy Code and to facilitate reconsideration of manufacturer certification requirements.

The daylighting control requirements were relocated from the Appliance Efficiency Regulations to Section 110.9(b)2. There are no substantive changes to these requirements.

110.9(b)3

All Lighting Controls, Dimmers

CHANGE TYPE: Modification

CHANGE SUMMARY: Dimmer controls no longer require manufacturer certification, however devices must still comply with specified requirements which have been relocated from the Appliance Efficiency Regulations to this section.

2019 CODE:

(b) **All ~~Installed~~ Lighting Controls. ~~Systems~~** Lighting controls listed in Section 110.9(b) shall comply with the requirements listed below; and all components of the system considered together as installed shall meet all applicable requirements for the application for which they are installed as required in Sections 130.0 through 130.5, Sections 140.6 through 140.8, Section 141.0, and Section 150.0(k).

[…]

3. **Dimmers.** ~~shall meet all requirements for Dimmer Control devices in the Title 20 Appliance Efficiency Regulations.~~Controls that provide dimming functionality shall:
   A. Be capable of reducing lighting power consumption by a minimum of 65% when at its lowest setting;
   B. Provide reduced flicker operation, meaning that directly controlled light sources shall be provided electrical power such that the light output has an amplitude modulation of less than 30 percent for frequencies less than 200 Hz without causing premature lamp failure;
   C. Provide an off setting that produces a zero lumen output; and
   D. For wall box dimmers and associated switches designed for use in three way circuits, be capable of turning lights off, and on to the level set by the dimmer if the lights are off.

CHANGE SIGNIFICANCE: The purpose of the changes in this section are to relocate lighting control device specifications present in the Appliance Efficiency Regulations to this section of the Energy Code. Previously, the Energy Code referred to the Appliance Efficiency Regulations for lighting control device requirements. This was done to facilitate manufacturer product certification. However, the Appliance Efficiency Regulations can be updated outside of the Building Code's triennial cycle, causing inconsistencies with Section 110.9. Relocating this language back into Section 110.9 is necessary to prevent out-of-cycle changes to the requirements of the Energy Code and to facilitate reconsideration of manufacturer certification requirements.

The dimmer control requirements previously contained within the Appliance Efficiency Regulations have been relocated to Section 110.9(b)3. There are no substantive changes to these requirements.

110.9(b)4

All Lighting Controls, Occupant Sensing Controls

CHANGE TYPE: Modification

CHANGE SUMMARY: Occupant sensing controls no longer require manufacturer certification, but these devices must still comply with specified requirements which have been relocated from the Appliance Efficiency Regulations to this section.

2019 CODE:

(b) **All ~~Installed~~ Lighting Controls.** ~~Systems~~ Lighting controls listed in Section 110.9(b) shall comply with the requirements listed below; and all components of the system considered together as installed shall meet all applicable requirements for the application for which they are installed as required in Sections 130.0 through 130.5, Sections 140.6 through 140.8, Section 141.0, and Section 150.0(k).

[…]

4. **Occupant Sensing Controls.**~~:~~ Occupant sensing controls include occupant sensors, motion sensors, and vacancy sensors, including those with a Partial-ON or Partial-OFF function. Occupant sensing controls shall:

A. Be capable of automatically turning the controlled lights in the area either off or down no more than 20 minutes after the area has been vacated;

B. For manual-on controls, have a grace period of no less than 15 seconds and no more than 30 seconds to turn on lighting automatically after the sensor has timed out; and

C. Provide a visible status signal that indicates that the device is operating properly, or that it has failed or malfunctioned. The visible status signal may have an override that turns off the signal.

~~Occupant, Motion, and Vacancy Sensor Controls shall meet the following requirements:~~

~~A. **Occupant Sensors** shall meet all applicable requirements for Occupant Sensor Control devices in the Title 20 Appliance Efficiency Regulations.~~

~~B. **Motion Sensors** shall meet all applicable requirements for Motion Sensor Controls devices in the Title 20 Appliance Efficiency Regulations.~~

~~C. **Vacancy Sensors** shall meet all applicable requirements for Vacancy Sensor Controls devices in the Title 20 Appliance Efficiency Regulations.~~

~~D. **Partial-ON Sensors** shall meet all applicable requirements for partial on sensing devices in the Title 20 Appliance Efficiency Regulations.~~

~~E. **Partial-OFF Sensors** shall meet all applicable requirements for partial off sensing devices in the Title 20 Appliance Efficiency Regulations.~~

~~F. All Occupant Sensing Control types shall be programmed to turn OFF all or part of the lighting no longer than 20 minutes after the space is vacated of occupants, except as specified by Section 130.1(c)8.~~

EXCEPTION to Section 110.9(b)4: Occupant Sensing Control systems may consist of a combination of single or multilevel Occupant, Motion, or Vacancy Sensor Controls, provided that components installed to comply with manual-on requirements shall not be capable of conversion by ~~the user~~occupants from manual-on to automatic-on functionality.

CHANGE SIGNIFICANCE: The purpose of the changes in this section are to relocate lighting control device specifications present in Appliance Efficiency Regulations to this section of the Energy Code. Previously, the Energy Code referred to the Appliance Efficiency Regulations for lighting control device requirements. This was done to facilitate manufacturer product certification. However, the Appliance Efficiency Regulations can be updated outside of the Building Code's triennial cycle, causing inconsistencies with Section 110.9. Relocating this language back into Section 110.9 is necessary to prevent out-of-cycle changes to the requirements of the Energy Code and to facilitate reconsideration of manufacturer certification requirements.

The occupant sensing control requirements previously contained within the Appliance Efficiency Regulations have been relocated to Section 110.9(b)4. There are no substantive changes to these requirements.

110.9(b)5

All Lighting Controls, Part-Night Outdoor Lighting Controls

CHANGE TYPE: Modification

CHANGE SUMMARY: Clarifies functionality requirements for part-night outdoor lighting controls.

2019 CODE:

(b) **All ~~Installed~~ Lighting Controls. ~~Systems~~** Lighting controls listed in Section 110.9(b) shall comply with the requirements listed below; and all components of the system considered together as installed shall meet all applicable requirements for the application for which they are installed as required in Sections 130.0 through 130.5, Sections 140.6 through 140.8, Section 141.0, and Section 150.0(k).

[…]

5. **Part-Night Outdoor Lighting Controls**, as defined in Section 100.1, shall meet all of the following requirements:
    - A. Have sunrise and sunset prediction accuracy within +/- 15 minutes, ~~and timekeeping accuracy within five minutes per year~~using both light sensing and time measurement; and
    - B. Have the ability to ~~setback~~ reduce or turn off ~~lighting~~ outdoor luminaire power at night as required in Section 130.2(c)~~, by means of a programmable timeclock or motion sensing device~~; and
    - C. ~~When controlled with a timeclock, s~~Shall be ~~capable of being programmed~~programmable to ~~allow the setback~~reduce or ~~turning~~ turn off ~~of the lighting~~outdoor luminaire power ~~to occur fromat~~ any time ~~at night until any time in the morning~~, as determined by the user. Time-based scheduling control is allowed to be relative to both sunset and sunrise, and to the midpoint between sunset and sunrise.

CHANGE SIGNIFICANCE: Part-night outdoor lighting controls are defined in Section 100.1 as "… a light sensing and time-based lighting control device or system that is programmed to reduce or turn off the lighting power to an outdoor luminaire for a portion of the night." The changes to Section 110.9(b)5 clarify specific functionality requirements for part-night outdoor lighting controls.

Part-night outdoor lighting controls must have the following capabilities so that outdoor lighting can be reduced during scheduled periods:

- Sunrise and sunset prediction accuracy within +/- 15 minutes, using both light sensing and time measurement; and
- Reduce or turn off outdoor luminaire power at night as required in Section 130.2(c). Section 130.2(c) addresses functional requirements for installed controls, and includes exceptions for safety or local needs; and
- Reduce or turn off outdoor luminaire power at any time the user chooses. Time-based scheduling control is allowed to be relative to both sunset and sunrise, and to the midpoint between sunset and sunrise.

Getty Images

Parking Lot Lighting – This lighting must satisfy automatic shutoff and reduction of power requirements where applicable.

110.9(b)6 and 7

All Lighting Controls, Sensors Used to Detect Occupants; Indicator Lights

CHANGE TYPE: Addition

CHANGE SUMMARY: Controls no longer require manufacturer certification, but these devices must still comply with specified requirements which have been relocated and consolidated from the Appliance Efficiency Regulations to Section 110.9(b)6 and 110.9(b)7.

2019 CODE:

(b) **All ~~Installed~~ Lighting Controls. ~~Systems~~** Lighting controls listed in Section 110.9(b) shall comply with the requirements listed below; and all components of the system considered together as installed shall meet all applicable requirements for the application for which they are installed as required in Sections 130.0 through 130.5, Sections 140.6 through 140.8, Section 141.0, and Section 150.0(k).

[…]

6. **Sensors used to detect occupants.** Sensors that are used by occupant sensing controls to detect occupants shall meet all of the following requirements:
   - A. Sensors shall not incorporate switches or mechanical devices that allow the sensor to be disabled without changing the settings of the control.
   - B. Sensors that utilize ultrasonic radiation for detection of occupants shall:
     - i. comply with 21 C.F.R. part 1002.12;
     - ii. not emit audible sound; and
     - iii. not emit ultrasound in excess of the decibel levels shown in Table 110.9-A measured no more than five feet from the source, on axis.
   - C. Sensors that utilize microwave radiation for detection of occupants shall:
     - i. comply with 47 C.F.R. parts 2 and 15; and
     - ii. not emit radiation in excess of 1 milliwatt per square centimeter measured at no more than 5 centimeters from the emission surface of the device.
7. **Indicator Lights.** Indicator lights integral to lighting controls shall consume no more than one watt of power per indicator light.

[…]

TABLE 110.9-A Ultrasound Maximum Decibel Values

Mid-frequency of Sound Pressure Third-Octave Band (in kHz)	Maximum db Level within Third-Octave Band (in dB reference 20 micropascals)
Less than 20	80
20 or more to less than 25	105
25 or more to less than 31.5	110
31.5 or more	115

CHANGE SIGNIFICANCE: The purpose of the changes in this section are to relocate lighting control device specifications present in the Appliance Efficiency Regulations to this section of the Energy Code. Previously, the Energy Code referred to the Appliance Efficiency Regulations for lighting control device requirements. This was done to facilitate manufacturer product certification. However, the Appliance Efficiency Regulations can be updated outside of the Building Code's triennial cycle, causing inconsistencies with Section 110.9. Relocating this language back into Section 110.9 is necessary to prevent out-of-cycle changes to the requirements of the Energy Code and to facilitate reconsideration of manufacturer certification requirements.

The occupant sensing control requirements previously contained within the Appliance Efficiency Regulations have been relocated to Section 110.9(b)6.

The indicator light requirements previously contained within the Appliance Efficiency Regulations have been relocated to Section 110.9(b)7. Section 110.9(b)7 applies to indicator lights that are integral to lighting controls. An individual indicator light can consume no more than one watt of power.

When it is difficult to verify that the device specifications comply with the Energy Code, the builder or installer should make the product documentation available to inspectors.

110.9(c)

Track Lighting Integral Current Limiter

CHANGE TYPE: Modification

CHANGE SUMMARY: Track lighting integral current limiters no longer require certification, but these devices must still comply with specified requirements in this section.

2019 CODE:

(c) **Track Lighting Integral Current Limiter.** An integral current limiter for line-voltage track lighting shall be recognized for compliance with Part 6 only if it meets all of the following requirements:

~~1. Shall be certified to the Energy Commission as meeting all of the applicable requirements in Section 110.9(c); and~~

~~2. Shall comply with the Lighting Control Installation requirements in accordance with Section 130.4; and~~

~~3. Shall be manufactured so that the current limiter housing is used exclusively on the same manufacturer's track for which it is designed; and~~

~~4. Shall be designed so that the current limiter housing is permanently attached to the track so that the system will be irreparably damaged if the current limiter housing were to be removed after installation into the track. Methods of attachment may include but are not limited to one-way barbs, rivets, and one-way screws; and~~

~~5. Shall employ tamper resistant fasteners for the cover to the wiring compartment; and~~

~~6~~1. Shall have the identical volt-ampere (VA) rating of the current limiter, as installed and rated for compliance with Part 6 clearly marked as follows; and:

   A. So that it is visible for the enforcement agency's field inspection without opening coverplates, fixtures, or panels; and

   B. Permanently marked on the circuit breaker; and

   C. On a factory-printed label that is permanently affixed to a nonremovable base-plate inside the wiring compartment.

~~7~~2. Shall have a conspicuous factory installed label permanently affixed to the inside of the wiring compartment warning against removing, tampering with, rewiring, or bypassing the device; and

~~8~~3. Each electrical panel from which track lighting integral current limiters are energized shall have a factory printed label permanently affixed and prominently located, stating the following: "NOTICE: Current limiting devices installed in track lighting integral current limiters connected to this panel shall only be replaced with the same or lower amperage. Adding track or replacement of existing current limiters with higher continuous ampere rating will void the track lighting integral current limiter certification, and will require resubmittal of compliance documentation to the enforcement agency responsible for compliance with the California Title 24, Part 6 Building Energy Efficiency Standards."

CHANGE SIGNIFICANCE: The significant changes to this subsection remove certification requirements for track lighting integral current limiters. The reference to Section 130.4 that addresses certification has been removed. The related design and manufacturing specifications referenced in Section 110.9 have also been removed.

This certification requirement was removed due to advancements in solid state lighting technology used in modular lighting systems. Solid state lighting systems have drivers and similar power transformers that limit modular system total power draw. Related updates to Section 130.0 reflect the value of installed efficient lamps used in modular lighting systems. Track lighting system power is no longer based solely on the maximum potential power draw. This change reduces the costs associated with product certification and simplifies compliance.

110.9(d)

Track Lighting Supplementary Overcurrent Protection Panel

CHANGE TYPE: Modification

CHANGE SUMMARY: Track lighting supplementary overcurrent protection panels no longer require certification, however devices must still comply with specified requirements in this section.

2019 CODE:

(d) Track Lighting Supplementary Overcurrent Protection Panel. A Track Lighting Supplementary Overcurrent Protection Panel shall be used only for line-voltage track lighting and shall be recognized for compliance with Part 6 only if it meets all of the following requirements:

~~1. Shall comply with the Lighting Control Installation requirements in accordance with Section 130.4; and~~

~~2~~1. Shall be listed as defined in Section 100.1; and

~~3. Shall be used only for line voltage track lighting. No other lighting or building power shall be used in a Supplementary Overcurrent Protection Panel used to determine input wattage for track lighting; and~~

~~4. Be permanently installed in an electrical equipment room, or permanently installed adjacent to the lighting panel board providing supplementary overcurrent protection for the track lighting circuits served by the supplementary over current protection pane; and~~

~~5~~2. Shall have a permanently installed label that is prominently located stating the following: "NOTICE: This Panel for Track Lighting Energy Code Compliance Only. The overcurrent protection devices in this panel shall only be replaced with the same or lower amperage. No other overcurrent protective device shall be added to this panel. Adding to, or replacement of existing overcurrent protective device(s) with higher continuous ampere rating, will void the panel listing and require resubmittal of compliance documentation to the enforcement agency responsible for compliance with the California Title 24, Part 6 Building Energy Efficiency Standards."

CHANGE SIGNIFICANCE: The changes to this subsection remove the certification requirements for track lighting supplementary overcurrent protection panels. The reference to Section 130.4 that addressed certification has also been removed. This was done because of advancements in solid state lighting technology used in modular lighting systems. Solid state lighting systems have drivers and similar power transformers that limit modular system total power draw. Related updates to Section 130.0 reflect the value of installed, efficient lamps used in modular lighting systems. Track lighting system power is no longer based solely on maximum potential power draw. The change reduces the costs associated with product certification, and simplifies compliance.

Two requirements remain in Section 110.9(d), addressing product listing and Energy Code compliance. The first states that the product should be listed as defined in Section 100.1, which defers to Article 100 of the *California Electrical Code* for defining these devices.

The second requirement is for an easily seen permanently installed label with a prescribed notification. The notice must state the panel is for energy code compliance only. It also requires that any replacements of the panel's overcurrent protection devices must be the same or lower amperage and prohibits replacement devices or additional devices with higher continuous ampere ratings.

110.9(e) and (f)

JA8 High Efficacy Light Sources and Ballasts for Residential Recessed Luminaires

CHANGE TYPE: Modification

CHANGE SUMMARY: Section 110.9(e) and (f) have been removed because the requirements are located in other sections of the Energy Code.

2019 CODE:

~~(e) **JA8 High Efficacy Light Sources.** To qualify as JA8 high efficacy light source for compliance with the residential lighting Standards in Section 150.0(k), a residential light source shall be certified to the Energy Commission according to Reference Joint Appendix JA-8. Nonresidential light sources are not required to be certified to the Energy Commission.~~

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

1. ~~Be rated by the ballast manufacturer to have a minimum rated life of 30,000 hours when operated at or below a specified maximum case temperature. This maximum ballast case temperature specified by the ballast manufacturer shall not be exceeded when tested in accordance to UL 1598 Section 19.15; and~~
2. ~~Have a ballast factor of not less than 0.90 for non-dimming ballasts and a ballast factor of not less than 0.85 for dimming ballasts.~~

CHANGE SIGNIFICANCE: Sections 110.9(e) and (f) have been removed from the Energy Code. The requirements are already stated in Section 150.0(k) for low-rise residential buildings, and in the Reference Joint Appendix JA8 (JA8).

Section 110.9(e) simply referred to Section 150.0(k) and JA8, the mandatory measures for residential lighting. JA8 also addresses the requirements of Section 110.9(f) with technologically neutral standards for product efficacy and rated life.

110.10(a)

Covered Occupancies

CHANGE TYPE: Modification

CHANGE SUMMARY: Single-family and low-rise multifamily buildings with installed photovoltaic systems, and healthcare facilities are exempted from the solar ready requirements.

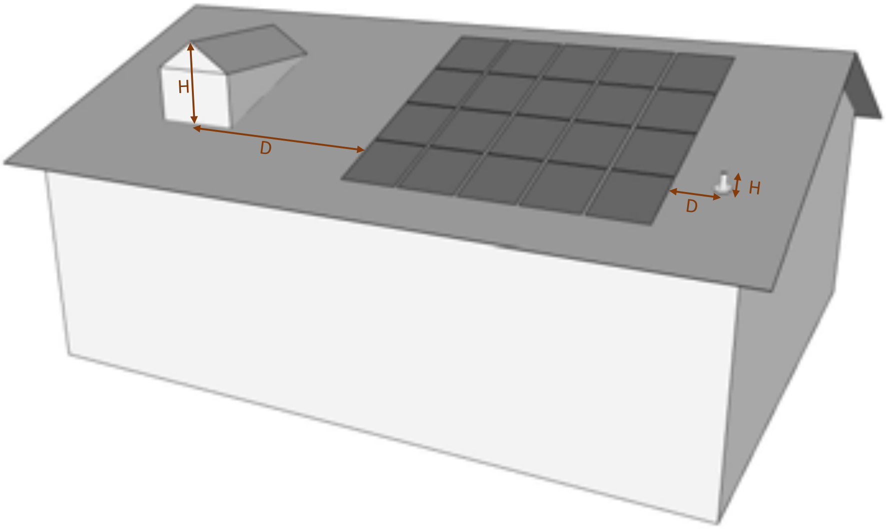
2019 CODE:

(a) **Covered Occupancies.**

1. **Single Family Residences.** Single family residences located in subdivisions with ten or more single family residences and where the application for a tentative subdivision map for the residences has been deemed complete and approved by the enforcement agency, which do not have a photovoltaic system installed, shall comply with the requirements of Sections 110.10(b) through 110.10(e).
2. **Low-rise ~~Multi-family~~Multifamily Buildings.** Low-rise multifamily buildings that do not have a photovoltaic system installed shall comply with the requirements of Sections 110.10(b) through 110.10(d).
3. **Hotel/Motel Occupancies and High-rise ~~Multi-family~~Multifamily Buildings.** Hotel/motel occupancies and high-rise ~~multi-family~~multifamily buildings with ten habitable stories or fewer shall comply with the requirements of Sections 110.10(b) through 110.10(d).
4. **~~All Other~~ Nonresidential Buildings.** ~~All other~~ Nonresidential buildings with three habitable stories or fewer, other than healthcare facilities, shall comply with the requirements of Sections 110.10(b) through 110.10(d).

CHANGE SIGNIFICANCE: The Solar ready requirements require a reserved space for future photovoltaic (PV) systems. The solar-ready requirements do not require installed equipment, other than compliant electrical panels on single-family homes. The 2016 Energy Code previously excluded buildings with PV systems installed by way of an exception in subsequent sections of 110.10. The 2019 Energy Code has now moved that exception into the covered occupancies language. The 2019 Energy Code also now includes solar PV systems in the prescriptive and performance compliance approaches for single-family and low-rise multifamily residential buildings. As a result, most new low-rise residential buildings will be required to have an installed PV system. The changes to Section 110.10(a) address these new requirements by clearly exempting these buildings at the top level of Section 110.10, and because reserved rooftop space is not needed.

The changes to Section 110.10(a)4 remove unneeded language and exclude healthcare facilities from the solar ready scope. Occupancy Groups I-1 and I-2 are now covered by the 2019 Energy Code, although there are exceptions for certain measures. The exception to Section 110.10(a) is necessary because solar ready measures could potentially conflict with health and safety requirements that govern power management strategies of these buildings. Solar ready requirements for healthcare facilities may be added in future code cycles after more detailed analysis; or a partial exception may be added that is specifically tailored for certain facilities.



Solar Ready Shading Limitations – In order to comply with the shading limits, in this illustration, the distance (D) between the peak of the potential shading object and the solar panels must be twice the height (H) of that peak.
Source: California Energy Commission, 2019 Residential Compliance Manual

110.12(a)

Demand Responsive Controls

CHANGE TYPE: Addition

CHANGE SUMMARY: The demand response and demand management control requirements located in various sections of the 2016 Energy Code have been consolidated into this new section of the 2019 Energy Code. Demand responsive controls must be certified to or compatible with OpenADR 2.0.

2019 CODE:

Buildings, other than healthcare facilities, shall comply with the applicable demand responsive control requirements of Sections 110.12(a) through 110.12(d).

(a) **Demand responsive controls.**

1. All demand responsive controls shall be either:
   A. A certified OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in the applicable OpenADR 2.0 Specification; or
   B. Certified by the manufacturer as being capable of responding to a demand response signal from a certified OpenADR 2.0b Virtual End Node by automatically implementing the control functions requested by the Virtual End Node for the equipment it controls.
2. All demand responsive controls shall be capable of communicating using one or more of the following: Wi-Fi, ZigBee, BACnet, Ethernet, or hard-wiring.
3. Demand responsive controls may incorporate and use additional protocols beyond those specified in Sections 110.12(a)1 and 2.
4. When communications are disabled or unavailable, all demand responsive controls shall continue to perform all other control functions provided by the control.
5. Demand responsive control thermostats shall comply with Reference Joint Appendix 5 (JA5), Technical Specifications For Occupant Controlled Smart Thermostats.

(b) **Demand Responsive Zonal HVAC Controls.** Nonresidential HVAC systems with DDC to the Zone level shall be programmed to allow centralized demand shed for non-critical zones as follows:

1. The controls shall have a capability to remotely increase the operating cooling temperature set points by 4 degrees or more in all noncritical zones on signal from a centralized contact or software point within an Energy Management Control System (EMCS).
2. The controls shall have a capability to remotely decrease the operating heating temperature set points by 4 degrees or more in all noncritical zones on signal from a centralized contact or software point within an EMCS.
3. The controls shall have capabilities to remotely reset the temperatures in all noncritical zones to original operating levels on signal from a centralized contact or software point within an EMCS.
4. The controls shall be programmed to provide an adjustable rate of change for the temperature increase, decrease, and reset.

5. The controls shall have the following features:
   A. Disabled. Disabled by authorized facility operators; and
   B. Manual control. Manual control by authorized facility operators to allow adjustment of heating and cooling set points globally from a single point in the EMCS; and
   C. Automatic Demand Shed Control. Upon receipt of a demand response signal, the space-conditioning systems shall conduct a centralized demand shed, as specified in Sections 110.12(b)1 and 110.12(b)2, for noncritical zones during the demand response period.

(c) **Demand Responsive Lighting Controls.** Lighting controls in nonresidential buildings larger than 10,000 square feet shall be capable of automatically reducing lighting power in response to a Demand Response Signal. General lighting shall be reduced in a manner consistent with the uniform level of illumination requirements in TABLE 130.1-A.

1. For compliance testing, the lighting controls shall demonstrate a lighting power reduction in controlled spaces of a minimum of 15 percent below the total installed lighting power. The controls may provide additional demand responsive functions or abilities.

EXCEPTION 1 to 110.12(c): Spaces with a lighting power density of 0.5 watts per square foot or less are not required to install demand responsive controls and do not count toward the 10,000 square foot threshold.

EXCEPTION 2 to 110.12(c): Spaces where a health or life safety statute, ordinance, or regulation does not permit the lighting to be reduced are not required to install demand responsive controls and do not count toward the 10,000 square foot threshold.

(d) **Demand Responsive Electronic Message Center Control.** Controls for electronic message centers greater than 15 kW shall be capable of reducing the lighting power by a minimum of 30 percent when receiving a demand response signal.

EXCEPTION to Section 110.12(d): Electronic message centers that are not permitted by a health or life safety statute, ordinance, or regulation to be reduced.

CHANGE SIGNIFICANCE: Section 110.12 is a new section that helps streamline Energy Code requirements. All the demand response (DR) and demand management (DM) requirements are now in one single location.

Although licensed healthcare facilities are included in the scope of the Energy Code for the first time, they are exempt from the demand response and demand management requirements. These measures could potentially conflict with health and safety requirements by affecting the power management strategies of these facilities. After more detailed analysis for future code cycles, the exception could be removed, or modified with partial exceptions for specific types of healthcare facilities.

Section 110.12(a) specifies communication protocols and capabilities for DR controls, including thermostats. DR controls must be compatible with OpenADR 2.0a or 2.0b. The OpenADR 2.0 specification resulted from a prior requirement to incorporate "at least one standards-based messaging protocol" for nonresidential devices. The specification also resulted from a prior requirement to incorporate either OpenADR2.0 or SEP 1.1 for residential devices. Specifying a communications protocol ensures that building management systems will continue to function even if proprietary software is updated, or technical support ceases. The technical specifications for occupant controlled smart thermostats are located in Reference Joint Appendix JA5 (JA5).

Section 110.12(b) specifies capabilities and programming for demand responsive zonal HVAC controls. Nonresidential HVAC systems must be capable of remotely controlling temperature settings and be programmed to adjust temperature changes. The controls must have three features: (1) disable, (2) manual control, and (3) automatic demand shed control.

Section 110.12(c) specifies capabilities for DR lighting controls. In nonresidential buildings larger than 10,000 square feet, controls must be capable of reducing lighting power. Note that spaces with a lighting power density of 0.5 watts per square foot or less do not count towards the 10,000 square foot threshold and are not subject to the demand responsive control requirements. The same exclusion applies to spaces where a health or life safety statute, ordinance, or regulation does not permit the lighting to be reduced.

Section 110.12(d) specifies lighting power reduction capabilities for DR electronic message center controls. There is an exception for health or life safety, statute, ordinance, or regulation.

A list of controls certified as an OPENADR 2.0a or b Virtual End Node (VEN) can be found at https://products.openadr.org/. A list of products certified to the California Energy Commission as being capable of responding to open ADR 2.0b VEN can be found at https://www.energy.ca.gov/title24/equipment_cert/.

PART 3

Nonresidential, High-Rise Residential, Hotel/Motel Occupancies and Covered Processes—Mandatory Requirements

Subchapter 3

Subchapter 3 identifies mandatory requirements that are applicable to all buildings regulated by the Energy Code except low-rise residential buildings. This includes high-rise residential, nonresidential, hotel/motel buildings, and covered processes. This subchapter spans from Section 120.0 through 120.9. These sections establish mandatory requirements for the design, installation, and insulation of building envelopes, mechanical ventilation and space conditioning, and service water heating systems for these buildings. It also identifies mandatory acceptance testing requirements for mechanical systems, commissioning requirements for newly constructed nonresidential buildings, and requirements for covered processes. ■

120.1

Requirements for Ventilation and Indoor Air Quality

120.1(b)

High-rise Residential Buildings

120.1(b)1

Air Filtration

120.1(b)2

Attached Dwelling Units

120.1(c)

Nonresidential and Hotel/Motel Buildings

120.1(c)1

Air Filtration

120.1(c)2

Natural Ventilation

120.1(c)3

Mechanical Ventilation

120.1(c)4

Exhaust Ventilation

120.1(d)

Operation and Control Requirements for Minimum Quantities of Outdoor Air

120.1(d)3

Demand Control Ventilation

120.1(d)5

Occupant Sensor Ventilation Control Devices

120.1(g)

Air Classification and Recirculation Limitations

120.2

Required Controls for Space Conditioning Systems

120.2(b)

Criteria for Zonal Thermostatic Controls

120.2(b)3

Demand Shed Control Exception

120.2(b)4

Thermostatic Controls

120.2(c)

Hotel/Motel Guest Room and High-rise Residential Dwelling Unit Thermostats

120.2(c)

Hotel/Motel Guest Room and High-rise
Residential Dwelling Units

120.2(e)

Shut-off and Reset Controls for Space-conditioning Systems

120.2(e)3

Occupancy Sensing Zone Controls

120.2(f)

Dampers for Air Supply and Exhaust Equipment

120.2(h)

Automatic Demand Shed Controls

120.2(i)

Economizer Fault Detection and Diagnostics (FDD)

120.2(j)

Direct Digital Controls (DDC)

120.2(k)

Optimum Start/Stop Controls

120.3

Requirements for Pipe Insulation Exception 3 to 120.3(a) General Requirements

120.3(a)

General Requirements

120.3(b)

Insulation Protection

TABLE 120.3-A

Pipe Insulation Thickness

120.4

Requirements for Air Distribution System Ducts and Plenums; Exception to Section 120.4

120.4(a)

CMC Compliance

120.5

Requirements for Nonresidential Mechanical System Acceptance; Exception to Section 120.5(a)

120.5(a)

Acceptance Testing

120.5(a)18

Occupant Sensing Zone Controls

120.6

Mandatory Requirements for Covered Processes

120.6(a)

Mandatory Requirements for Refrigerated Warehouses

120.6(a)4

Condensers

120.6(b)

Mandatory Requirements for Commercial Refrigeration1

120.6(e)

Mandatory Requirements for Compressed Air Systems

120.6(f)

Mandatory Requirements for Elevators

120.7

Mandatory Insulation Requirements

120.7(b)

Wall Insulation

120.8

Nonresidential Building Commissioning

120.1

Requirements for Ventilation and Indoor Air Quality

CHANGE TYPE: Modification

CHANGE SUMMARY: New indoor air quality requirements in the 2019 Energy Code apply to high-rise residential, hotel motel, and nonresidential buildings.

2019 CODE:

SECTION 120.1 – REQUIREMENTS FOR VENTILATION AND INDOOR AIR QUALITY

~~Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the requirements of Section 120.1(a) through 120.1(e).~~

(a) **General Requirements.**

1. All occupiable spaces in high-rise residential buildings, hotel/motel buildings, and nonresidential buildings other than healthcare facilities shall comply with the applicable requirements of Section 120.1(a) through 120.1(g). Healthcare facilities shall be ventilated in accordance with Chapter 4 of the *California Mechanical Code*.

~~All enclosed spaces in a building shall be ventilated in accordance with the requirements of this section and the *California Building Code*.~~

~~**EXCEPTION to Section 120.1(a)1:** Refrigerated warehouses and other spaces or buildings that are not normally used for human occupancy and work.~~

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

CHANGE SIGNIFICANCE: The title of Section 120.1 has been updated to reflect new requirements for indoor air quality (IAQ). The change describes the contents of this extensive revision. It also aligns with the titles of ASHRAE 62.1 and ASHRAE 62.2, where most of the ventilation and IAQ requirements come from.

The additional language in Section 120.1(a)1 clarifies the section's scope. Healthcare facilities are now covered by the Energy Code but have different ventilation requirements than the other covered occupancies. This change is necessary to inform users of the Energy Code that the ventilation rate requirements for healthcare facilities are found in the *California Mechanical Code*, not in the Energy Code.

STATE OF CALIFORNIA

Mechanical Systems

NRCC-MCH-E (Created 7/20) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE	NRCC-MCH-E
This document is used to demonstrate compliance for mechanical systems that are within the scope of the permit application and are demonstrating compliance using the prescriptive path outlined in §140.4, or §141.0(b)2 for alterations.	
Project Name:	Report Page: Page 1 of 8
Project Address:	Date Prepared:

A. GENERAL INFORMATION

01	Project Location (city)		04	Total Conditioned Floor Area	
02	Climate Zone		05	Total Unconditioned Floor Area	
03	Occupancy Types Within Project:		06	# of Stories (Habitable Above Grade)	

☐ Office (B)	☐ Retail (M)	☐ Non-refrigerated Warehouse (S)
☐ Hotel/ Motel Guest Rooms (R-1)	☐ School (E)	☐ Healthcare Facility (I)
☐ High-Rise Residential (R-2/R-3)	☐ Relocatable Class Bldg (E)	☐ Other (Write In):

[1] *FOOTNOTES: Climate zone can be determined on the California Energy Commission's website at http://www.energy.ca.gov/maps/renewable/building_climate_zones.html*

B. PROJECT SCOPE

Table Instructions: Include any mechanical systems that are within the scope of the permit application and are demonstrating compliance using the prescriptive path outlined in §140.4, or §141.0(b)2 for alterations.

My project consists of (check all that apply)		
01	02	03
Air System(s)	Wet System Components	Dry System Components
☐ Heating Air System	☐ Water Economizer	☐ Air Economizer
☐ Cooling Air System	☐ Pumps	☐ Electric Resistance Heat
Mechanical Controls	☐ Hydronic System Piping	☐ Fan Systems
☐ Mechanical Controls (existing to remain, altered or new)	☐ Cooling Towers	☐ Ductwork (existing to remain, altered or new)
	☐ Chillers	☐ Ventilation
	☐ Boilers	☐ Zonal Systems/ Terminal Boxes

C. COMPLIANCE RESULTS

Table Instructions: If any cell on this table says "DOES NOT COMPLY" or "COMPLIES with Exceptional Conditions" refer to Table D. for guidance.

01		02		03		04		05		06		07		08	09
System Summary §110.1, §110.2, §140.4	AND	Pumps §140.4(k)	AND	Fans/ Economizers §140.4(c), §140.4(e)	AND	System Controls §110.2, §120.2, §140.4(f)	AND	Ventilation §120.1	AND	Terminal Box Controls §140.4(d)	AND	Distribution §120.3, §140.4(l)	AND	Cooling Towers §110.2(e)2	**Compliance Results**
(See Table F)		(See Table G)		(See Table H)		(See Table I)		(See Table J)		(See Table K)		(See Table L)		(See Table M)	
No	AND		AND		AND		AND	No	AND		AND		AND		**DOES NOT COMPLY**
Mandatory Measures Compliance (See Table Q for Details)															**DOES NOT COMPLY**

CA Building Energy Efficiency Standards - 2019 Nonresidential Compliance: http://www.energy.ca.gov/title24/2019standards/ July 2020

2019 Nonresidential Certificate of Compliance for Mechanical Systems
Source: California Energy Commission

120.1(b)1

High-rise Residential Buildings, Air Filtration

CHANGE TYPE: Addition

CHANGE SUMMARY: This is a new section that focuses on indoor air quality (IAQ) for high-rise residential buildings and includes filtration system efficiency and ventilation system design requirements.

2019 CODE:

(b) **High-rise Residential Buildings.**

Attached dwellings units shall comply with the requirements of subsections 1 and 2 below. Occupiable spaces other than attached dwelling units shall comply with the requirements of Section 120.1(c).

1. **Air Filtration.**

A. System types specified in subsections i, ii, and iii shall be provided with air filters in accordance with Sections 120.1(b)1B through 1D. System types specified in subsection i shall also comply with Section 120.1(b)1E.

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

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

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

B. **System Design and Installation.**

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

EXCEPTION to Section 120.1(b)1Bi: For heat recovery ventilators and energy recovery ventilators the location of the filters required by Section 120.1(b) 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 120.1(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 filters(s) shall be allowed if the filter(s) are sized according to Equation 120.1-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 120.1(b)1Dii

$$A_{face} = Q_{filter} / V_{face} \qquad \text{(Equation 120.1-A)}$$

Where,

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

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

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

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

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

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

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

i. The maximum allowable clean-filter pressure drop determined by the system design for the nominal two inch minimum depth air filter required by Section 120.1(b)1Biia; or

ii. A maximum of 25 PA (0.1 in. of water) clean-filter pressure drop shall be allowed for a nominal one-inch depth air filter sized according to Section 120.1(b)1Biib; or

iii. For system specified in 120.1(b)1Aii, and 120.1(b)1Aiii, the maximum allowable clean filter pressure drop determined by the system design.

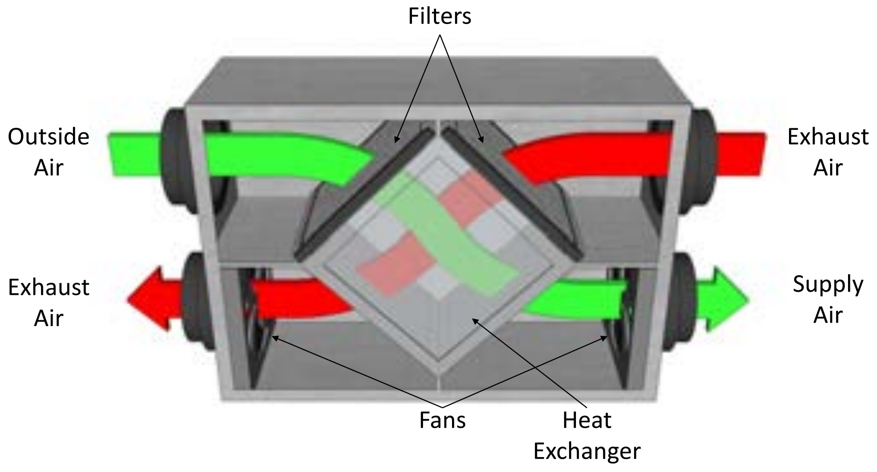
E. **Air Filter Product Labeling.** Systems described in 120.1(b)1Ai shall be equipped with air filters that have been labeled by the manufacturer to disclose the efficiency and pressure drop ratings that demonstrate conformance with Sections 120.1(b)1.

EXCEPTION to Section 120.1(b)1: Evaporative coolers are not subject to the air filtration requirements of Section 120.1(b)1.

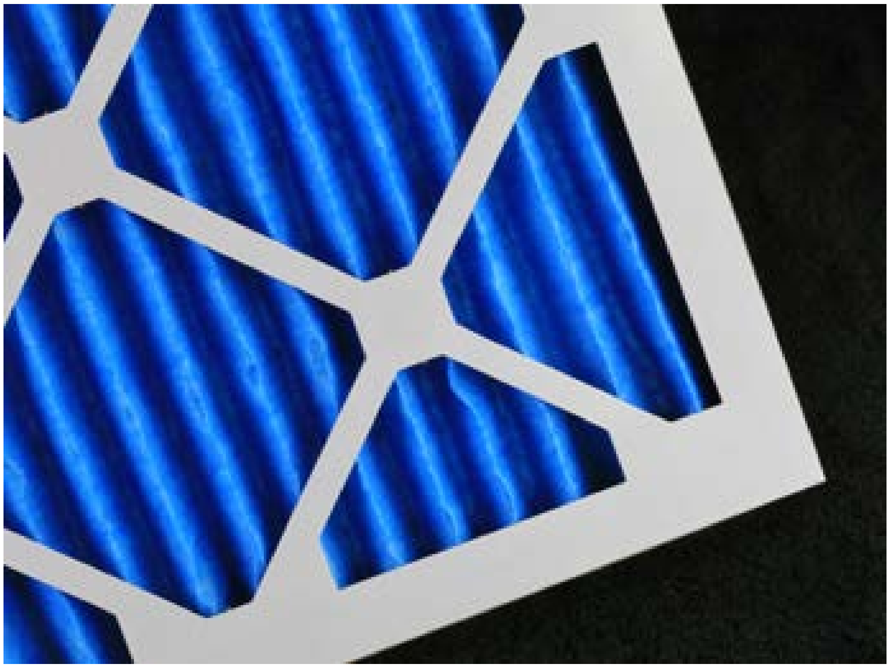
CHANGE SIGNIFICANCE: Section 120.1(b)1 improves indoor air quality of high-rise residential dwelling units by increasing the air filtration particle size efficiency requirement in space conditioning systems from MERV 6 to MERV 13. Air filters are now required to be at least 2 inches in depth for improved filter airflow, or 1 inch in depth if 0.1 inch w.c. (25 Pascals) pressure drop and 150 feet per minute filter face velocity are used for the design.

Supply ventilation systems and the supply side of balanced ventilation systems (including heat recovery ventilation and energy recovery ventilation systems) are now required to have MERV 13 air filtration. Ventilation system filters are not required to be two inches and the ventilation system pressure drop may be determined by the designer while maintaining the required ventilation rate delivered to the dwelling unit.

New information about the effects of indoor particulate pollutants was a consideration of new and amended standards for 2019, noting that filters meeting current MERV 6 and MERV 8 requirements are only moderately effective at filtering out airborne particulates (PM10) and are unable to capture or filter out fine particulates (PM2.5). Energy Commission staff identified a MERV rating of 13 as being effective at filtering out fine particulate matter (PM2.5).



Energy Recovery Ventilator – The supply air (green arrow) must pass through a MERV 13 filter.
Source: California Energy Commission


Getty Images

HVAC Filter – MERV 13 Filters are now required for ducted HVAC systems, and on the the supply side of ventilation systems.

120.1(b)2

High-rise Residential Buildings, Attached Dwelling Units

CHANGE TYPE: Addition

CHANGE SUMMARY: ASHRAE Standard 62.2-2016 "Ventilation and Acceptable Indoor Air Quality in Residential Buildings" is incorporated by reference with California-specific amendments. HERS verification of minimum airflow and HVI certification status is required for kitchen range hoods.

2019 CODE:

(b) **High-rise Residential Buildings.**

Attached dwellings units shall comply with the requirements of subsections 1 and 2 below. Occupiable spaces other than attached dwelling units shall comply with the requirements of Section 120.1(c).

[…]

1. **Attached dwelling units.** All dwelling units shall meet the requirements of ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Residential Buildings, subject to the amendments specified in subsection A below. All dwelling units shall comply with the Acceptance requirements specified in subsection B below.

A. Amendments to ASHRAE 62.2 requirements.

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

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

EXCEPTION to Section 120.1(b)2Aii: The Energy Commission may approve continuous operation of central fan integrated ventilation systems pursuant to Section 10-109(h).

iii. Air filtration shall conform to the specifications in Section 120.1(b)1. Compliance with ASHRAE 62.2 Sections 6.7 (Minimum Filtration) and 6.7.1 (Filter Pressure Drop) shall not be required.

iv. Multifamily attached dwelling units shall comply with subsections a and b.

a. Mechanical ventilation airflow shall be provided at rates determined in accordance with Equation 120.1-B.

Total Required Ventilation Rate [ASHRAE 62.2.4.1.1]

$$Q_{tot} = 0.03A_{floor} + 7.5(N_{br} + 1)$$

(Equation 120.1-B)

Where,

Q_{tot} = total required ventilation rate, cfm

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

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

b. The mechanical ventilation system shall comply with one of the following subsections 1 or 2 below. When subsection 2 is utilized for compliance, all dwelling units in the multifamily building shall use the same ventilation system type.

1. A balanced mechanical ventilation system shall provide the required dwelling-unit ventilation airflow.

2. Continuously operating supply ventilation systems or continuous operating exhaust ventilation systems shall be allowed to be used to provide the required dwelling unit ventilation airflow if the dwelling-unit envelope leakage is less than or equal to 0.3 cubic feet per minute at 50 Pa (0.2 in. of water) per ft^2 of dwelling unit envelope surface area as confirmed by field verification and diagnostic testing in accordance with Reference Nonresidential Appendix NA7.18.2.

v. Multifamily building central ventilation systems that serve multiple dwelling-units shall be balanced to provide ventilation airflow to each dwelling-unit served at a rate equal to or greater than the rate specified by Equation 120.1-B, but not more than twenty percent greater than the specified rate. These systems shall utilize balancing means to ensure the dwelling unit airflows can be adjusted to meet this balancing requirement. These system balancing means may include but not be limited to constant air regulation devices, orifice plates, and variable speed central fans.

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

EXCEPTION to Section 120.1(b)2Avii: Kitchen range hoods may be rated for sound at a static pressure determined at working speed as specified in HVI 916 Section 7.2.

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

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

B. **High-Rise Residential Dwelling Unit Acceptance.**

i. Airflow Performance. The dwelling-unit ventilation airflow required by Section 120.1(b)2Aiv or 120.1(b)2Av shall be confirmed through field verification and diagnostic testing in accordance with Reference Nonresidential Appendix NA7.18.1.

ii. Kitchen Range Hoods. The installed kitchen range hood shall be field verified in accordance with Reference Nonresidential Appendix NA7.18.1 to confirm the model is rated by HVI to comply with the following requirements:

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

b. The maximum sound rating as specified in Section 120.1(b)2Avi.

~~**Design Requirements for Minimum Quantities of Outdoor Air.** Every space in a building shall be designed to have outdoor air ventilation according to Item 1 or 2 below:~~

~~1. **Natural ventilation.**~~

~~A. Naturally ventilated spaces shall be permanently open to and within 20 feet of operable wall or roof openings to the outdoors, the openable area of which is not less than 5 percent of the conditioned floor area of the naturally ventilated space. Where openings are covered with louvers or otherwise obstructed, openable area shall be based on the free unobstructed area through the opening.~~

~~**EXCEPTION to Section 120.1(b)1A:** Naturally ventilated spaces in high-rise residential dwelling units and hotel/motel guest rooms shall be open to and within 25 feet of operable wall or roof openings to the outdoors.~~

~~B. The means to open required operable openings shall be readily accessible to building occupants whenever the space is occupied.~~

~~2. **Mechanical ventilation.** Each space that is not naturally ventilated under Item 1 above shall be ventilated with a mechanical system capable of providing an outdoor air rate no less than the larger of:~~

~~A. The conditioned floor area of the space times the applicable ventilation rate from TABLE 120.1-A; or~~

~~B. 15 cfm per person times the expected number of occupants.~~

~~For meeting the requirement in Section 120.1(b)2B for spaces without fixed seating, the expected number of occupants shall be either the expected number specified by the building designer or one half of the maximum occupant load assumed for egress purposes in the CBC, whichever is greater. For spaces with fixed seating, the expected number of occupants shall be determined in accordance with the CBC.~~

~~**EXCEPTION to Section 120.1(b)2:** Transfer air. The rate of outdoor air required by Section 120.1(b)2 may be provided with air transferred from other ventilated spaces if:~~

~~A. None of the spaces from which air is transferred have any unusual sources of indoor air contaminants; and~~

~~B. The outdoor air that is supplied to all spaces combined, is sufficient to meet the requirements of Section 120.1(b)2 for each space individually.~~

CHANGE SIGNIFICANCE: Section 120.1(b)2A incorporates ASHRAE Standard 62.2-2016 "Ventilation and Acceptable Indoor Air Quality in Residential Buildings" by reference, with California-specific amendments described in subsections Ai through vi. Subsection 2B requires HERS verification of minimum airflow and HVI certification status for kitchen range hoods.

Subsection Ai states that window operation is not a permissible method of providing ventilation to the dwelling unit. This requirement mirrors the same restriction for low-rise residential dwelling units. The change ensures that mechanical ventilation will be used to comply with the minimum air ventilation requirement.

Subsection Aii addresses the central forced air system air handlers in central fan integrated ventilation systems. Continuous operation of these systems is not an allowable method of providing ventilation to the dwelling unit. Air handler fans consume a fair amount of energy and are an energy intensive method of providing ventilation. Also, central fan integrated ventilation systems may not be an effective way to provide fresh air in high-rise structures due to building pressure issues (the "stack effect"). However, the exception allows energy efficient designs that achieve proper outside air flow. The design must be approved as an Energy Commission compliance option. See Sections 10-104 and 10-109 in Title 24, Part 1 for information about "exceptional design" requirements and approvals.

Subsection Aiii simplifies the method for calculating the required mechanical ventilation airflow rate for multifamily attached dwelling units specified by ASHRAE 62.2. The calculation uses a fixed default value based on a dwelling enclosure leakage rate of 2 air changes per hour at 50 Pa (2ACH50). This will simplify the mandatory field measurement of dwelling enclosure leakage, and is necessary for consistency with the updates to Section 120.1(b)1.

Subsection Aiv specifies two options for mechanically ventilating high-rise dwellings. Broadly speaking, there are three ways to mechanically ventilate a space: you can supply air to the space, which adds new outside air and pressurizes the space; you can exhaust the air in the space, which depressurizes the space and causes air to be pulled into the dwelling from its surroundings; or you can balance supply and exhaust ventilation so that air is exchanged without creating a pressure differential. For dwelling units sharing walls with other indoor spaces, nonbalanced ventilation approaches are potentially less effective and less energy efficient than balanced ventilation approaches. This is because pressurizing a space means pushing depleted or polluted air into those adjacent spaces; depressurizing a space means pulling depleted or polluted air in from adjacent spaces. A balanced ventilation strategy ensures that air is exchanged with the outside, and not with adjacent dwellings or indoor spaces.

Option one of subsection Aiv requires balanced ventilation systems that supply the same amount of outside air as they exhaust. This minimizes any pressure differences between dwellings that could cause transfer of contaminated air between units.

Option two of subsection Aiv allows for supply only or exhaust only if the dwelling unit is sealed to minimize leakage between adjacent dwelling units, such that the enclosure leakage is less than 0.3 cubic feet per minute at 50 Pa (0.2 inch water) per square feet of enclosure area. The leakage rate is determined by a field test performed by a HERS Rater. This ensures that energy used for ventilation efficiently provides its intended benefit to indoor air quality and is not wasted on pulling or pushing depleted or polluted air back and forth between adjacent dwellings.

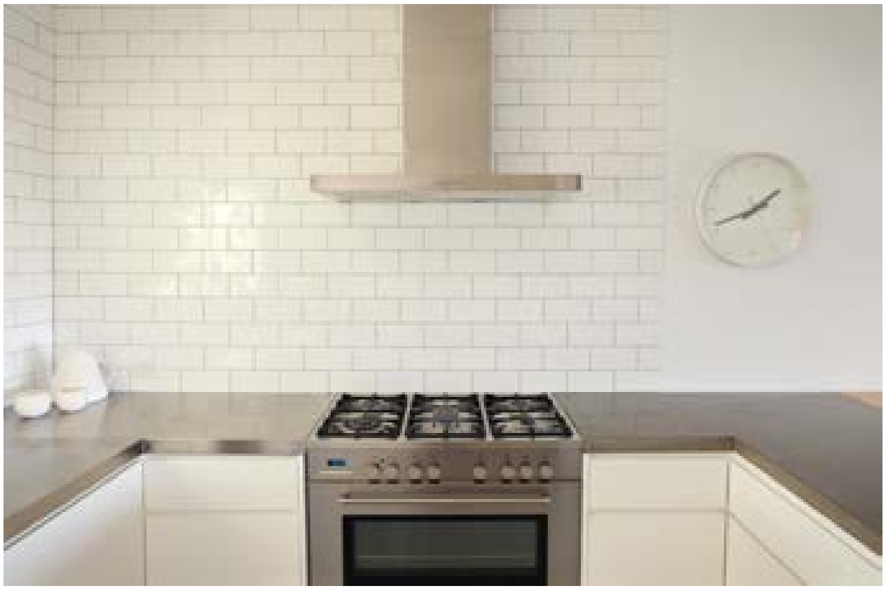
Subsection Av applies to multifamily buildings with central ventilation systems that serve multiple dwelling units. The system must be balanced such that the airflow rate for every dwelling unit is greater than or equal to the rate specified by ASHRAE 62.2 section 4.1.1. However, the airflow rate must be no more than twenty percent greater than the specified rate. The system designer may choose to include constant air regulation devices, orifice plates, variable speed central fans, or other components that achieve compliance. The whole-building pressure relationship (between dwellings and other spaces) is an extremely important characteristic that impacts the ventilation system's ability to provide outside air to the space. This code change limits the impact of high differential pressures throughout the building, and avoids inadvertent impacts on indoor air quality.

Subsection Avi incorporates high-rise residential kitchen range hood sound rating requirements to be consistent with low-rise residential requirements in Section 150.0(o)1G, ensuring the requirements will be applied for all residential buildings.

Subsection Avii specifies that compliance with ASHRAE 62.2 Section 6.5.2 (Space Conditioning System Ducts) is not required. The change was needed to eliminate a conflict between the ASHRAE 62.2 duct leakage requirements and existing duct leakage requirements in the Energy Code.

Subsection Aviii specifies the text for the labels on mechanical ventilation fan controls required by ASHRAE 62.2 Section 4.4. It addresses concerns that IAQ ventilation fans are often turned off by dwelling occupants who do not understand that the fans must be operated in order to protect the quality of the indoor air.

Section 120.1(b)2B requires HERS verification of dwelling unit ventilation rate and HERS verification of kitchen range hood airflow, sound rating, and HVI certification. Indoor pollutants from inadequate range hood exhaust performance are a significant danger to human health. Minimum airflow was not a HERS-verified measure in the 2016 Energy Code.



Getty Images

Range Hood – Residential kitchen range hoods require HERS verification under the 2019 Energy Code.

120.1(c)1

Nonresidential and Hotel/Motel Buildings, Air Filter

CHANGE TYPE: Modification

CHANGE SUMMARY: New requirements for air filtration systems and performance, with specified mechanical systems, and air filter efficiency and sizes.

2019 CODE:

(c) **Nonresidential and Hotel/Motel Buildings.** All occupiable spaces shall meet the requirements of subsection 1 and either 2 or 3:

1. **Air Filtration.**
   - A. Mechanical system types described in Section 120.1(b)1A shall be provided with air filters to clean the outside and return air prior to its introduction into occupied spaces.
   - B. Air Filter Efficiency. The filters shall have a designated efficiency equal to or greater than MERV 13 when tested in accordance with ASHRAE Standard 52.2, or a particle size efficiency rating equal to or greater than 50 percent in the 0.30-1.0 μm range, and equal to or greater than 85 percent in the 1.0-3.0 μm range when tested in accordance with AHRI Standard 680; and
   - C. Systems shall be equipped with air filters that meet either subsection i or ii below.
     - i. Nominal two inch minimum depth filter(s); or
     - ii. Nominal one inch minimum depth filter(s) shall be allowed if the filter(s) are sized according to Equation 120.1-A, based on a maximum face velocity of 150 ft per minute.

CHANGE SIGNIFICANCE: The extensive changes to Section 120.1 address outdoor air ventilation and indoor air quality (IAQ) with new requirements for air filtration and system designs. Subsection (c) applies to the occupiable spaces in high-rise nonresidential buildings, and hotels/motels. Subsection (c)1 addresses air filtration. It specifies the types of mechanical systems that must have air filters, air filter efficiency, and sizes. The 2019 Energy Code ensures that HVAC systems are designed to accommodate higher MERV filters so that occupants can improve filtration without inadvertently harming the energy efficiency, lifespan, or overall performance of their HVAC system.

Three types of mechanical systems are subject to the air filtration requirements, and are specified by reference to Section 120.1(b)1A. These systems must have air filters to clean the outside and return air before the air enters the occupied spaces. The three system types are:

- Systems that supply air to an occupiable space through ductwork exceeding 10 feet (3 m) in length.
- Mechanical supply-only ventilation systems that provide outside air to an occupiable space.
- 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.

To improve indoor air quality, the air filtration particle size efficiency requirement has increased from MERV 6 to MERV 13. A MERV 13 filter effectively filters out fine particulate matter (PM 2.5). There are two options specified for particle size filtration:

- ≥ MERV 13 when tested in accordance with ASHRAE Standard 52.2.
- Particle size efficiency rating ≥ 50% in the 0.30–1.0 μm range, and ≥ 85% in the 1.0–3.0 μm range when tested in accordance with AHRI Standard 680.

The Energy Code requires these filters to meet one of the following size options:

- Nominal two-inch minimum depth filter(s); or
- Nominal one-inch minimum depth filter(s) if the filter(s) are sized according to Equation 120.1-A, based on a maximum face velocity of 150 feet per minute.

120.1(c)2

Nonresidential and Hotel/Motel Buildings, Natural Ventilation

CHANGE TYPE: Addition

CHANGE SUMMARY: Natural ventilation requirements with specifications for design, operation, and mechanical systems, including floor area, openings, and controls.

2019 CODE:

(c) **Nonresidential and Hotel/Motel Buildings.** All occupiable spaces shall meet the requirements of subsection 1 and either 2 or 3:

[...]

2. **Natural Ventilation.** Naturally ventilated spaces shall be designed in accordance with 120.1(c)2A through 120.1(c)2C and include a mechanical ventilation system designed in accordance with 120.2(c)3:

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

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

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

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

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

   EXCEPTION to Section 120.1(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]

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

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

CHANGE SIGNIFICANCE: The extensive changes to Section 120.1 address outdoor air ventilation and indoor air quality (IAQ) with new requirements for air filtration and ventilation system designs. Subsection (c) applies to occupiable spaces in hotel/motel and nonresidential buildings. The occupiable spaces must meet air filter efficiency requirements in subsection (c)1 and mechanical system specifications in (c)3. This discussion covers the natural ventilation system requirements in (c)2.

Even when natural ventilation is used, the buildings must include a mechanical ventilation system, although there are two exceptions. Exception 1 explains that a mechanical ventilation system is not required when natural ventilation openings are either permanently open, or have controls that prevent closure during periods of expected occupancy. Exception 2 allows spaces to not be served by a mechanical ventilation system if the zone is not served by a space conditioning system.

The 2016 Energy Code allowed natural ventilation; however, a new, more detailed procedure helps determine the correct location of ventilation openings in occupiable spaces. This subsection aligns the 2019 Energy Code with the natural ventilation procedure of ASHRAE 62.1-2016.

The space's floor area and ceiling height (H) are the primary factors when calculating the allowable location of ventilation openings. (H) is the minimum ceiling height in the space. In a scenario where the ceiling height varies, and the distance from the operable openings also varies, the exception to Section 120.1(c)2Aiv specifies that (H) will be the average height of the ceiling, as measured within 20 feet of the ventilation opening [ASHRAE 62.1:6.4.1].

For spaces with an operable ventilation opening on only one side, the maximum distance from the operable opening must be ≤ 2H [ASHRAE 62.1:6.4.1.1].

For spaces with operable ventilation openings on two opposite sides, the maximum distance from the operable opening must be ≤ 5H. [ASHRAE 62.1:6.4.1.2]

For spaces with operable openings on the two adjacent sides of a corner, the maximum distance from the operable openings must be ≤ 5H along a line drawn between the two openings that are the farthest apart.

Naturally ventilated spaces must have wall openings that directly access the outdoors, and the openings must be operable. The openings must be ≤ 4 percent of the total net floor area. If openings are covered with louvers or other obstructions, the openings' area size is considered to be the total of unobstructed area.

In a scenario where an interior room without direct outdoor openings is ventilated through adjoining rooms, the opening between rooms must be permanently unobstructed with a free area of at least 8 percent of the interior room area, or no less than 25 square feet. [ASHRAE 62.1:6.4.2]

Operable openings must be readily accessible to the building occupants whenever the space is occupied. Any controls must be designed for coordination between the natural and mechanical ventilation systems. [ASHRAE 62.1:6.4.3]

120.1(c)3

Nonresidential and Hotel/Motel Buildings Mechanical Ventilation

CHANGE TYPE: Addition

CHANGE SUMMARY: Mechanical ventilation systems must provide specified outdoor airflow rate. Table 120.1-A significantly expanded to more easily determine minimum ventilation rates.

2019 CODE:

(c) **Nonresidential and Hotel/Motel Buildings.** All occupiable spaces shall meet the requirements of subsection 1 and either 2 or 3:

[…]

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

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

$$V_z = R_a \times A_z \qquad \textbf{(Equation 120.1-F)}$$

Where:

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

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

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

$$V_z = R_p \times P_z \qquad \textbf{(Equation 120.1-G)}$$

Where:

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

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

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

A. Use of transfer air is in accordance with Section 120.1(g); and

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

CHANGE SIGNIFICANCE: The extensive changes to Section 120.1 address outdoor air ventilation and indoor air quality (IAQ) with new requirements for air filtration and system designs. Subsection (c) applies to the occupiable spaces in hotels/motels and nonresidential buildings. Air filter efficiency requirements are in subsection (c)1, and the outdoor airflow rates for mechanical systems are in (c)3. Most spaces using natural ventilation complying with (c)2 will also need to comply with these mechanical system airflow rates.

Mechanical ventilation systems must be capable of providing a specified outdoor airflow rate (V_z) to the zone. The changes provide more direction for determining minimum ventilation rates. There are two calculations. The first calculation is specified in Equation 120.1-F. The second calculation is for spaces with fixed seating or an expected number of occupants. That calculation, Equation 120.1-G, includes the number of expected occupants.

New minimum ventilation rate calculations have been added to Table 120.1-A. The table includes significantly more information, reducing the need to cross reference between the Building or and Energy Code to determine the minimum ventilation rates. It includes many additional space types (occupancy categories) and identifies the "air classifications" referenced by §120.1(g).

There is one exception that applies when using air transferred from other ventilated space. The exception provides consistency with Section 120.1(g) and allows appropriate use of transfer air.

CHANGE TYPE: Addition

CHANGE SUMMARY: Exhaust ventilation requirements were added to align the Energy Code with ASHRAE 62.1-2016.

2019 CODE:

(c) **Nonresidential and Hotel/Motel Buildings.** All occupiable spaces shall meet the requirements of subsection 1 and either 2 or 3:

[…]

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

[…]

120.1(c)4

Nonresidential and Hotel/Motel Buildings Exhaust Ventilation

TABLE 120.1-B Minimum Exhaust Rates [ASHRAE 62.1: Table 6.5]

Occupancy Category	Exhaust Rete, cfm/unit	Exhaust Rate, cfm/ft²	Air Class	Notes
Arenas	-	0.50	1	B
Art classrooms	-	0.70	2	
Auto repair rooms	-	1.5	2	A
Barber shops	-	0.50	2	
Beauty and nail salons	-	0.60	2	
Cells with toilet	-	1.00	2	
Copy, printing rooms	-	0.50	2	
Darkrooms	-	1.00	2	
Educational science laboratories	-	1.00	2	
Janitor closets, trash rooms, recycling	-	1.00	3	
Kitchenettes	-	0.30	2	
Kitchens – commercial	-	0.70	2	
Locker rooms for athletic or industrial facilities	-	0.50	2	
All other locker rooms	-	0.25	2	
Shower rooms	20/50	-	2	G,H
Paint spray booths	-	-	4	F
Parking garages	-	0.75	2	C
Pet shops (animal areas)	-	0.90	2	

Table 120.1-B continues

Table 120.1-B continued

TABLE 120.1-B Minimum Exhaust Rates [ASHRAE 62.1: Table 6.5]

Occupancy Category	Exhaust Rete, cfm/unit	Exhaust Rate, cfm/ft^2	Air Class	Notes
Pet shops (animal areas)	-	0.90	2	
Refrigerating machinery rooms	-	-	3	F
Soiled laundry storage rooms	-	1.00	3	F
Storage rooms, chemical	-	1.50	4	F
Toilets – private	25/50	-	2	E
Toilets – public	50/70	-	2	D
Woodwork shop/classrooms	_	0.50	2	

Notes:
a. Stands where engines are run shall have exhaust systems that directly connect to the engine exhaust and prevent escape of fumes.
b. Where combustion equipment is intended to be used on the playing surface, additional dilution ventilation, source control, or both shall be provided.
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

CHANGE SIGNIFICANCE: The extensive changes to Section 120.1 address outdoor air ventilation and indoor air quality (IAQ) with new requirements for system designs. Subsection (c) applies to the occupiable spaces in hotel/motel and nonresidential buildings. Section 120.1(c)4 aligns the Energy Code with the exhaust ventilation requirements of ASHRAE 62.1-2016. Exhaust airflow specifications are in Table 120.1-B. Exhaust makeup air can be any combination of outdoor air, recirculated air, or transfer air. [ASHRAE 62.1:6.5.1]

The exhaust ventilation requirements are new for the 2019 Energy Code. They are aligned with ASHRAE 62.1 and require certain occupancy categories to be exhausted to the outdoors. The spaces listed in Table 120.1-B are expected to have contaminants not generally found in adjacent occupied spaces. Therefore, the air supplied to the space to replace the air exhausted may be any combination of outdoor air, recirculated air, and transfer air—all of which are expected to have low or zero concentration of the pollutants generated in the listed spaces. For example, the exhaust from a toilet room can draw air from either the outdoors, adjacent spaces, or from a return air duct or plenum.

The rates specified must be provided during all periods when the space is expected to be occupied, like the requirement for ventilation air.

120.1(d)3

Operation and Control Requirements for Minimum Quantities of Outdoor Air, Demand Control Ventilation

CHANGE TYPE: Modification and Addition

CHANGE SUMMARY: Demand control ventilation requirements were modified, and their scope was expanded.

2019 CODE:

(d) **Operation and Control Requirements for Minimum Quantities of Outdoor Air.**

[…]

3. **Required Demand Control Ventilation.** Demand ventilation controls complying with Section 120.1(d)4 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: ~~HVAC systems with the following characteristics shall have demand ventilation controls complying with 120.1(c)4:~~

   A. ~~They have~~ an air economizer; or~~and~~

   B. modulating outside air control; or ~~They serve 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); and~~

   C. design outdoor airflow rate > 3,000 cfm~~They are either:~~

      ~~i. Single zone systems with any controls; or~~

      ~~ii. Multiple zone systems with Direct Digital Controls (DDC) to the zone level~~.

   ~~**EXCEPTION 1 to Section 120.1(c)3:** Classrooms, call centers, office spaces served by multiple zone systems that are continuously occupied during normal business hours with occupant density greater than 25 people per 1000 ft² as specified by Section 120.1(b)2B, healthcare facilities and medical buildings, and public areas of social services buildings are not required to have demand control ventilation.~~

   EXCEPTION 1~~2~~ to Section 120.1(~~c~~d)3: Where space exhaust is greater than the design ventilation rate specified in Section 120.1(~~b~~c)3~~2B~~ minus 0.2 cfm per ft² of conditioned area.

   EXCEPTION 2~~3~~ to Section 120.1(~~c~~d)3: 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~~4~~ to Section 120.1(~~c~~d)3: Spaces with an area of less than 150 square feet, or a design occupancy of less than 10 people as specified by Section 120.1(~~b~~c)3~~2B~~.

   ~~**EXCEPTION 5 to Section 120.1(c)3:** Spaces with an area of less than 1,500 square feet complying with Section 120.1(c)5.~~

CHANGE SIGNIFICANCE: The changes to this section expand on the number of spaces having to comply with demand control ventilation. The analysis for this new requirement showed that it will save fan energy, as well as cooling or heating energy, by controlling the amount of air introduced to the space. Demand control ventilation had been required for single-or multizone systems with direct digital controls in spaces served by an air economizer that are classified as high density. The new requirement results in more spaces becoming subject to demand control ventilation.

Demand ventilation controls are required for spaces that have:

1. A design occupant density (or a maximum occupant load factor for egress purposes in the CBC) ≥ 25 people per 1,000 square feet (≤ 40 SF per person), and
2. A system serving the space with one or more of the following:

- o an air economizer,
- o modulating outside air control, or
- o design outdoor airflow rate > 3,000 cfm.

There are now only three exceptions to the Demand Control Ventilation requirement. A 2016 exception for classrooms, call centers, and specific office spaces was removed.

120.1(d)5

Operation and Control Requirements for Minimum Quantities of Outdoor Air, Occupant Sensor Ventilation Control Devices

CHANGE TYPE: Modification

CHANGE SUMMARY: The operating scheme for occupant sensor ventilation controls is deleted and now references the operating scheme in Section 110.9(b)4.

2019 CODE:

(d) **Operation and Control Requirements for Minimum Quantities of Outdoor Air.**

[…]

5. **Occupant Sensor Ventilation Control Devices.** When occupancy sensor ventilation devices are required by Section 120.2(e)~~3 or when meeting EXCEPTION 5 to Section 120.1(c)3~~, occupant sensors shall be used to reduce the rate of outdoor airflow when occupants are not present in accordance with the following:

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

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

   ~~C. Within 30 minutes after being vacant for all rooms served by a zone damper on a multiple zone system, and the space temperature is between the heating and cooling setpoints, then no outside air is required and supply air shall be zero.~~

   ~~D. Within 30 minutes after being vacant for all rooms served by a single zone system, the single zone system shall cycle off the supply fan when the space temperature is between the heating and cooling setpoints.~~

   ~~E. In spaces equipped with an occupant sensor, when vacant during hours of expected occupancy and the occupied ventilation rate required by Section 120.1(b)2 is not provided, then the system or zone controls shall cycle or operate to maintain the average outdoor air rate over an averaging period of 120 minutes equal to 25percent of the rate listed in TABLE 120.1-A.~~

   ~~**Exception to 120.1(c)5:** If Demand Control Ventilation is implemented as required by Section 120.1(4).~~

CHANGE SIGNIFICANCE: This change removes the operating scheme for occupant sensor ventilation controls, and now references the operating scheme in Section 110.9(b)4. The change avoids overlapping and potentially conflicting requirements.

When occupancy sensor ventilation devices are required by Section 120.2(e)3, occupant sensors must be used to reduce the rate of outdoor air flow when occupants are not present. Section 120.2(e)3 requires:

- Occupant sensing controls on conditioning systems that serve rooms with shut-off controls for indoor lighting; and
- The space must be an occupancy category that permits ventilation air to be reduced to zero when in occupied-standby mode. This is indicated with an "F" in the notes column of Table 120.1-A.

When lighting control sensors are also being used for ventilation, the ventilation signal must be independent of the lighting functions.

When a single zone damper or a single zone system serves multiple rooms, each room must have an occupancy sensor. Also, the zone is not considered vacant until all of its rooms are vacant.

CHANGE TYPE: Addition

CHANGE SUMMARY: New air classifications and recirculation limits for ventilation air.

120.1(g)

Air Classification and Recirculation Limitations

2019 CODE:

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

1. Class 1 Air. Recirculation or transfer of Class 1 air to any space shall be permitted; [ASHRAE 62.1:5.16.3.1]
2. Class 2 Air. Recirculation or transfer of Class 2 air shall be permitted in accordance with 120.1(g)A through 120.1(g)E:
   - A. Recirculation of Class 2 air within the space of origin shall be permitted [ASHRAE 62.1:5.16.3.2.1]:
   - B. 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
   - C. Transfer of Class 2 air to toilet rooms [ASHRAE 62.1:5.16.3.2.3]; or
   - D. Recirculation or transfer of Class 2 air to Class 4 spaces [ASHRAE 62.1:5.16.3.2.4]; or
   - E. Class 2 air shall not be recirculated or transferred to Class 1 spaces. [ASHRAE 62.1:5.16.3.2.5]

   EXCEPTION to Section 120.1(g)2E: 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.
3. Class 3 Air. Recirculation or transfer of Class 3 air shall be permitted in accordance with 120.1(g)3A and B:
   - A. Recirculation of Class 3 air within the space of origin shall be permitted. [ASHRAE 62.1:5.16.3.3.1]
   - B. Class 3 air shall not be recirculated or transferred to any other space. [ASHRAE 62.1:5.16.3.3.2].

   EXCEPTION to Section 120.1(g)3B: 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.
4. Class 4 Air. Class 4 air shall not be recirculated or transferred to any space or recirculated within the space of origin. [ASHRAE 62.1:5.16.3.4]
5. 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]

6. 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]
7. Classification. Air leaving each space or location shall be designated at an expected air-quality classification not less than that shown in Tables 120.1-A, 120.1-B or 120.1-C. Air leaving spaces or locations that are not listed in Tables 120.1-A, 120.1-B or 120.1-C 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.

[…]

TABLE 120.1-C Airstreams or Sources [ASHRAE 62.1: Table 5.16.1]

Description	Air Class
Diazo printing equipment discharge	4
Commercial kitchen grease hoods	4
Commercial kitchen other than grease	3
Laboratory hoods	4[a]
Hydraulic elevator machine room	2

a. Air Class 4 unless determined otherwise by the Environmental Health and Safety professional responsible to the owner or to the owner's designee.

CHANGE SIGNIFICANCE: This change adds air classifications and recirculation limits for ventilation air. Previously, the Energy Code did not give direction on these two concepts, although they may have a significant impact on indoor air quality. They are present in ASHRAE standards that were incorporated by reference but not directly stated in the Energy Code. The new subsection helps designers by clarifying the Energy Code requirements for ventilation systems.

Based on the air class, air can be transferred to other spaces in the building or must be exhausted. The new requirement specifies air classifications for occupancy categories in Table 120.1-A (Minimum Ventilation Rates). Air classifications are also included in Table 120.1-C (Airstreams or Sources).

The exceptions to (g)2 and (g)3 permit a small amount of transfer air to facilitate heat recovery. They were added to avoid restricting heat recovery devices or systems, and their associated energy efficiency benefits.

120.2(b)3

Criteria for Zonal Thermostatic Controls Demand Shed Control Exceptions

TYPE: Modification

CHANGE SUMMARY: An exception is added for healthcare facilities.

2019 CODE:

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

[…]

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

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

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

CHANGE SIGNIFICANCE: The purpose of the change to this section is to add an exception for systems serving healthcare facilities. This is necessary because the dead band may need to be smaller than 5°F in a healthcare facility.

120.2(b)4

Criteria for Zonal Thermostatic Controls, Thermostatic Controls

CHANGE TYPE: Clarification

CHANGE SUMMARY: The purpose of the change to this section is to correct a reference to requirements in Reference Joint Appendix JA5 (JA5) to instead refer to Section 110.12, and to exempt systems serving healthcare facilities.

2019 CODE:

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

[…]

4. Thermostatic controls for all single zone air conditioners and heat pumps, shall comply with the requirements of Section<u>s</u> 110.2(c) and ~~Reference Joint Appendix JA5~~<u>110.12(a)</u> ~~or~~<u>and</u>, if equipped with DDC to the Zone level, with the Automatic Demand Shed Controls of Section ~~120.2(h)~~<u>110.12(b)</u>.

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

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

<u>**EXCEPTION 3 to Section 120.2(b)4:** Systems serving healthcare facilities</u>.

CHANGE SIGNIFICANCE: The purpose of the change to this section is to correct a reference to requirements in Reference Joint Appendix JA5 (JA5) to instead refer to Section 110.12. This is necessary because JA5 has been revised, and the necessary requirements are now located in Section 110.12. The changes in JA5 were made to remove requirements that are redundant with Section 110.12, including OpenADR2.0a and 2.0b as incorporated by reference into Section 110.12, and to clarify and reorganize the remaining language. An exception for systems serving healthcare facilities is added because healthcare facilities are exempt from all demand management sections of the code in order to ensure the health and safety of patients.

120.2(c)

Hotel/Motel Guest Room and High-rise Residential Dwelling Units

CHANGE TYPE: Clarification

CHANGE SUMMARY: The change improves the clarity of the requirement by referring directly to 110.2(c) rather than indirectly via section 150.0(i).

2019 CODE:

(c) **Hotel/Motel Guest Room and High-rise Residential Dwelling Unit Thermostats.**

1. Hotel/motel guest room thermostats shall:
   - A. Have numeric temperature setpoints in °F and °C; and
   - B. Have setpoint stops, which are accessible only to authorized personnel, such that guest room occupants cannot adjust the setpoint more than ±5°F (±3°C); and
   - C. Meet the requirements of Section 110.2(c)~~150.0(i)~~.

     EXCEPTION to Section 120.2(c)1: Thermostats that are integrated into the room heating and cooling equipment.
2. High-rise residential dwelling unit thermostats shall meet the requirements of Section 110.2(c)~~150.0(i)~~.

CHANGE SIGNIFICANCE: The purpose of the changes to this section are to update references to thermostat requirements to refer to Section 110.2(c) rather than Section 150.0(i). Section 150.0(i) itself only specifies compliance with Section 110.2(c), thus it improves the clarity of the requirement to refer directly to Section 110.2(c) rather than indirectly via Section 150.0(i). The changes are necessary to improve Part 6's clarity and consistency.

120.2(e)3

Shut-off and Reset Controls for Space-conditioning Systems, Occupancy Sensing Zone Controls

CHANGE TYPE: Modification

CHANGE SUMMARY: Changes were made to the applicability of the space-conditioning occupancy sensor zonal control requirements, and to how they function.

2019 CODE:

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

[...]

3. Occupancy Sensing Zone Controls. Space conditioning systems serving room(s) that are required to have occupant sensing controls in accordance with Section 130.1(c), and where the Table 120.1-A occupancy category permits ventilation air to be reduced to zero when the space is in occupied-standby mode, shall meet the following:~~Multipurpose room less than 1000 square feet, classrooms greater than 750 square feetand conference, convention, auditorium and meeting center rooms greater than 750 square feet that do not have processes or operations that generate dusts, fumes, vapors or gasses shall be equipped with occupant sensor(s) to accomplish the following during unoccupied periods:~~

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

   B. During occupied standby mode.

      i. Automatically set up the operating cooling temperature set point by 2°F or more and set back the operating heating temperature set point by 2~~°~~°F or more; ~~and~~or

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

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

   ~~B. Automatically reset the minimum required ventilation rate with an occupant sensor ventilation control device according to Section 120.1(c)5.~~

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

   ~~**EXCEPTION 2 to Sections 120.2(e)1, 2, and 3:** Where it can be demonstrated to the satisfaction of the enforcing agency that shutdown, setback, and setup will not result in a decrease in overall building source energy use.~~

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

EXCEPTION <u>3</u>~~4~~ to Sections 120.2(e)1 and 2: Systems serving hotel/motel guest rooms, if they have a readily accessible manual shut-off switch.

~~**EXCEPTION 5 to Sections 120.2(e)3:**. If Demand Control Ventilation is implemented as required by Section 120.1(c)3 and 120.1(c)(4).~~

CHANGE SIGNIFICANCE: For space types identified as eligible to be in occupied standby mode according to the new Table 120.1-A, and for which an occupancy sensor control is used to satisfy the lighting control requirement, the ventilation provided to the zone may be reduced to zero when the zone is unoccupied and within the system deadband. Changes to this section also include the elimination of two exceptions, the first is now irrelevant due to Section 120.1(c)3 and 4 being deleted, and the second being unnecessary since continuous operation is already exempted from Sections 120.2(e)1, 2, and 3.

The analysis for this new requirement showed that it will save fan energy and cooling or heating energy by controlling the amount of air introduced to the space. This change is necessary to achieve savings. The changes to the exceptions were intended to simplify the code language.

120.2(f)

Dampers for Air Supply and Exhaust Equipment

CHANGE TYPE: Clarification

CHANGE SUMMARY: Changes were made to simplify code language for clarity.

2019 CODE:

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

EXCEPTION 1 to Section 120.2(f): ~~Where it can be demonstrated to the satisfaction of the enforcing agency that the equipment~~Equipment that serves an area that must operate continuously.

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

EXCEPTION 3 to Section 120.2(f): At combustion air intakes and shaft vents.

EXCEPTION 4 to Section 120.2(f): Where prohibited by other provisions of law.

CHANGE SIGNIFICANCE: The purpose of the change to the exception to this section is to simplify the code language. This change clarifies the exception without materially altering the requirements.

120.2(h)

Automatic Demand Shed Controls

CHANGE TYPE: Clarification

CHANGE SUMMARY: The requirements of this section have been relocated to Section 110.12.

2019 CODE:

(h) **Automatic Demand Shed Controls.** See Section 110.12 for requirements for Automatic Demand Shed Controls.~~HVAC systems with DDC to the Zone level shall be programmed to allow centralized demand shed for non-critical zones as follows:~~

1. ~~The controls shall have a capability to remotely setup the operating cooling temperature set points by 4 degrees or more in all non-critical zones on signal from a centralized contact or software point within an Energy Management Control System (EMCS).~~
2. ~~The controls shall have a capability to remotely setdown the operating heating temperature set points by 4 degrees or more in all non-critical zones on signal from a centralized contact or software point within an EMCS.~~
3. ~~The controls shall have capabilities to remotely reset the temperatures in all non-critical zones to original operating levels on signal from a centralized contact or software point within an EMCS.~~
4. ~~The controls shall be programmed to provide an adjustable rate of change for the temperature setup and reset.~~
5. ~~The controls shall have the following features:~~
   - ~~A. Disabled. Disabled by authorized facility operators; and~~
   - ~~B. Manual control. Manual control by authorized facility operators to allow adjustment of heating and cooling set points globally from a single point in the EMCS; and~~
   - ~~C. Automatic Demand Shed Control. Upon receipt of a demand response signal, the space-conditioning systems shall conduct a centralized demand shed, as specified in Sections 120.2(h)1 and 120.2(h)2, for non-critical zones during the demand response period.~~

CHANGE SIGNIFICANCE: The purpose of the change to this section is to relocate its requirements to Section 110.12 as a part of consolidating all of the demand response and demand management requirements in a single section. The change clarifies without materially altering the requirements.

120.2(i)

Economizer Fault Detection and Diagnostics (FDD)

CHANGE TYPE: Modification

CHANGE SUMMARY: The changes to this section extend the requirements for FDD to all cooling systems with an economizer and a cooling capacity over 4.5 tons.

2019 CODE:

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

1. 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
2. Temperature sensors shall have an accuracy of ±2°F over the range of 40°F to 80°F; and
3. The controller shall have the capability of displaying the value of each sensor; and
4. 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.
5. The unit controller shall allow manual~~ly~~ initiation of~~initiate~~ each operating mode so that the operation of cooling systems~~compressors~~, economizers, fans, and heating systems can be independently tested and verified; and
6. 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.

7. The FDD system shall detect the following faults:
   A. Air temperature sensor failure/fault;
   B. Not economizing when it should;
   C. Economizing when it should not;
   D. Damper not modulating; and
   E. Excess outdoor air.
8. The FDD System shall be certified by the Energy Commission as meeting requirements of Sections 120.2(i)1 through 120.2(i)7 in accordance with Section 110.0 and JA6.3.

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

CHANGE SIGNIFICANCE: The changes to this section expand existing Fault Detection and Diagnostic (FDD) requirements for air cooled packaged direct expansion units to all mechanical cooling systems over 4.5 tons with an air economizer.

An exception was added to exempt FDD algorithms based on direct digital control systems from the certification requirements of the Energy Code. In the analysis for expanding this requirement to all cooling system types, it was identified that certain FDD's have several people responsible for the operation of the FDD. The installing contractor, control contractor, FDD manufacturer, or another person may be responsible for the control algorithms, and requiring certification of the control algorithms was not feasible, therefore, the exception was necessary.

Other changes to this section are to simplify phrasing and correct an error in section numbering and do not alter the requirements.

120.2(j)

Direct Digital Controls (DDC)

CHANGE TYPE: Clarification

CHANGE SUMMARY: The primary change to this section updates section references that have changed due to updates to the Energy Code.

2019 CODE:

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

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

1. Monitoring zone and system demand for fan pressure, pump pressure, heating and cooling;
2. ~~Transfering~~Transferring zone and system demand information from zones to air distribution system controllers and from air distribution systems to heating and cooling plant controllers;
3. 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;
4. Readily allow operator removal of zones(s) from the reset algorithm;
5. For new buildings, trending and graphically displaying input and output points; and
6. Resetting heating and cooling setpoints in all noncritical zones upon receipt of a signal from a centralized contact or software point as described in Section 120.2(h).

CHANGE SIGNIFICANCE: The purpose of the changes to this section is to update a reference to Section 120.1 to account for amendments to Section 120.1. Other changes are made to correct spelling and punctuation. These changes clarify without materially altering the requirements.

120.2(k)

Optimum Start/Stop Controls

CHANGE TYPE: Modification

CHANGE SUMMARY: An exception is added to this section for systems that must operate continuously.

2019 CODE:

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

> **EXCEPTION to Section 120.2(k):** Systems that must operate continuously.

CHANGE SIGNIFICANCE: The purpose of the change to this section is to add an exception for continuously operating equipment. Continuously operating equipment never stops, therefore requirements relating to stopping and restarting are unnecessary. This exception was added to avoid applying this section's requirement where it would serve no purpose and provide no benefit.

120.3

Requirements for Pipe Insulation Exception 3 to 120.3(a) General Requirements

CHANGE TYPE: Clarification

CHANGE SUMMARY: A redundant exception to the pipe insulation requirements of Section 120.3 was removed for clarity.

2019 CODE:

~~**EXCEPTION 3 to Section 120.3:** Gas piping, cold domestic water piping, condensate drains, roof drains, vents, or waste piping.~~

CHANGE SIGNIFICANCE: The piping insulation requirements in Section 120.3 are for specific types of piping which do not include the piping types called out in the exception. As none of the piping in Exception 3 have any requirements in Section 120.3, the exception is not needed.

120.3(a)

General Requirements

CHANGE TYPE: Clarification

CHANGE SUMMARY: Restructured and clarified which pipes are subject to the pipe insulation requirements.

2019 CODE:

(a) **General Requirements.** The piping conditions listed below for space-conditioning and service water-heating systems with fluid normal operating temperatures listed in TABLE 120.3-A, shall have at least the amount of insulation specified in Subsection (c):

1. **Space Cooling Systems.** All refrigerant suction, chilled water, ~~and brine lines~~and brine fluid distribution systems.
2. **Space Heating Systems.** All refrigerant, steam, steam condensate and hot water ~~lines~~fluid distribution systems.
3. **Service water-heating systems.**
   - A. Recirculating system piping, including the supply and return piping ~~of~~ to the water heater.
   - B. The first 8 feet of hot and cold outlet piping, including piping between a storage tank and a heat trap, for a nonrecirculating storage system.
   - ~~C. The inlet pipe between the storage tank and a heat trap in a nonrecirculating storage system. D~~C. Pipes that are externally heated.

Insulation conductivity shall be determined in accordance with ASTM C335 at the mean temperature listed in TABLE 120.3-A, 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.

CHANGE SIGNIFICANCE: The purpose of the changes to this section are to clarify that the insulation requirements of Section 120.3 are minimum requirements, and that the amount of insulation is based on normal operating temperatures and not temperatures that may theoretically occur under abnormal circumstances, and to clarify an ambiguity regarding refrigerant lines for heat pump space conditioning equipment when that equipment is operating exclusively in a heating mode. The change is necessary to preclude this unintended reading of this section's requirements. These changes clarify without materially altering the requirements.

120.3(b)

Insulation Protection

CHANGE TYPE: Modification

CHANGE SUMMARY: These changes merge requirements for residential and nonresidential pipe insulation, clarify insulation protection requirements, and prevent the use of adhesive tape as a weather protection cover.

2019 CODE:

(b) **Insulation Protection.** Pipe Insulation shall be protected from damage, ~~including that~~ due to sunlight, moisture, equipment maintenance, and wind.~~;~~ Protection shall, at minimum, include~~ing but not limited to,~~ the following:

1. Pipe ~~I~~insulation exposed to weather shall be ~~installed with~~protected by a cover suitable for outdoor service. The cover shall be water retardant and provides shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be used to provide this protection.
2. Pipe ~~I~~insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall include, or be protected by, ~~have~~ a Class I or Class II vapor retarder. All penetrations and joints ~~of which~~ shall be sealed.
3. Pipe insulation buried below grade must be installed in a water proof and non-crushable casing or sleeve.

CHANGE SIGNIFICANCE: The purpose of these changes are to standardize insulation protection requirements between residential and nonresidential buildings, clarifying that if the outer surface of the insulation provides the required protection that an additional cover is not needed, and to make nonsubstantive grammatical improvements to the language. The changes have the substantive effect of prohibiting the use of adhesive tape as a weather protecting cover, and of requiring that pipe insulation buried below grade to be installed in a waterproof and noncrushable casing or sleeve for both residential and nonresidential applications.

The 2016 Energy Code language could have been misinterpreted as requiring a separate weather protecting cover, even when either the insulation itself or the insulation integrates a protective cover that provides the required level of protection. The language has been clarified to show that a redundant cover is not necessary when the insulation incorporates the proper protection. These changes are necessary to ensure that pipe insulation is installed with protective features that ensure and preserve its long-term performance, and to create consistency between residential and nonresidential requirements.

Getty Images

Pipe insulation – When exposed to weather, pipe insulation must be protected as described in Section 120.3(b) of the Energy Code.

Table 120.3-A

Pipe Insulation Thickness

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: Changes to Table 120.3-A have been made to clarify existing requirements and simplify insulation material selection.

2019 CODE:

TABLE 120.3-A Pipe Insulation Thickness

~~FLUID TEMPERATURE RANGE (°F)~~	~~CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)~~	~~INSULATION MEAN RATING TEMPERATURE (°F)~~	~~NOMINAL PIPE DIAMETER (in inches)~~				
			~~< 1~~	~~1 to <1.5~~	~~1.5 to <4~~	~~4 to <8~~	~~8 and larger~~
			~~INSULATION THICKNESS REQUIRED (in inches)~~				
~~Space heating, Hot Water systems (steam, steam condensate and hot water) and Service Water Heating Systems (recirculating sections, all piping in electric trace tape systems, and the first 8 feet of piping from the storage tank for nonrecirculating systems)~~							
~~Above 350~~	~~0.32-0.34~~	~~250~~	~~4.5~~	~~5.0~~	~~5.0~~	~~5.0~~	~~5.0~~
~~251-350~~	~~0.29-0.32~~	~~200~~	~~3.0~~	~~4.0~~	~~4.5~~	~~4.5~~	~~4.5~~
~~201-250~~	~~0.27-0.30~~	~~150~~	~~2.5~~	~~2.5~~	~~2.5~~	~~3.0~~	~~3.0~~
~~141-200~~	~~0.25-0.29~~	~~125~~	~~1.5~~	~~1.5~~	~~2.0~~	~~2.0~~	~~2.0~~
~~105-140~~	~~0.22-0.28~~	~~100~~	~~1.0~~	~~1.5~~	~~1.5~~	~~1.5~~	~~1.5~~
~~Space cooling systems (chilled water, refrigerant and brine)~~							
~~40-60~~	~~0.21-0.27~~	~~75~~	~~Nonres 0.5~~ ~~Res 0.75~~	~~Nonres 0.5~~ ~~Res 0.75~~	~~1.0~~	~~1.0~~	~~1.0~~
~~Below 40~~	~~0.20-0.26~~	~~50~~	~~1.0~~	~~1.5~~	~~1.5~~	~~1.5~~	~~1.5~~

TABLE 120.3-A Pipe Insulation Thickness

FLUID OPERATING TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)		NOMINAL PIPE DIAMETER (in inches) < 1	1 to < 1.5	1.5 to < 4	4 to < 8	8 and larger
				INSULATION THICKNESS REQUIRED (in inches or *R*-value)				
Space heating, Service Water Heating Systems (Steam, Steam Condensate Refrigerant, Space Heating, Service Hot Water)								
Above 350	0.32–0.34	250	Inches	4.5	5.0	5.0	5.0	5.0
			R-value	R 37	R 41	R 37	R 27	R 23
251–350	0.29–0.32	200	Inches	3.0	4.0	4.5	4.5	4.5
			R-value	R 24	R 34	R 35	R 26	R 22
201–250	0.27–0.30	150	Inches	2.5	2.5	2.5	3.0	3.0
			R-value	R 21	R 20	R 17.5	R 17	R 14.5
141–200	0.25–0.29	125	Inches	1.5	1.5	2.0	2.0	2.0
			R-value	R 11.5	R 11	R 14	R 11	R 10
105–140	0.22–0.28	100	Inches	1.0	1.5	1.5	1.5	1.5
			R-value	R 7.7	R 12.5	R 11	R 9	R 8
				Nominal Pipe Diameter (in inches)				
				< 1	1 to < 1.5	1.5 to < 4	4 to < 8	8 and larger
Space cooling systems (chilled water, refrigerant and brine)				Minimum Pipe Insulation Required (Thickness in inches or R-value)[1]				
40–60	0.21–0.27	75	Inches	Nonres 0.5 / Res 0.75	Nonres 0.5 / Res 0.75	1.0	1.0	1.0
			R-value	Nonres R 3 / Res R 6	Nonres R 3 / Res R 5	R 7	R 6	R 5
Below 40	0.20–0.26	50	Inches	1.0	1.5	1.5	1.5	1.5
			R-value	R 8.5	R 14	R 12	R 10	R 9

Footnote to TABLE 120.3-A:

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

CHANGE SIGNIFICANCE: Language has been added to Table 120.3-A to clarify that the listed thickness and *R*-values are minimum requirements. *R*-values have been added to the table to allow materials which are listed by their *R*-values to be selected for the needed application without having to calculate the required thickness based on the rated thermal conductivity. The listed *R*-values correspond to the listed minimum conductivities, so there is no change in the efficiency requirements.

120.4

Requirements for Air Distribution System Ducts and Plenums Exception to Section 120.4 General Requirements

CHANGE TYPE: Addition

CHANGE SUMMARY: An exception to Section 120.4 for healthcare facilities is added.

2019 CODE:

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.4(a) through 120.4(f).

EXCEPTION to Section 120.4: Systems serving healthcare facilities shall comply with the applicable requirements of the *California Mechanical Code*.

CHANGE SIGNIFICANCE: The purpose of this change is to exempt systems serving healthcare facilities from all requirements of Section 120.4. This change is necessary to prevent conflict between the requirements of the Mechanical Code and Section 120.4 of the Energy Code by incorporating a reference to the Mechanical Code sections that apply to healthcare facilities.

120.4(a)

CMC Compliance

CHANGE TYPE: Clarification

CHANGE SUMMARY: Unnecessary verbiage relating to air distribution duct systems was removed to simplify the code language.

2019 CODE:

(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 ~~be installed, sealed and insulated to~~ 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.

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:

1. Outdoors; or
2. In a space between the roof and an insulated ceiling; or
3. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces; or
4. In an unconditioned crawl space; or
5. 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 any higher level required by CMC Section 605.0)~~ or be enclosed in directly conditioned space.

CHANGE SIGNIFICANCE: The purpose of the changes to this section are to remove unnecessary verbiage, including a parenthetical statement that has no regulatory effect. These changes clarify without materially altering the requirements and are necessary to improve the clarity of the Energy Code.

120.5

Requirements for Nonresidential Mechanical System Acceptance Exception to Section 120.5(a) General Requirements

CHANGE TYPE: Addition

CHANGE SUMMARY: An exception to Section 120.4 for healthcare facilities is added.

2019 CODE:

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.4(a) through 120.4(f).

EXCEPTION to Section 120.5: Systems serving healthcare facilities.

CHANGE SIGNIFICANCE: The purpose of this exception is to exempt licensed healthcare facilities from all of the requirements of Section 120.5. This exception is necessary because licensed healthcare facilities are being brought into the scope of the Energy Code for the first time, but this section has been identified as potentially not cost effective when applied to a healthcare facility. Licensed healthcare facilities are permitted and built under the close supervision and continuous inspection of the Office of Statewide Health Planning and Development (OSHPD), and the requirements of this section would likely duplicate existing testing and certification requirements under OSHPD. Future code cycles may remove this exception based on more detailed analysis, partial exceptions tailored specifically for healthcare facilities, or both.

120.5(a)18

Acceptance Testing, Occupant Sensing Zone Controls

CHANGE TYPE: Addition

CHANGE SUMMARY: A new occupant sensing zone controls Acceptance Test has been added to the mandatory mechanical system acceptance test requirements.

2019 CODE:

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

[…]

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

CHANGE SIGNIFICANCE: The purpose of this change is to add a reference to a new Acceptance Test. The new acceptance test will verify the occupant sensors and ventilation controls comply with the intent of the new occupant sensing zone control requirement of Section 120.2(e)3. This acceptance testing is vital to ensure the ventilation controls scheme correctly delivers and reduces ventilation to the zone, which has both energy savings and indoor air quality implications.

120.6(a)

Mandatory Requirements for Refrigerated Warehouses

CHANGE TYPE: Clarification

CHANGE SUMMARY: Clarification of the code language is needed to remove ambiguity about the size of a refrigerated space that triggers the requirements in 120.6(a) and when each requirement is applicable.

2019 CODE:

(a) **Mandatory Requirements for Refrigerated Warehouses**

Refrigerated warehouses that are greater than or equal to 3,000 square feet and refrigerated spaces with a sum total of 3,000 square feet or more that are served by the same refrigeration system shall meet the requirements of ~~Subsections 1, 2, 3, 6 and 7 of~~ Section 120.6(a).

Refrigerated spaces that are less than 3,000 square feet shall meet the requirements of the Appliance Efficiency Regulations for walk-in coolers or freezers contained in the Appliance Efficiency Regulations (California Code of Regulations, Title 20, Sections 1601 through 1608).

~~Refrigerated Spaces that (i) comprise a total of 3,000 square feet or more; and (ii) are collectively served by the same refrigeration system compressor(s) and condenser(s) shall meet the requirements of Subsections 4, 5 and 7 of Section 120.6(a).~~

[…]

CHANGE SIGNIFICANCE: The 2016 Energy Code language was unclear about the size that a refrigerated space needed to be in order to trigger the refrigerated warehouse requirements. There are two scenarios where the refrigerated warehouse requirements are triggered. First, when a single refrigerated space is 3,000 square feet or larger, the space is considered a refrigerated warehouse. Second, if there is more than one space served by a single refrigeration system, and the combined floor area of those spaces served by that system are 3,000 square feet or larger, the collective spaces are considered a refrigerated warehouse. If the thresholds are met to be a refrigerated warehouse, all of Section 120.6(a) is applicable to the space(s). If the refrigerated space, or spaces, do not meet the size requirements, the space is not a refrigerated warehouse. Instead, these spaces are considered a walk-in cooler or freezer, and none of the requirements in Section 120.6(a) are applicable. Walk-in coolers and freezers are covered under the federal Department of Energy requirements and the California Appliance Efficiency Regulations.

120.6(a)4

Mandatory Requirements for Refrigerated Warehouses, Condensers

CHANGE TYPE: Addition

CHANGE SUMMARY: Requirements have been added to allow the use of adiabatic condensers for refrigerated warehouse refrigeration systems.

2019 CODE:

(a) **Mandatory Requirements for Refrigerated Warehouses**

[…]

4. **Condensers.** New fan-powered condensers on new refrigeration systems shall conform to the following:

   A. Design saturated condensing temperatures for evaporative-cooled condensers and water-cooled condensers served by fluid coolers or cooling towers shall be less than or equal to:

      i. The design wetbulb temperature plus 20°F in locations where the design wetbulb temperature is less than or equal to 76°F;

      ii. The design wetbulb temperature plus 19°F in locations where the design wetbulb temperature is between 76°F and 78°F; or

      iii. The design wetbulb temperature plus 18°F in locations were the design wetbulb temperature is greater than or equal to 78°F.

   EXCEPTION 1 to Section 120.6(a)4A: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

   B. Design saturated condensing temperatures for air-cooled condensers shall be less than or equal to:

      i. ~~t~~The design drybulb temperature plus 10°F for systems serving freezers;

      ii. ~~and shall be less than or equal to t~~The design drybulb temperature plus 15°F for systems serving coolers.

   EXCEPTION 1 to Section 120.6(a)4B: Condensing units with a total compressor horsepower less than 100 HP.

   EXCEPTION 2 to Section 120.6(a)4B: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

   C. The saturated condensing temperature necessary for adiabatic condensers to reject the design total heat of rejection of a refrigeration system assuming dry mode performance shall be less than or equal to:

      i. The design drybulb temperature plus 20°F for systems serving freezers;

      ii. The design drybulb temperature plus 30°F for systems serving coolers.

EXCEPTION 1 to Section 120.6(a)4C: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

D. All condenser fans for air-cooled condensers, evaporative-cooled condensers, adiabatic condensers, gas coolers, air or water fluid coolers or cooling towers ~~or fans on cooling towers or fluid coolers~~ shall be continuously variable speed, ~~and the condensing temperature control system shall control~~ with the speed of all fans serving a common condenser high side controlled in unison. ~~The minimum condensing temperature setpoint shall be less than or equal to 70°F.~~

~~D. All condenser fans for air-cooled condensers shall be continuously variable speed and the condensing temperature or pressure control system shall control the speed of all condenser fans serving a common condenser high side in unison. The minimum condensing temperature setpoint shall be less than or equal to 70°F.~~

E. The minimum condensing temperature setpoint shall be less than or equal to 70°F for air-cooled condensers, evaporative-cooled condensers, adiabatic condensers, gas coolers, air or water-cooled fluid coolers or cooling towers.

F~~E.~~ Condensing temperature reset. The condensing temperature set point of systems served by air-cooled condensers shall be reset in response to ambient drybulb temperature. The condensing temperature set point of systems served by evaporative-cooled condensers or water-cooled condensers (via cooling towers or fluid coolers) shall be reset in response to ambient wetbulb temperatures. The condensing temperature set point for systems served by adiabatic condensers shall be reset in response to ambient drybulb temperature while operating in dry mode.

EXCEPTION 1 to Section 120.6(a)4~~E~~F: Condensing temperature control strategies approved by the Executive Director that have been demonstrated to provide at least equal energy savings.

EXCEPTION 2 to Section 120.6(a)4F: Systems served by adiabatic condensers in Climate Zones 1, 3, 5, 12, 14 and 16.

~~F~~G. Fan-powered condensers shall meet the condenser efficiency requirements listed in TABLE 120.6-B. Condenser efficiency is defined as the total heat of rejection (THR) capacity divided by all electrical input power including fan power at 100 percent fan speed, and power of spray pumps for evaporative condensers.

EXCEPTION to Section 120.6(a)4G: Adiabatic condensers with ammonia as refrigerant.

H~~G.~~ Air-cooled condensers shall have a fin density no greater than 10 fins per inch.

EXCEPTION to Section 120.6(a)4~~H~~G: Micro-channel condensers.

EXCEPTION to Section 120.6(a)4A, 4B, 4C, 4E, 4F and 4G: Transcritical CO2 refrigeration systems.

TABLE 120.6-B Fan-Powered Condensers–Minimum Efficiency Requirements

CONDENSER TYPE	REFRIGERANT TYPE	MINIMUM EFFICIENCY	RATING CONDITION
Outdoor Evaporative-Cooled with THR Capacity > 8,000 MBH	All	350 Btuh/Watt	100°F Saturated Condensing Temperature (SCT), 70°F Outdoor Wetbulb Temperature
Outdoor Evaporative-Cooled with THR Capacity < 8,000 MBH and Indoor Evaporative-Cooled	All	160 Btuh/Watt	
Outdoor Air-Cooled	Ammonia	75 Btuh/Watt	105°F Saturated Condensing Temperature (SCT), 95°F Outdoor Drybulb Temperature
	Halocarbon	65 Btuh/Watt	
Adiabatic Dry Mode	Halocarbon	45 Btuh/Watt	105°F Saturated Condensing Temperature (SCT), 95°F Outdoor Drybulb Temperature
Indoor Air-Cooled	All		Exempt

CHANGE SIGNIFICANCE: The purpose of the changes to this section are to incorporate appropriate standards for adiabatic condenser equipment. Establishing efficiency standards for adiabatic equipment is necessary to prevent the Energy Code from inadvertently restricting the use of such equipment in California. This will broaden the options for energy efficient equipment available to California builders.

Adiabatic condensers function like a hybrid between evaporative and dry condensers with the use of cooling pads. Running water over the cooling pads and drawing air through the pads reduces the ambient dry bulb of the incoming air, which allows for greater system heat rejection. These systems are most effective in hot, dry climates, and use water only when ambient temperatures and system demand require it. Adiabatic cooling systems offer an energy efficient solution that provides dramatic water savings relative to traditional evaporative systems.

120.6(b)

Mandatory Requirements for Commercial Refrigeration

CHANGE TYPE: Addition

CHANGE SUMMARY: Language is added to appropriately scope the application of this section to equipment that is not subject to federal appliance efficiency requirements, and to allow and regulate additional energy efficient technologies.

2019 CODE:

(b) **Mandatory Requirements for Commercial Refrigeration.**

Retail food stores with 8,000 square feet or more of conditioned floor area, and that utilize either~~:~~ refrigerated display cases, or walk-in coolers or freezers ~~connected to remote compressor units or condensing units,~~ shall meet all applicable State and federal appliance and equipment standards consistent with Section 110.0 and 110.1 or, for equipment not subject to such standards, the requirements of Subsections 1 through 4.

1. **Condensers serving refrigeration systems.** Fan-powered condensers shall conform to the following requirements:
   - A. All condenser fans for air-cooled condensers, evaporative-cooled condensers, adiabatic condensers, gas coolers, air- or water-cooled fluid coolers or cooling towers shall be continuously variable speed, with the speed of all fans serving a common condenser high side controlled in unison.
   - B. The refrigeration system condenser controls for systems with air-cooled condensers shall use variable-setpoint control logic to reset the condensing temperature setpoint in response to ambient drybulb temperature.
   - C. The refrigeration system condenser controls for systems with evaporative-cooled condensers shall use variable-setpoint control logic to reset the condensing temperature setpoint in response to ambient wetbulb temperature.

     ~~**EXCEPTION to Section 120.6(b)1B and C:** Condensing temperature control strategies approved by the executive director that have been demonstrated to provide equal energy savings.~~
   - D. The refrigeration system condenser controls for systems with adiabatic condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient drybulb temperature while operating in dry mode.

   EXCEPTION 1 to Section 120.6(b)1B, C and D: Condensing temperature control strategies approved by the executive director that have been demonstrated to provide equal energy savings.

   EXCEPTION 2 to Section 120.6(b)1D: Systems served by adiabatic condensers in Climate Zone 16.
   - E. The saturated condensing temperature necessary for adiabatic condensers to reject the design total heat of rejection of a refrigeration system assuming dry mode performance shall be less than or equal to:
     - i. The design drybulb temperature plus 20°F for systems serving freezers;

ii. The design drybulb temperature plus 30°F for systems serving coolers.

F~~D~~. The minimum condensing temperature setpoint shall be less than or equal to 70°F.

G~~E~~. Fan-powered condensers shall meet the specific efficiency requirements listed in Table 120.6-C.

TABLE 120.6-C Fan-Powered Condensers–Specific Efficiency Requirements

CONDENSER TYPE	MINIMUM SPECIFIC EFFICIENCY[a]	RATING CONDITION
Evaporative-Cooled	160 Btuh/W	100°F Saturated Condensing Temperature (SCT), 70°F Entering Wetbulb Temperature
Air-Cooled	65 Btuh/W	105°F Saturated Condensing Temperature (SCT), 95°F Entering Drybulb Temperature
Adiabatic Dry Mode	45 Btuh/W (halocarbon)	105°F Saturated Condensing Temperature (SCT), 95°F Entering Drybulb Temperature

a. See Section 100.1 for definition of condenser specific efficiency.

EXCEPTION 1 to Section 120.6(b)1~~E~~G: Condensers with a Total Heat Rejection capacity of less than 150,000 Btuh at the specific efficiency rating condition.

EXCEPTION 2 to Section 120.6(b)1~~E~~G: Stores located in Climate Zone 1.

EXCEPTION 3 to Section 120.6(b)1~~E~~G: E1xisting condensers that are reused for an addition or alteration.

CHANGE SIGNIFICANCE: The addition of the words "shall meet all applicable State and federal appliance and equipment standards" is needed to clarify that these Energy Code Requirements do not apply to federally regulated appliance for which the State is preempted. Most commercial refrigeration appliances used in retail food stores are already federally regulated.

Adiabatic condensers (also known as hybrid condensers) and systems using gas coolers and CO_2 (typically known as R744 refrigerant) can be very energy efficient when used properly. Adiabatic condensers can also significantly reduce water use in hot dry climates. CO_2 has far better heat transfer properties than most other common refrigerants and in many cases will allow compressors to be much smaller for a given application. CO_2 has the added benefits of being non-ozone depleting, non-flammable, and has a low global warming potential. Establishing efficiency standards for these technologies is necessary to prevent the Energy Code from inadvertently restricting the use of such technology in California. This will broaden the options for energy efficient equipment available to California builders.

120.6(e)

Mandatory Requirements for Compressed Air Systems

CHANGE TYPE: Addition

CHANGE SUMMARY: An exception was added to Section 120.6(e) excluding healthcare facilities from the mandatory requirements for compressed air systems.

2019 CODE:

(e) **Mandatory Requirements for Compressed Air Systems.** All new compressed air systems, and all additions or alterations of compressed air systems where the total combined online horsepower (hp) of the compressor(s) is 25 horsepower or more shall meet the requirements of Subsections 1 through 3. These requirements apply to the compressors and related controls that provide compressed air and do not apply to any equipment or controls that use or process the compressed air.

[…]

EXCEPTION 1 to Section 120.6(e): Alterations of existing compressed air systems that include one or more centrifugal compressors.

EXCEPTION 2 to Section 120.6(e): Compressed air systems, including medical gas, serving healthcare facilities.

CHANGE SIGNIFICANCE: The purpose of this exception is to exempt licensed healthcare facilities from compliance with this code section. This exception is necessary because licensed healthcare facilities are being brought into the scope of the Energy Code for the first time. This section has been identified as having the potential to interfere with the primary health and safety responsibilities of healthcare facilities due to stringent specifications on medical gas distribution systems. In addition, time constraints have prevented the needed analysis to determine cost effectiveness. Future code cycles may remove this exception based on more detailed analysis, partial exceptions tailored specifically for healthcare facilities, or both.

120.6(f)

Mandatory Requirements for Elevators

CHANGE TYPE: Addition

CHANGE SUMMARY: An exception was added to Section 120.6(f) excluding healthcare facilities from the mandatory requirements for elevators.

2019 CODE:

(f) **Mandatory Requirements for Elevators.** Elevators shall meet the following requirements:

1. The light power density for the luminaires inside the elevator cab shall be no greater than 0.6 watts per square foot.

   EXCEPTION to Section 120.6(f)1: Interior signal lighting and interior display lighting are not included in the calculation of lighting power density.

2. Elevator cab ventilation fans for cabs without space conditioning shall not exceed 0.33 watts per CFM as measured at maximum speed.
3. When the elevator cab is stopped and unoccupied with doors closed for over 15 minutes, the cab interior lighting and ventilation fans shall be switched off until elevator cab operation resumes.
4. Lighting and ventilation shall remain operational in the event that the elevator cabin gets stuck when passengers are in the cabin.
5. Elevator Lighting and Ventilation Control Acceptance. Before an occupancy permit is granted for elevators subject to 120.6(f), the following equipment and systems shall be certified as meeting the Acceptance Requirement for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.14.

EXCEPTION to Section 120.6(f): Elevators located in healthcare facilities.

CHANGE SIGNIFICANCE: The purpose of this exception is to exempt licensed healthcare facilities from compliance with this code section. This exception is necessary because licensed healthcare facilities are being brought into the scope of the Energy Code for the first time. This section has been identified as having the potential to interfere with the primary health and safety responsibilities of healthcare facilities since occupancy sensors could fail to detect unconscious patients left alone in an elevator, potentially harming such a patient. Future code cycles may remove this exception based on more detailed analysis, partial exceptions tailored specifically for healthcare facilities, or both.

120.7(b)

Wall Insulation

CHANGE TYPE: Clarification

CHANGE SUMMARY: The 2019 Energy Code clarifies that all curtain walls, regardless of opacity, must meet the mandatory assembly *U*-factor requirements.

2019 CODE:

(b) **Wall Insulation.** The opaque portions of walls that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 7 below:

[…]

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

CHANGE SIGNIFICANCE: The purpose of this change was to remove the word "opaque" as it was unnecessary, and to be consistent with the proposed change to Reference Joint Appendix JA4. Curtain walls are defined as walls, which are distinct from fenestration. Additionally, this avoids questions related to semi-translucent materials, and at what point material is considered "opaque." The intent is to ensure that curtain walls meet these efficiency requirements, as they are applicable to curtain walls, regardless of their opacity.

Getty Images

Glass Curtain Wall System.

120.8

Nonresidential Building Commissioning

CHANGE TYPE: Addition

CHANGE SUMMARY: Language is added to this section to prevent duplicative commissioning requirements.

2019 CODE:

Nonresidential buildings other than healthcare facilities, with conditioned space of 10,000 square feet or more, shall comply with the applicable requirements of Sections 120.8(a) through 120.8(i) in the building design and construction processes. All building systems and components covered by Sections 110.0, 120.0, 130.0, and 140.0 shall be included in the scope of the commissioning requirements in this Section, excluding those related solely to covered processes.

Nonresidential buildings other than healthcare facilities, with conditioned space of less than 10,000 square feet, shall comply with the design review requirements specified in Sections 120.8(d)~~,~~ and shall include any measures or requirements necessary for completing this review in the construction documents in a manner consistent with Section 120.8(e).

Healthcare facilities shall instead comply with the applicable requirements of Chapter 7 of the *California Administrative Code* (Title 24, Part 1).

[…]

CHANGE SIGNIFICANCE: The purpose of the change to this section is to add a provision that directs healthcare facilities to the applicable commissioning requirements of the Administrative Code, Title 24, Part 1, Chapter 7. Healthcare facilities are already subject to the commissioning requirements of the Administrative Code, making the requirements of the Energy Code potentially duplicative.

PART 4

Nonresidential, High-Rise Residential and Hotel/Motel Occupancies— Mandatory Requirements for Lighting Systems and Equipment, and Electrical Power Distribution Systems

Subchapter 4

Subchapter 4 identifies mandatory requirements that are applicable to all buildings regulated by the Energy Code except low-rise residential buildings. This includes high-rise residential, nonresidential, hotel/motel buildings, and covered processes. This subchapter spans from Section 130.0 through 130.5. These sections establish mandatory requirements for the design and installation of lighting and electrical power distribution systems for these buildings.

Mandatory requirements for determining when the residential lighting requirements can apply to nonresidential, high-rise residential and hotel/motel buildings are found in Section 130.0, along with how to determine luminaire power.

Sections 130.1 and 130.2 establish mandatory lighting requirements for indoor and outdoor lighting systems, including manual and automatic control requirements. Section 130.3 addresses sign lighting control requirements, and Section 130.4 identifies the acceptance and installation certificate requirements for lighting control systems. Section 130.5 is the only section in the Energy Code that addresses mandatory electrical power distribution requirements, including metering, separation of circuits, voltage drop limitations, and controlled receptacles. ■

130.0

Lighting Systems and Equipment, and Electrical Power Distribution Systems – General

130.0(c)

Luminaire Classification and Power

130.0(c)1 – 4

Luminaire Classification and Power

130.0(c)5 – 10

Luminaire Classification and Power

130.1(a)

Manual Area Controls

130.1(b)

Multilevel Lighting Controls

130.1(c)1 and 2

Shut-OFF Controls

130.1(c)5

Shut-OFF Controls

130.1(d)

Automatic Daylighting Controls

130.1(e)

Demand Responsive Controls

130.1(f)

Control Interactions

130.2

Outdoor Lighting Controls and Equipment

130.2(a)

Reserved

130.2(b)

Luminaire Cutoff Requirements

130.2(c)

Controls for Outdoor Lighting

130.3

Sign Lighting Controls

130.4

Lighting Control Acceptance
and Installation Certificate Requirements

130.5

Electrical Power Distribution Systems

130.0(c)1 – 4

Luminaire Classification and Power

CHANGE TYPE:

Clarification and Modification

CHANGE SUMMARY:

Luminaire wattage labeling requirements were clarified, an option for determining luminaire power was added.

2019 CODE:

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

1. ~~**Luminaire labeling.**~~ Luminaire wattage shall be labeled as follows:

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

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

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

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

   ii. Low-voltage luminaires (except low voltage track systems), ≤ 24 volts, with a maximum relamping rated wattage of 50 watts.

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

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

   A. The maximum relamping rated wattage of the luminaire; and

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

~~3. Luminaires and luminaire housings designed to accommodate a variety of trims or modular components that allow the conversion between incandescent and any other lighting technology~~

~~without changing the luminaire housing or wiring shall be classified as incandescent.~~

~~4. Screwbased adaptors shall not be used to convert an incandescent luminaire to any type of nonincandescent technology. Screw-based adaptors, including screw-base adaptors classified as permanent by the manufacturer, shall not be recognized for compliance with Part 6.~~

~~5. Luminaires and luminaire housings with incandescent screw base sockets shall be classified only as incandescent. Field modifications, including but not limited to hard wiring of an LED module, shall not be recognized as converting an incandescent luminaire or luminaire housing to a nonincandescent technology for compliance with Part 6 unless such sockets are removed.~~

3.~~6.~~ For ~~L~~luminaires with permanently installed or remotely installed ballasts, ~~or drivers. T~~the wattage of such luminarires ~~shall be determined as follows:~~

~~The operating input wattage of the rated ballast or lamp/ballast combination~~ 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.~~;~~

~~A. The maximum input wattage of the rated driver published in driver's manufacturer catalogs based on independent testing lab reports as specified by UL 8750 or LM-79~~.

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

CHANGE SIGNIFICANCE: The purpose of the changes to this section are to redraft the language to improve clarity and streamline its application to various lighting designs and equipment. The substantive changes are necessary to ensure the Energy Code encompasses modern, modular LED systems, and to allow the use of energy efficient lamps for compliance. Specific changes for each subsection are as follows:

Section 130.0(c)1 – The purpose of the change to this section is to remove its heading. This change is necessary for consistency with the other subsections to Section 130.0(c), which do not have headings.

Section 130.0(c)2 – The purpose of the change to this section is to allow consideration of lamp wattage in recessed luminaires with line-voltage screw base sockets when the lamps populating those sockets comply with Reference Joint Appendix JA8 (JA8). This change is necessary to provide flexibility to lighting designers.

Getty Images

LED with Screw Base Socket vs. Incandescent – Rated wattage of LED lamp will be recognized for compliance if certified to the CEC and labeled as JA8-2016 or JA8-2019.

Sections 130.0(c)3, 4, and 5 (removed) – The purpose of removing these sections and renumbering subsequent sections is to remove language that categorizes luminaires based on the lamp socket type, rather than the lamps installed in the luminaire. Removing these sections is necessary to allow consideration of the efficiency of installed lamps.

Section 130.0(c)4 (added, renumbered) – The purpose of adding this language is to clarify that the requirement applies whether the driver is mounted within the solid-state lighting (SSL) luminaire or mounted remotely from the SSL luminaire.

130.0(c)5 – 10

Luminaire Classification and Power

CHANGE TYPE: Clarification, Modification, and Addition

CHANGE SUMMARY: This section has been redrafted to improve clarity and streamline its application to various lighting designs. A provision for lighting power classification for LED tape lighting was added, and requirements for modular lighting systems were consolidated.

2019 CODE:

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

[…]

~~7~~5. 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.

6. ~~Line-voltage lighting track and plug-in busway~~For modular lighting systems that allow~~s~~ the addition or relocation of luminaires without altering the wiring of the system~~.~~, ~~The wattage of such luminaires~~ shall be determined ~~by one of the following methods~~as follows:

   ~~A. The wattage of line voltage busway and track rated for more than 20 amperes shall be the total volt-ampere rating of the branch circuit feeding the busway and track.~~

   ~~B. The wattage of line voltage busway and track rated for 20 amperes or less shall be determined by one of the following methods:~~

   A. The wattage shall be the greater of:

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

      ii. the rated wattage of all of the luminaires included in the system, where the luminaire wattage is determined as specified in Section 130.0(c)1~~The volt-ampere rating of the branch circuit feeding the track or busway~~; or

      ~~ii. The higher of the rated wattage of all of the luminaires included in the system, where luminaire classification and wattage is determined according to the applicable provisions in Section 130.0(c), or 45 watts per linear foot; or~~

   ~~iii~~B. ~~When using a line-voltage track lighting integral current limiter,~~ 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:

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

      ii. 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 ~~the~~

~~higher of the volt-ampere rating of an integral current limiter controlling the track or busway, or 12.5 watts per linear foot of track or busway. An Integral current limiter shall be certified to the Energy Commission in accordance with Section 110.9, and shall comply with the Lighting Control Installation Requirements in accordance with Section 130.4, to qualify to use Subsection Biii to determine luminaire power;~~ or

~~iv. When using a dedicated track lighting supplementary overcurrent protection panel, the rated power shall be the sum of the ampere (A) rating of all of the overcurrent protection devices times the branch circuit voltages. Track lighting supplementary overcurrent protection panels shall comply with the applicable requirements in Section 110.9, and shall comply with the Lighting Control Installation Requirements in accordance with Section 130.4, to qualify to use Subsection Biv to determine luminaire power~~.

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

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

~~8. Luminaires and lighting systems with permanently installed or remotely installed transformers. The wattage of such luminaires shall be determined as follows:~~

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

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

~~9. Light emitting diode (LED) Luminaires, and LED Light Engine.~~

~~A. The wattage of such luminaires shall be the maximum rated input wattage of the system when tested in accordance with IES LM-79-08.~~

~~B. The maximum rated input wattage shall be labeled in accordance with Section 130.0(c)1.~~

~~C. An LED lamp, integrated or nonintegrated type in accordance with the definition in ANSI/IES RP-16-2010, shall not be classified as a LED lighting system for compliance with Part 6.~~

~~LED modules having screw bases, including but not limited to screw based pig-tails, screw-based sockets, or screw-based adaptors, shall not be recognized as a LED lighting system for compliance with Part 6.~~

~~D. Luminaires manufactured or rated for use with low-voltage incandescent lamps, into which have been installed LED modules or LED lamps, shall not be recognized as a LED lighting system for compliance with Part 6.~~

~~E. For LED lighting systems that allow the addition of luminaires or light engines without rewiring, the wattage of such luminaires shall be the maximum rated input wattage of the power supply, labeled in accordance with Section 130.0(c)1 or published in the power supply manufacturer's catalog.~~

~~**EXCEPTION to Section 130.0(c)9:** Luminaires in areas that must comply with Section 150.0(k), as specified by Section 130.0(b).~~

~~10~~7. ~~The wattage of~~For all other ~~miscellaneous~~ lighting equipment not addressed by Sections 130.0(c)2 through 6, the wattage of the lighting equipment shall be the maximum rated wattage of the lighting equipment, or operating input wattage of the system, labeled in accordance with Section 130.0(c)1, or published in manufacturer's catalogs, based on independent testing lab reports as specified by UL 1574~~, or UL~~ 1598, 2108, 8750, or IES LM-79. ~~Lighting technologies listed in Subsections 2 through 9 shall be determined in accordance with the applicable requirements in Subsections 1 through 9.~~

CHANGE SIGNIFICANCE: Section 130.0(c)5 (new) – The purpose of adding this section is to provide language that is specific to LED tape lighting. The maximum rated wattage for LED tape lighting is the rated linear power rating of the LED tape lighting multiplied by the length of installed tape, or the maximum rated input wattage of the driver or power supply of the LED tape lighting system. A reference to the applicable UL test procedure was added and is necessary to ensure that the list of tests used in industry to rate power consumption is complete and is applicable to all types of lighting covered by this section.

Section 130.0(c)6 (previously 7) – The purpose of the change to this section is to pre-sent requirements for modular lighting in a clear, consistent, and technology neutral manner. This section now applies to modular lighting systems generally, and not solely to track-based lighting systems. Additionally, this section merges similar requirements contained in Section 130.0(c)8 for modular low-voltage systems. This change is necessary to apply consistent requirements to a diverse range of modular lighting systems, including LED systems with varied form factors and other lighting that may not make use of a traditional track or busway.

Section 130.0(c)6A – The purpose of this change is to update the lighting power allowed for modular lighting systems to correspond to similar lighting power allowances in ASHRAE 90.1-2016. Federal law (Title 42 of the United States Code, Section 6316(b092)) grants State and local governments the ability to adopt ASHRAE 90.1-2016 efficiency requirements into the local building codes, given that the building codes do not exceed the minimum efficiency requirements of ASHRAE 90.1-2016. This change is necessary to maintain alignment with ASHRAE 90.1, consistent with the above law.

The requirement for accounting of the wattage of all luminaires in the modular lighting system was moved to this section. The change clarifies without materially altering the requirements in the Draft Express Terms and are necessary to improve the Energy Code's clarity.

Section 130.0(c)6B – The purpose of this change is to consolidate the requirements for line-voltage modular lighting systems which utilize track lighting integral current limiters or track lighting supplementary overcurrent protection panels.

Lighting power for modular systems utilizing integral current limiters is no longer dependent on the greater of the volt-ampere rating of the current limiter or 12.5 watts per linear foot of track or busway. Lighting power for these systems is now dependent solely on the volt-ampere rating of the integral current limiter. The change is necessary to improve clarity and streamline application of the two sections for the track lighting integral current limiter and overcurrent protection panel into one section.

Section 130.0(c)6C – The purpose this change is to relocate requirements for low-voltage modular lighting systems from Section 130.0(c)8B to this section. This section now refers to modular lighting systems with a driver, power supply, or transformer. Modular lighting systems can use any of these technologies for providing input power. The change clarifies without materially altering the requirements.

Exception to Section 130.0(c)6 – The purpose of adding this exception for Power over Ethernet (PoE) lighting systems (a type of modular lighting system) is to exclude the wattage of any nonlighting devices from lighting power calculations. Section 130.0(c)6 is intended to quantify lighting power for modular lighting systems only. Inclusion of nonlighting devices in lighting power calculations would make it difficult to achieve compliance using these systems.

Section 130.0(c)7 (previously 10) – This change relocates the requirements for determining wattage of all other lighting equipment types from Section 130.0(c)10 to this section. The language was also updated to reduce redundant phrasing and to improve clarity.

Reference to standard UL 8750 was added to cover lighting types that may be subject to this section. The addition of the UL test procedure is necessary to ensure that the list of tests used in industry to rate power consumption is complete and is applicable to all types of lighting that may be found in a nonresidential setting. The improvements to phrasing are necessary to improve the Energy Code's clarity and consistency.

Section 130.0(c)8 (removed) – This section was removed. Requirements for low-voltage lighting systems have been relocated to other sections of the Energy Code. Low-voltage nonmodular lighting systems are addressed in Section 130.0(c)2. Low voltage modular lighting systems are addressed in Section 130.0(c)6.

Section 130.0(c)9 (removed) – This section was removed to simplify requirements for LED lighting. The requirements for Solid State Lighting

(SSL) are reorganized and redrafted into other sections of the Energy Code. LED light sources are addressed in Section 130.0(c)2 which covers light fixtures populated with LED lamps, Sections 130.0(c)4 and 130.0(c)5, which cover integrated SSL fixtures and tape lighting respectively, and Section 130.0(c)6, which covers modular LED systems. This change is necessary to remove redundant language and to prevent conflict between this section and adopted new sections related to LED light sources.

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LED Tape Lighting – New for 2019 Energy Code, the maximum rated wattage for LED tape lighting can be determined according to the rated linear power rating of the LED tape lighting multiplied by the length of installed tape, or the maximum rated input wattage of the driver or power supply of the LED tape lighting system.

130.1(a)

Manual Area Controls

CHANGE TYPE: Clarification and Addition

CHANGE SUMMARY: Manual area control language was simplified, and new language was added to address manual area controls in healthcare facilities.

2019 CODE:

(a) **Manual Area Controls.**

~~1. All luminaires shall be functionally controlled with manual ON and OFF lighting controls.~~ Each area enclosed by ceiling-height partitions shall ~~be independently controlled~~provide lighting controls that allow the lighting in that area to be manually turned on and off. The manual control shall~~.~~:

1. Be readily accessible; and

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

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

   EXCEPTION 1 to Section 130.1(a)2: For malls and atria, auditorium areas, retail merchandise sales areas, wholesale showroom areas, commercial and industrial storage areas, general commercial and industrial work areas, convention centers, arenas, psychiatric and secure areas in healthcare facilities, and other areas where placement of a manual area control poses a health and safety hazard, the manual area control may instead be located so that a person using the control can see the lights or area controlled by that control, or visually signal or display the current state of the controlled lighting.

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

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

EXCEPTION to Section 130.1(a)~~1~~: Up to 0.2 watts per square foot of indoor lighting ~~in any area within a building~~ 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:

~~A~~1. 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

~~B~~2. The controls for the egress lighting are not accessible to unauthorized personnel.

~~2. The lighting controls shall meet the following requirements:~~

~~A. Be readily accessible; and~~

~~B. Be operated with a manual control that is located in the same room or area with the lighting that is controlled by that lighting control.~~

~~**EXCEPTION 1 to Section 130.1(a)2:** In malls and atria, auditorium areas, retail merchandise sales areas, wholesale showroom areas, commercial and industrial storage areas, general commercial and industrial work areas, convention centers, and arenas, the lighting control shall~~

~~1. be located so that a person using the lighting control can see the lights or area controlled by that lighting control, or~~

~~2. so that the area being lit is annunciated.~~

~~**EXCEPTION 2 to Section 130.1(a)2:** Public restrooms having two or more stalls, parking areas, stairwells, and corridors may use a manual control not accessible to unauthorized personnel.~~

~~3. **Other Lighting Controls.**~~

~~A. Other lighting controls may be installed in addition to the manual lighting controls provided they do not override the functionality of controls installed in accordance with Section 130.1(a)1, 2, or 4.~~

~~4. **Separately Controlled Lighting Systems.** In addition to the requirements in Section 130.1(a)1, 2, and 3:~~

~~A. General lighting shall be separately controlled from all other lighting systems in an area.~~

~~B. Floor and wall display, window display, case display, ornamental, and special effects lighting shall each be separately controlled on circuits that are 20 amps or less.~~

~~C. When track lighting is used, general, display, ornamental, and special effects lighting shall each be separately controlled.~~

CHANGE SIGNIFICANCE: The purpose of the changes to this section are to improve the readability and enhance clarity, to add healthcare facilities to an existing exception relating to the location of controls, and to add a separate exception related to restrooms and bathrooms in healthcare facilities.

The changes to the exceptions are necessary to incorporate healthcare facilities into the Energy Code and ensure controls are not required in inappropriate locations. The remaining changes to the section are not substantive.

Section 130.1(a)2, Exception 1 – The purpose of this change is to exempt psychiatric and secure areas in healthcare facilities from control location requirements. This exception is necessary because licensed healthcare facilities are included in the scope of the Energy Code for the first time, and area lighting controls (manual light switches) must be located where only authorized users have access to them in these types of healthcare settings. In addition, the phrase "and other areas where placement of a manual area control poses a health and safety hazard" is added to ensure that the application of the exception is not based on an exact match of the terms used in the exception with those stated on blueprints or other plans.

Section 130.1(a)2, Exception 2 – The purpose of adding this exception is to exempt single occupant restrooms, and bathing rooms in healthcare facilities from control location requirements. This exception is necessary because patient rooms in healthcare facilities are commonly designed with restrooms that double as bathing areas, and the area lighting controls (light switch) must be allowed to be placed in a safe, dry area, but still within reach of the user or caregiver.

Manual Area Control Options – Depending on the space size, connected lighting load, and space type, Section 130.1(b) of the Energy Code details when the area control for a space must be a dimmer.
Source: California Energy Commission

130.1(b)

Multilevel Lighting Controls

CHANGE TYPE: Clarification and Addition

CHANGE SUMMARY: Multilevel lighting control requirements were simplified, and exceptions were added to address restrooms and healthcare facilities.

2019 CODE:

(b) **Multilevel 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 multilevel lighting controls that ~~meets the following requirements~~allow the level of lighting to be adjusted up and down. The multilevel controls shall~~:~~

~~1. Lighting shall have~~provide the ~~required~~ number of control steps and meet the uniformity requirements specified in ~~accordance with~~ TABLE 130.1-A.;

~~2. Multi-level lighting controls shall not override the functionally of other lighting controls required for compliance with Sections 130.1(a), and (c) through (e); and~~

~~3. Dimmable luminaires shall be controlled by a dimmer control that is capable of controlling lighting through all required lighting control steps and that allows the manual ON and OFF functionality required by Section 130.1(a).~~

~~**EXCEPTION 1 to Section 130.1(b):** Classrooms with a connected general lighting load of 0.7 watts per square feet or less and public restrooms shall have at least one control step between 30-70 percent of full rated power.~~

EXCEPTION ~~2~~ 1 to Section 130.1(b): An area enclosed by ceiling height partitions that has only one luminaire with no more than two lamps.

EXCEPTION 2 to Section 130.1(b): Restrooms.

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

~~The areas specified in Sections 130.1(c)6 and 7 are not also required to meet the requirements of Section 130.1(b).~~

[…]

TABLE 130.1-A Multilevel Lighting Controls and Uniformity Requirements

Luminaire Type	Minimum Required Control Steps (percent of full rated power[1])	Uniform level of illumination shall be achieved by:
Line-voltage sockets except GU-24 Low-voltage incandescent systems LED luminaires and LED source systems GU-24 rated for LED	Continuous dimming 10-100 percent	
GU-24 sockets rated for fluorescent > 20 watts Pin-based compact fluorescent > 20 watts[2]	Continuous dimming 20-100 percent	
GU-24 sockets rated for fluorescent ≤ 20 watts Pin-based compact fluorescent ≤ 20 watts[2] Linear fluorescent and U-bent fluorescent ≤ 13 watts	Minimum one step between 30-70 percent	Stepped dimming; or Continuous dimming; or Switching alternate lamps in a luminaire
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 area and in the same manner
Track Lighting	Minimum one step between 30 – 70 percent	Step dimming; or Continuous dimming; or Separately switching circuits in multicircuit track with a minimum of two circuits.
HID > 20 watts Induction > 25 watts Other light sources	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 ballast and lamp, corresponding to maximum ballast factor
2. Includes only pin based lamps: twin tube, multiple twin tube, and spiral lamps

EXCEPTION 1 to Table 130.1-A, Minimum Required Control Steps: Classrooms with a connected general lighting load of 0.7 watts per square feet or less shall have a minimum of one control step between 30-70 percent of full rated power, regardless of luminaire type.

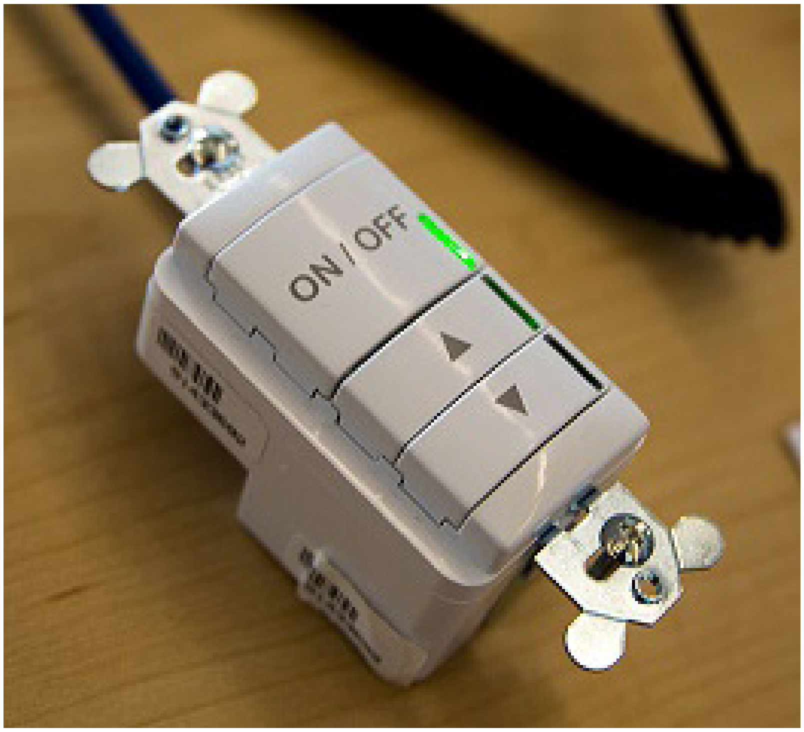
EXCEPTION 2 to Table 130.1-A, Minimum Required Control Steps: Library stack aisles, aisle ways and open areas in warehouses, parking garages, parking areas, loading and unloading areas, stairwells, and corridors shall have a minimum of one control step between 20–60 percent of full rated power, regardless of luminaire type.

CHANGE SIGNIFICANCE: The purpose of the changes to this section are to improve the readability and enhance the clarity of the Energy Code. The provisions for the interactions of multilevel controls with other controls have been relocated to Section 130.1(f).

Two exceptions have been relocated to the footnote of Table 130.1-A, the exception for classrooms, and the exception for areas specified in Sections 130.1(c)6 and 7. Two new exceptions have been added, one for restrooms, and one for healthcare facilities. The new exceptions are described below.

Exception 2 to Section 130.1(b) – The purpose of adding this exception is to facilitate new occupant sensing requirements for restroom lighting. Advancements in occupant sensing technology have overcome prior concerns about detection of occupants in stalls, therefore occupant sensing controls are now required. Occupancy sensing controls have a greater potential for energy savings than dimming of restroom lighting (which rarely, if ever, occurs). This change is necessary to support a more energy efficient and cost effective control strategy in restrooms.

Exception 3 to Section 130.1(b) – The purpose of this exception is to exempt licensed healthcare facilities from compliance with this code section. This exception is necessary because licensed healthcare facilities are being brought into the scope of the Energy Code for the first time, but this section has been identified as duplicating, and potentially conflicting, with existing requirements for healthcare facilities contained in *California Electrical Code* Article 517.



Manual Dimmer – Section 130.1(b) of the Energy Code describes when manual multilevel controls like dimmers are required for nonresidential spaces.
Source: California Energy Commission

130.1(c)1 and 2

Shut-OFF Controls

CHANGE TYPE: Clarification and Addition

CHANGE SUMMARY: Automatic shut-off control requirements were clarified, and exceptions were removed, and new exceptions were added.

2019 CODE:

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

EXCEPTION to Section 130.1(c): Healthcare facilities.

1. In addition to lighting controls installed to comply with Sections 130.1(a) 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 to Section 130.1(c)1C: In the following function areas the area controlled may not exceed 20,000 square feet: malls, auditoriums, single tenant retail, industrial, convention centers, and arenas.

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

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

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

   EXCEPTION 2 to Section 130.1(c)1: Lighting complying with Section 130.1(c)5 or 7.

   EXCEPTION 3 to Section 130.1(c)1: Up to 0.1 watts per square foot of lighting in any area within a building may be continuously illuminated, provided that the area is designated for means of egress on the plans and specifications submitted to the enforcement agency under Section 10-103(a)2 of Part 1.

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

   EXCEPTION 5 to Section 130.1(c)1: 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.

2. Countdown timer switches ~~shall not~~may be used to comply with the automatic shut-OFF control requirements in Section 130.1(c)1 only in closets less than 70 square feet, and server aisles in server rooms. The maximum timer setting shall be 10 minutes for closets, and 30 minutes for server aisles.

~~**EXCEPTION 1 to Section 130.1(c)2:** Single-stall bathrooms less than 70 square feet, and closets less than 70 square feet may use countdown timer switches with a maximum setting capability of ten minutes to comply with the automatic shut-Off requirements.~~

~~**EXCEPTION 2 to Section 130.1(c)2:** Lighting in a Server Aisle in a Server Room, as defined in Section 100.1, may use countdown timer switches with a maximum setting capability of 30 minutes to comply with the automatic shut-OFF requirements.~~

[…]

EXCEPTION 2 to Section 130.1(c): 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.

CHANGE SIGNIFICANCE: Section 130.1(c) – The change to this section adds an explanatory sentence to its header for consistency with the other subsections of Section 130.1.

Exception to Section 130.1(c) – The purpose of this exception is to exempt licensed healthcare facilities from the shut-off control requirements. This exception is necessary because licensed healthcare facilities are included in the scope of the Energy Code for the first time, and this section is identified as having the potential to interfere with the primary health and safety responsibilities of healthcare facilities.

Section 130.1(c)1 – The purpose of the change is to expressly permit automatic time-switch controls to operate in manual-on mode. This change is necessary to clarify that manual-on can be utilized for the operation of the building space. Manual-on behavior can produce energy savings since lighting will not turn on until the control is activated manually by building occupants. This will reduce the amount of time that indoor lighting is on when the space is unoccupied.

Section 130.1(c)2 – The change to this section incorporates the two exceptions directly into the section language. Exceptions 1 and 2 to Section 130.1(c)2 were removed to accommodate this change. This change clarifies without materially altering the requirements.

Exception 2 to Section 130.1(c) – The purpose of the addition of this exception is to align the shut-off control requirements of Section 130.1(c) with the minimum egress illumination requirements of the *California Building Code*.

130.1(c)5

Shut-OFF Controls

CHANGE TYPE: Addition

CHANGE SUMMARY: Restrooms are now required to have occupant sensing controls.

2019 CODE:

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

[…]

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

In areas required by Section 130.1(b) to have multilevel lighting controls, the occupant sensing controls shall function either as a:

A. Partial-ON Occupant Sensor capable of automatically activating between 50–70 percent of controlled lighting power, or

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

In areas not required by Section 130.1(b) to have multilevel lighting controls, the occupant sensing controls shall function either as a:

A. Occupant Sensor; or

B. Partial-ON Occupant Sensor, or

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

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

CHANGE SIGNIFICANCE: The change to this section adds restrooms to the areas required to have occupancy sensing controls. This change is responsive to advances in occupant sensing control technology that accurately determines occupancy even with the presence of restroom stalls and is consistent with a finding that automatic shut-off controls in restrooms has a greater potential for energy savings than dimming controls. This change also aligns with requirements in ASHRAE 90.1-2016.

130.1(d)

Automatic Daylighting Controls

CHANGE TYPE: Clarification and Addition

CHANGE SUMMARY: Automatic daylighting control requirements were restructured for clarity, and new exceptions were added.

2019 CODE:

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

~~1. Daylit Zones shall be defined as follows:~~

~~A. **SKYLIT DAYLIT ZONE** is the rough area in plan view under each skylight, plus 0.7 times the average ceiling height in each direction from the edge of the rough opening of the skylight, minus any area on a plan beyond a permanent obstruction that is taller than the following: A permanent obstruction that is taller than one-half the distance from the floor to the bottom of the skylight. The bottom of the skylight is measured from the bottom of the skylight well for skylights having wells, or the bottom of the skylight if no skylight well exists.~~

~~For the purpose of determining the skylit daylit zone, the geometric shape of the skylit daylit zone shall be identical to the plan view geometric shape of the rough opening of the skylight; for example, for a rectangular skylight the skylit daylit zone plan area shall be rectangular, and for a circular skylight the skylit daylit zone plan area shall be circular.~~

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

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

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

~~2. Luminaires providing general lighting that are in or are partially in the Skylit Daylit Zones or the Primary Sidelit Daylit Zones shall be controlled independently by fully functional automatic~~

~~daylighting controls that meet the applicable requirements of~~ Section 110.9, and the applicable requirements below:

~~A~~1. All ~~S~~skylit ~~D~~daylit ~~Z~~zones and ~~P~~primary ~~S~~sidelit ~~D~~daylit ~~Z~~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.

~~B~~2. ~~Luminaires in the Skylit Daylit Zone shall be controlled separately from those in the Primary Sidelit Daylit Zones.~~The automatic daylighting controls shall provide separate control for luminaires in each type of daylit zone. ~~C.~~ Luminaires that fall in both a ~~S~~skylit and ~~Primary~~ ~~S~~sidelit ~~D~~daylit ~~Z~~zone shall be controlled as part of the ~~S~~skylit ~~Daylit~~ ~~Z~~zone.

~~D~~3. ~~**Automatic Daylighting Control Installation and Operation.**~~ ~~For luminaires in daylight zones,~~ The automatic daylighting controls shall ~~be installed and configured to operate according to all of the following requirements~~:

~~i. Photosensors shall be located so that they are not readily accessible to unauthorized personnel. The location where calibration adjustments are made to automatic daylighting controls shall be readily accessible to authorized personnel and may be inside a locked case or under a cover which requires a tool for access~~.

~~ii~~A. For spaces required to install multilevel controls under Section 130.1(b), adjust lighting via continuous dimming or ~~Automatic daylighting controls shall provide functional multilevel lighting having at least~~ the number of control steps ~~specified in TABLE 130.1-A~~provided by the multilevel controls;~~.~~

~~EXCEPTION 1 to Section 130.1(d)2Dii: Controlled lighting having a lighting power density less than 0.3 W/ft2 is not required to provide multilevel lighting controls.~~

~~iii~~B. For each space, ensure the combined illuminance from the controlled lighting and daylight ~~shall~~ is not ~~be~~ less than the illuminance from controlled lighting when no daylight is available;~~.~~

~~iv~~C. ~~In areas served by lighting that is daylight controlled~~For areas other than parking garages, ensure that, when the daylight illuminance is greater than 150 percent of the design illuminance received from the general lighting system at full power, the general lighting power in that daylight zone shall be reduced by a minimum of 65 percent;~~.~~ and

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

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

5. The location where calibration adjustments are made to the automatic daylighting controls shall be readily accessible to authorized personnel but may be inside a locked case or under a cover which requires a tool for access.

EXCEPTION 1 to Section 130.1(d): 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 8 a.m. and 4 p.m.

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

EXCEPTION 3 to Section 130.1(d): Rooms in which the combined total installed general lighting power in the Skylit Daylit Zone and Primary Sidelit Daylit Zone is less than 120 Watts, or parking garage areas where the total combined general lighting power in the sidelit daylight zones is less than 60 watts.

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

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

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

~~**EXCEPTION 1 to Section 130.1(d)2:** Rooms in which the combined total installed general lighting power in the Skylit Daylit Zone and Primary Sidelit Daylit Zone is less than 120 Watts.~~

~~**EXCEPTION 2 to Section 130.1(d)2:** Rooms that have a total glazing area of less than 24 square feet.~~

~~**EXCEPTION 3 to Section 130.1(d)2:** Parking garages complying with Section 130.1(d)3.~~

~~3. **Parking Garage Daylighting Requirements.** In a parking garage area with a combined total of 36 square feet or more of glazing or opening, luminaires providing general lighting that are in the combined primary and secondary sidelit daylit zones shall be controlled independently from other lighting in the parking garage by automatic daylighting controls, and shall meet the following requirements as applicable:~~

~~A. All primary and secondary sidelit daylit zones shall be shown on the plans.~~

~~B. Automatic Daylighting Control Installation and Operation. Automatic daylighting control shall be installed and configured to operate according to all of the following requirements:~~

~~i. Automatic daylighting controls shall have photosensors that are located so that they are not readily accessible to unauthorized personnel. The location where calibration adjustments are made to the automatic daylighting controls shall be readily accessible to authorized personnel but may be inside a locked case or under a cover which requires a tool for access.~~

~~ii. Automatic daylighting controls shall be multilevel, continuous dimming or ON/OFF.~~

~~iii. The combined illuminance from the controlled lighting and daylight shall not be less than the illuminance from controlled lighting when no daylight is available.~~

~~iv. When illuminance levels measured at the farthest edge of the secondary sidelit zone away from the glazing of opening are greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power consumption shall be zero.~~

~~**EXCEPTION 1 to Section 130.1(d)3:** Luminaires located in the daylight transition zone and luminaires for only dedicated ramps. Daylight transition zone and dedicated ramps are defined in Section 100.1.~~

~~**EXCEPTION 2 to Section 130.1(d)3:** The total combined general lighting power in the primary sidelit daylight zones is less than 60 watts.~~

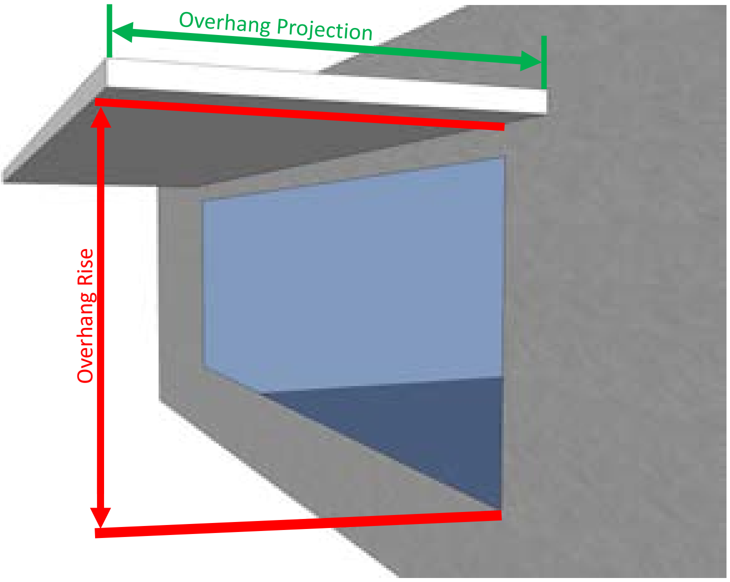
CHANGE SIGNIFICANCE: Section 130.1(d) – The purpose of the changes to this section are to improve the readability and enhance clarity, to amend the requirement for all photosensors to be located so that they are not readily accessible, and to add exceptions to address circumstances where daylighting may not be effective.

The definitions for “Skylit Daylit Zone,” “Primary Sidelit Daylit Zone,” and “Secondary Sidelit Daylit Zone,” were relocated to Section 100.1.

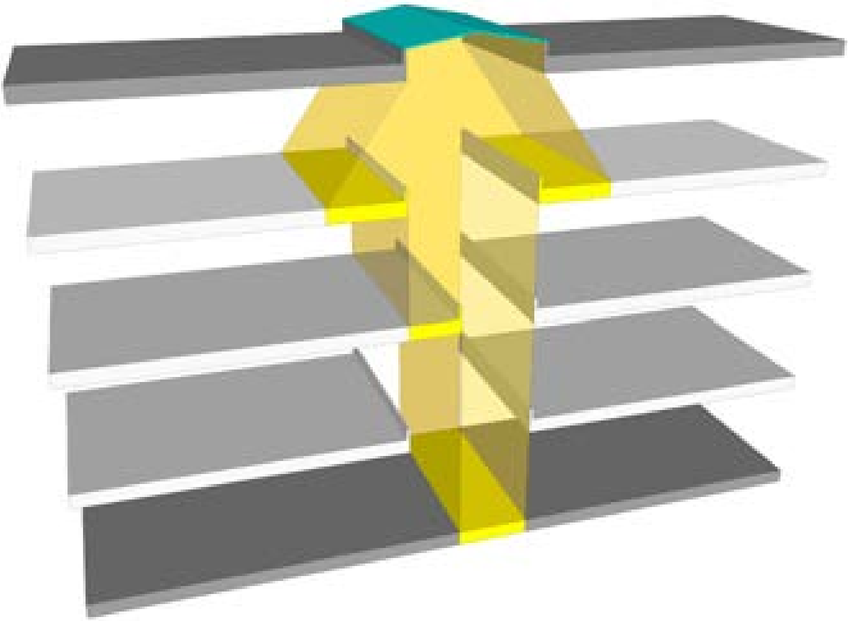
Section 130.1(d)4 – This change specifies that at least one photosensor shall be located so that they are not readily accessible to unauthorized personnel, rather than all photosensors. This change is necessary to prevent inadvertently restricting or prohibiting lighting products that include an integrated photosensor.

Exceptions 1 and 2 to Section 130.1(d) – The purpose of adding these two exceptions is to address scenarios with limited access to direct sunlight. In buildings with large overhangs or nearby obstructions which block direct access to sunlight, the daylit zone will receive a significantly reduced amount of daylighting. Adding Exceptions 1 and 2 is necessary to prevent daylighting controls from being installed where it may not be utilized effectively.

Exception 6 to Section 130.1(d) – The purpose of adding this exception is to address the need for uniform lighting in merchandise sales and wholesale showroom areas. This exception is necessary to address concerns regarding lighting gradients where merchandise is displayed in a sidelit daylit area.



Overhangs – Overhangs can limit the amount of daylight that enters a space. For South, East, and West-facing fenestration, if the overhang projection-to-rise ratio is 1.5 or greater, the area adjacent to that fenestration is exempt from the daylighting control requirements. For north-facing fenestration, these areas are exempt if the overhang projection-to-rise ratio is 1.0 or greater. This is detailed in Exception 2 to Section 130.1(d) of the Energy Code.
Source: California Energy Commission



Atriums – New language was added to clarify which areas are considered daylit zones and are subject to daylighting control requirements.
Source: Kevin Mouayang, California Energy Commission

130.1(e)

Demand Responsive Controls

CHANGE TYPE: Modification

CHANGE SUMMARY: Demand responsive control requirements were relocated to Section 110.12.

2019 CODE:

(e) **Demand Responsive Controls.** <u>See Section 110.12 for requirements for demand responsive lighting controls.</u>

1. ~~foot or less, shall be capable of automatically reducing lighting power in response to a Demand Response Signal; so that the total lighting power of non-excluded spaces can be lowered by a minimum of 15 percent below the total installed lighting power when a Demand Response Signal is received. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in TABLE 130.1-A.~~

~~**EXCEPTION to Section 130.1(e):** Lighting not permitted by a health or life safety statute, ordinance, or regulation to be reduced shall not be counted toward the total lighting power.~~

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

CHANGE SIGNIFICANCE: The purpose of the change to this section is to consolidate all demand response requirements into a single section. The demand response requirements have been relocated to Section 110.12.

130.1(f)

Control Interactions

CHANGE TYPE: Addition

CHANGE SUMMARY: This new section was added to specify requirements for lighting control interactions.

2019 CODE:

(f) **Control Interactions.** Each lighting control installed to comply with Section 130.1 shall permit or incorporate the functions of the other lighting controls required by this section.

1. 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 Section 130.1(b), (c), (d), and (e).
2. The manual area control shall permit the shutoff control to turn the lighting down or off.
3. The multilevel 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.
4. The multilevel 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.
5. The shutoff control shall permit the manual area control to turn the lighting on. If the on request occurs while an automatic time switch control would turn the lighting off, then the on request shall be treated as an override request consistent with Section 130.1(c)3.
6. The automatic daylighting control shall permit the multilevel lighting control to adjust the level of lighting.
7. For lighting controlled by multilevel 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.

CHANGE SIGNIFICANCE: The purpose of adding this section is to clarify the expected interactions between the lighting controls required by Section 130.1. This section provides specific requirements for the interactions of the mandatory lighting control requirements. This is necessary to ensure that all of the lighting controls are installed and operating in accordance with the requirements of the Energy Code, to prevent control operation from becoming antagonistic, to prevent confusion on the part of the lighting system designer or installer, and to ensure complete control of the lighting system is available to building operators.

130.2(a)

Reserved

CHANGE TYPE: Modification

CHANGE SUMMARY: Motion sensor requirements specific to outdoor incandescent lighting were no longer relevant, and thus were removed.

2019 CODE:

(a) **RESERVED**~~**Outdoor Incandescent Lighting.** All outdoor incandescent luminaires rated over 100 watts, determined in accordance with Section 130.0(c)2, shall be controlled by a motion sensor.~~

CHANGE SIGNIFICANCE: The purpose of this change is to remove the motion sensor requirement applicable to outdoor incandescent lighting. This requirement is redundant with the motion sensor requirements applicable to all lighting in Section 130.2(c).

130.2(b)

Luminaire Cutoff Requirements

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: Redundant language that is included in the Green Code was removed, and the trigger for outdoor luminaire cutoff requirements was modified.

2019 CODE:

(b) **Luminaire Cutoff Requirements.** All outdoor luminaires of 6,200 initial luminaire lumens or greater~~rated for use with lamps greater than 150 lamp watts, determined in accordance with Section 130.0(c)~~, shall comply with Backlight, Uplight, and Glare (collectively referred to as "BUG" in accordance with IES TM-15-11, Addendum A) requirements as follows:

1. Maximum zonal lumens for Backlight, Uplight, and Glare shall be in accordance with Title 24, Part 11, Section 5.106.8~~There are no Backlight requirements in Section 130.2 of Part 6; and~~
2. ~~Maximum zonal lumens for Uplight shall be in accordance with TABLE 130.2-A; and~~
3. ~~Maximum zonal lumens for Glare shall be in accordance with TABLE 130.2-B~~.

~~**NOTE:** Title 24, Part 11, Section 5.106.8 includes additional restrictions on backlight, uplight and glare that may apply.~~

EXCEPTION 1 to Section 130.2(b): Signs.

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

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

EXCEPTION 4 to Section 130.2(b): Temporary outdoor lighting.

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

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

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

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

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

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

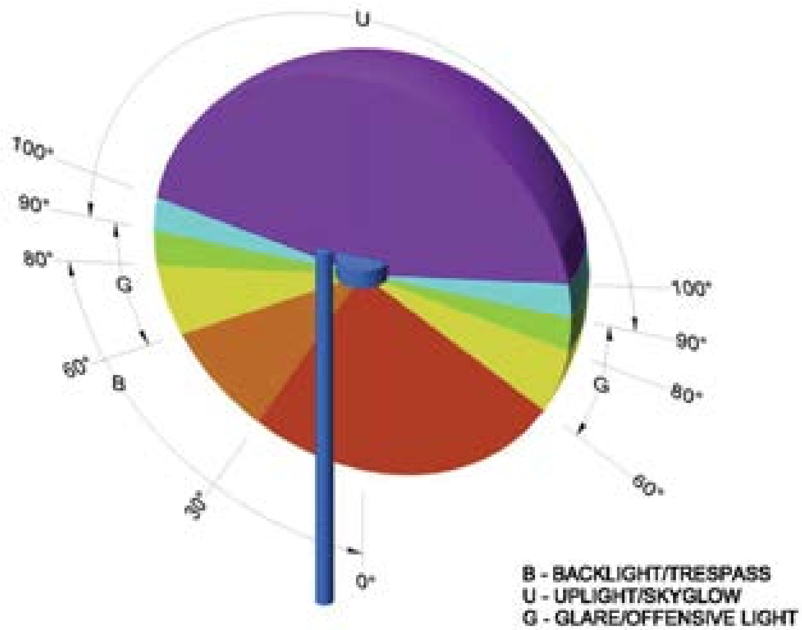
EXCEPTION 6 to Section 130.2(b): Luminaires that illuminate the public right of way on publicly maintained roadways, sidewalks, and bikeways.

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

CHANGE SIGNIFICANCE: Section 130.2(b), Tables 130.2-A and -B – The purpose of the change to this section and its associated tables is to remove language that is redundant with the requirements contained in the referenced section of the *California Green Building Standards Code* (CALGreen). The CALGreen Code contains the maximum allowable backlight, uplight, and glare requirements that were previously included in this section.

The trigger for outdoor luminaire cutoff requirements was changed from a wattage threshold to an initial lumens threshold. Outdoor luminaires rated at 6,200 initial lumens or greater must now meet cutoff requirements. This change is necessary to account for LED technology and ensure technology neutrality in this section's application.

Exception 7 to Section 130.2(b) – The purpose of adding this exception is to clarify that outdoor lighting attached to a high-rise residential or hotel/motel building falls under the low-rise residential lighting requirements as specified in Section 130.0(b). This exception restates existing language in Section 130.0(b)2, and is added to clarify how the requirements apply, and to prevent nonresidential controls from being installed in low-rise residential lighting applications.



Backlight, Uplight, and Glare Ranges
Source: California Energy Commission, 2019 Nonresidential Compliance Manual

130.2(c)

Controls for Outdoor Lighting

CHANGE TYPE: Clarification, Addition, and Modification

CHANGE SUMMARY: Language for outdoor lighting controls was modified and rewritten for clarity, and exceptions were modified and added to account for LED lighting.

2019 CODE:

(c) **Controls for Outdoor Lighting.** Outdoor lighting ~~controls~~ shall be independently controlled from other electrical loads, and the controls for outdoor lighting shall ~~installed that~~ meet the following functional requirements: ~~as applicable:~~

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

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

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

2. **Automatic Scheduling Controls.**

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

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

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

3. **Motion Sensing Controls.**

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

   B. 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.

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

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

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

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

~~All installed outdoor lighting shall be independently controlled from other electrical loads by an automatic scheduling control.~~

~~3. All installed outdoor lighting, where the bottom of the luminaire is mounted 24 feet or less above the ground, shall be controlled with automatic lighting controls that meet all of the following requirements:~~

~~A. Shall be motion sensors or other lighting control systems that automatically controls lighting in accordance with Item B in response to the area being vacated of occupants; and~~

~~B. Shall be capable of automatically reducing the lighting power of each luminaire by at least 40 percent but not exceeding 90 percent, or provide continuous dimming through a range that includes 40 percent through 90 percent, and~~

~~C. Shall employ auto-ON functionality when the area becomes occupied; and~~

~~D. No more than 1,500 watts of lighting power shall be controlled together.~~

~~**EXCEPTION 1 to Section 130.2(c)3:** Lighting for Outdoor Sales Frontage complying with Section 130.2(c)4.~~

~~**EXCEPTION 2 to Section 130.2(c)3:** Lighting for Building Facades, Ornamental Hardscape and Outdoor Dining complying with Section 130.2(c)5.~~

~~EXCEPTION 3~~ 1 to Section 130.2(c)3:, ~~Outdoor lighting, where luminaire rated wattage is determined in accordance with Section 130.0(c), and which meet one of the following conditions:~~

~~A. Pole-mounted luminaires each with a maximum rated wattage of 75 watts; or~~

~~B. Non-pole mounted l~~Luminaires with a maximum rated wattage of 30 40 watts each are not required to have motion sensing controls~~;~~ ~~or~~

~~C. Linear lighting with a maximum wattage of 4 watts per linear foot of luminaire~~.

EXCEPTION ~~4~~ 2 to Section 130.2(c)3: Applications listed as Exceptions to Section 140.7(a) ~~shall not be required to meet the requirements of Section 130.2(c)3~~are not required to have motion sensing controls.

EXCEPTION 3 to Section 130.2(c)3: 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.

~~4. For Outdoor Sales Frontage lighting, an automatic lighting control shall be installed that meets the following requirements:~~

~~A. A part-night outdoor lighting control as defined in Section 100.1; or~~

~~B. Motion sensors capable of automatically reducing lighting power by at least 40 percent but not exceeding 90 percent, and which have auto-ON functionality.~~

~~5. For Building Facade, Ornamental Hardscape and Outdoor Dining lighting, an automatic lighting control shall be installed that meets one or more of the following requirements:~~

~~A. A part-night outdoor lighting control as defined in Section 100.1; or~~

~~B. Motion sensors capable of automatically reducing lighting power by at least 40 percent but not exceeding 90 percent, and which have auto-ON functionality; or~~

~~C. A centralized time-based zone lighting control capable of automatically reducing lighting power by at least 50 percent.~~

~~D. Outdoor wall mounted luminaires having a bilaterally symmetric distribution as described in the IES Handbook (typically referred to as "wall packs") where the bottom of the luminaire is mounted 24 feet or less above the ground shall comply with the applicable requirements in Section 130.2(c)3.~~

CHANGE SIGNIFICANCE: Section 130.2(c) – The purpose of the changes to this section, its subsections, and exceptions, is to improve readability by reorganizing the requirements in an itemized format so that Section 130.2(c)1 is about daylight availability, Section 130.2(c)2 is about automatic time-switch controls, and Section 130.2(c)3 is about motion sensing controls. Subsections specific to outdoor sales frontage, building façade, ornamental hardscape, and outdoor dining lighting applications were removed. These lighting applications are now subject to the general control requirements applicable to all outdoor lighting applications.

Section 130.2(c)2 – The purpose of the change to this section is to clarify and simplify the section's layout and phrasing. The term "automatic scheduling control" is used in place of the prior term "part-night control," and its required behavior is specified in the section rather than in a separate definition. The language has been updated to clearly state that the ability to reduce the lighting power and the ability to turn lighting off are separate and distinct requirements.

Section 130.2(c)3 – The purpose of the change to this section is to clarify and simplify the section's layout and phrasing, to provide language that states that the controls may be installed in combination with other lighting controls.

Exception 1 to Section 130.2(c)3 – The purpose of the change to this exception is to reduce wattage thresholds for the motion sensor requirements for outdoor lighting. This change was made to account for low-wattage LED lighting, and applies to all outdoor luminaires that are rated at 40 watts or less, rather than specifying separate wattage thresholds for different types of outdoor luminaires, thus simplifying the requirements.

Exception 2 to Section 130.2(c)3 – The purpose of the change to this exception is to more clearly state its purpose and application, using language consistent with the language added to Exception 1. The change clarifies without materially altering the requirements.

Exception 3 to Section 130.2(c)3 – The purpose of the change to this exception is to add an exception consistent with Exception 3 to Section 130.2(b), and with similar exceptions for demand responsive controls. Adding the exception is necessary to ensure consistency in addressing circumstances where health or life safety statutes, ordinances, or regulations apply to outdoor lighting.

Getty Images

Outdoor Pole Lighting – Pole lighting is subject to automatic shutoff control and reduction of power requirements, depending on the application, per Section 130.2(c) of the Energy Code.

130.3

Sign Lighting Controls

CHANGE TYPE: Clarification, Addition, and Modification

CHANGE SUMMARY: Language was added to exclude exit signs and healthcare facilities from the sign lighting control requirements.

2019 CODE:

Nonresidential buildings other than healthcare facilities, high-rise residential buildings, and hotel/motel buildings shall comply with the applicable requirements of Sections 130.3(a)1 through 130.3(a)3.

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

1. **Indoor Signs.** All indoor sign lighting other than exit sign lighting shall be controlled with an automatic time-switch control or astronomical time-switch control.
2. **Outdoor Signs.** Outdoor sign lighting shall meet the following requirements as applicable:
   A. All outdoor sign lighting shall be controlled with a photocontrol in addition to an automatic time-switch control, or an astronomical time-switch control.

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

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

   EXCEPTION to Section 130.3(a)2B: 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.~~An Electronic Message Center (EMC) having a new connected lighting power load greater than 15 kW shall have a control installed that is capable of reducing the lighting power by a minimum of 30 percent when receiving a demand response signal.~~

   ~~**EXCEPTION to Section 130.3(a)3:** Lighting for EMCs that is not permitted by a health or life safety statute, ordinance, or regulation to be reduced by 30 percent.~~

CHANGE SIGNIFICANCE: The purpose of the change to this section is to exempt licensed healthcare facilities from compliance with sign lighting control requirements. This exception is necessary because licensed healthcare facilities are now included in the scope of the Energy Code. This section has been identified as having the potential to interfere with the primary health and safety responsibilities of healthcare facilities since sign lighting is necessary for directing emergency response, and where delay or confusion could harm patients.

Section 130.3(a)1 – The purpose of the change to this section is to exclude exit sign lighting from requirements for sign lighting to be controlled by time-switch controls. This clarification is necessary to prevent time-switch controls from shutting off exit sign illumination while occupants are still present in the building.

Section 130.3(a)3 – The purpose of the change to this section is to relocate demand response requirements for electronic message centers to Section 110.12. This is consistent with the effort to consolidate all demand response requirements in a single section.

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Exit Signs – Exit signs are excluded from the sign lighting control requirements of the Energy Code.

130.4

Lighting Control Acceptance and Installation Certificate Requirements

CHANGE TYPE: Clarification and Addition

CHANGE SUMMARY: Acceptance and installation documentation requirements for healthcare facilities were clarified, and requirements that were no longer relevant were removed.

2019 CODE:

Nonresidential buildings other than healthcare facilities, high-rise residential buildings, and hotel/motel buildings shall comply with the applicable requirements of Sections 130.4(a) through 130.4(c). Healthcare facilities shall comply with the applicable acceptance and installation documentation requirements of OSHPD.

[…]

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

[…]

3. ~~Certification that line-voltage track lighting integral current limiters comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.3.~~**Reserved**
4. ~~Certification that line-voltage track lighting supplementary overcurrent protection panels comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.4.~~**Reserved**

CHANGE SIGNIFICANCE: The purpose of the change to this section is to ensure consistency with inspection and documentation requirements for healthcare facilities overseen by the California Office of Statewide Health Planning and Development (OSHPD). The change clarifies without altering the requirements.

Section 130.4(b) – The purpose of the change to this section is to remove language requiring installation certificates for line-voltage track lighting current limiters and over-current protection panels. Classification of luminaire power requirements for line-voltage track lighting has been simplified in Section 130.0(c). Certificates of Installation are no longer necessary for verification of these devices.

130.5

Electrical Power Distribution Systems

CHANGE TYPE: Addition and Modification

CHANGE SUMMARY: Language was added to exempt healthcare facilities from the electrical power distribution requirements, and the demand response requirements were relocated to Section 110.12.

2019 CODE:

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

(a) **Service Electrical Metering.** Each electrical service or feeder shall have a permanently installed metering system which measures electrical energy use in accordance with TABLE 130.5-A.

> **EXCEPTION 1 to Section 130.5(a):** Service or feeder for which the utility company provides a metering system that indicates instantaneous kW demand and kWh for a utility-defined period.
>
> **EXCEPTION 2 to Section 130.5(a):** Electrical power distribution systems subject to *California Electrical Code* Article 517.

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

> **EXCEPTION 1 to Section 130.5(b):** For each separate load type, up to 10 percent of the connected load may be of any type.
>
> **EXCEPTION 2 to Section 130.5(b):** Electrical power distribution systems subject to *California Electrical Code* Article 517.
>
> […]

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

[…]

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

(e) **Demand responsive controls and equipment.** See Section 110.12 for requirements for demand responsive controls and equipment.~~Demand responsive controls and equipment, where installed, shall be capable of receiving and automatically responding to at least one standards-based messaging protocol which enables demand response after receiving a demand response signal.~~

CHANGE SIGNIFICANCE: Section 130.5(a), and (b), and Exception 2 to Section 130.5(d) – The purpose of the changes to these sections is to exempt licensed healthcare facilities from compliance with the service metering, separation of electrical circuits, and controlled receptacle requirements. These exceptions are necessary because licensed healthcare facilities are now within the scope of the Energy Code. These sections have been identified as duplicating, and potentially conflicting, with existing requirements for healthcare facilities contained in the *California Electrical Code*, Article 517.

Section 130.5(e) – The purpose of the change to this section is to relocate demand response requirements into Section 110.12. This is consistent with the effort to consolidate all demand response requirements into a single section.

PART 5

Nonresidential, High-Rise Residential and Hotel/Motel Occupancies—Performance and Prescriptive Compliance Approaches for Achieving Energy Efficiency

Subchapter 5

Subchapter 5 defines the prescriptive and performance compliance approaches and establishes prescriptive requirements that are applicable to all buildings regulated by the Energy Code except low-rise residential buildings. This includes high-rise residential, nonresidential, hotel/motel buildings, and covered processes. This subchapter spans from Section 140.0 through 140.9. These sections establish all performance and prescriptive requirements for these buildings.

Sections 140.0 through 140.2 establish the performance and prescriptive compliance approaches, energy budgets, and designate Sections 140.3–140.9 as the sections that define prescriptive compliance with the Energy Code for nonresidential, high-rise residential, hotel/motel buildings, and covered processes.

Section 140.3 establishes prescriptive envelope requirements for building envelopes, including roofing product, insulation, fenestration, doors, air barriers, and requirements for relocatable public school buildings. Section 140.4 establishes prescriptive HVAC sizing, control, and efficiency requirements. Section 140.5 is where prescriptive water heating requirements are located. Sections 140.6 through 140.8 establish prescriptive requirements for indoor and outdoor lighting systems, and signs. Section 140.9 establishes prescriptive requirements for covered processes, including computer rooms, commercial kitchens, and laboratory and factory exhaust systems. ■

140.3

Prescriptive Requirements for Building Envelopes

140.3(a)

Envelope Component Requirements

140.3

Prescriptive Requirements for Building Envelopes – Sizing

140.3(d)

Daylighting Design Power Adjustment Factors (PAFs)

140.4

Prescriptive Requirements for Space Conditioning Systems

140.4(a) and (b)

Sizing and Equipment Selection, Calculations

140.4(c)

Fan Systems

140.4(d)

Space-Conditioning Zone Controls

140.4(e)

Economizers

140.4(f)

Supply Air Temperature Reset Controls

140.4(g)

Electric Resistance Heating

140.4(h)

Heat Rejection Systems

140.4(j)

Limitation of Air Cooled Chillers

140.4(k)4

Hydronic System Measures

140.4(l)

Air Distribution System Duct Leakage Sealing

140.4(m)

Fan Control

140.4(n)

Mechanical System Shut-off

140.6

Prescriptive Requirements for Indoor Lighting

140.6(a)

Calculation of Adjusted Indoor Lighting Power

140.6(a)1

Two Interlocked Systems

140.6(a)2

Reduction of Wattage Through Controls

140.6(a)3

Lighting Wattage Excluded

140.6(a)4

Luminaire Classification and Power Adjustment

140.6(c)

Calculation of Allowed Indoor Lighting Power: Specific Methodologies

140.6(c)2

Area Category Method

140.6(c)3

Tailored Method

140.6(d)

Automatic Daylighting Controls in Secondary Daylit Zones

140.7

Prescriptive Requirements for Outdoor Lighting

TABLES 140.7-A and 140.7-B

Lighting Power Allowances

140.8

Prescriptive Requirements for Signs

140.8(b)

Alternate Lighting Sources

140.9

Prescriptive Requirements for Covered Processes

140.9(a)

Prescriptive Requirements for Computer Rooms

140.9(b)

Prescriptive Requirements for Kitchens

140.9(c)

Prescriptive Requirements for Laboratory and Factory Exhaust Systems

140.3(a)

Envelope Component Requirements

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: Requirements for fenestration in demising walls were modified to only require maximum *U*-factor efficiency values.

2019 CODE:

(a) **Envelope Component Requirements.**

[…]

3. **Demising Walls.** Demising walls shall meet the requirements of Section 120.7(b)7. <u>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 140.3-B, C or D.</u>

   […]

   <u>**NOTE:** Demising walls are not exterior walls, and therefore windows in demising walls are not subject to SHGC requirements.</u>

   […]

   <u>**NOTE:** Demising walls are not exterior walls, and therefore windows in demising walls are not subject to VT requirements.</u>

CHANGE SIGNIFICANCE: Windows in demising walls that separate conditioned space from unconditioned space must continue to meet the fenestration *U*-factor requirements in prescriptive Table 140.3-B, C, or D. Windows in demising walls do not have to meet the requirements for solar heat gain coefficient (SHGC) or visible transmittance (VT), as they do not experience the same solar exposure as windows in exterior walls.

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Fenestration in Demising Walls – This fenestration no longer has SHGC or VT requirements.

140.3(d)

Daylighting Design Power Adjustment Factors (PAFs)

CHANGE TYPE: Addition

CHANGE SUMMARY: The purpose of the addition of this section and its associated table and equation is to provide power adjustment factors (PAFs) for clerestory fenestration, horizontal slats, and light shelves that may have the effect of reducing electrical lighting loads by increasing use of natural daylight.

2019 CODE:

(d) **Daylighting Design Power Adjustment Factors (PAFs).** To qualify for a Power Adjustment Factor (PAF) as specified in Section 140.6(a)2L, daylighting devices shall meet the following requirements:

1. **Clerestory Fenestration.** To qualify for a PAF, clerestory fenestration shall meet the following requirements:
   A. Shall be installed on east-, west-, or south-facing facades.
   B. Shall have a head height that is at least 10 feet above the finished floor.
   C. Shall have a glazing height that is greater than or equal to 10 percent of the head height.
   D. If operable shading is installed on the clerestory fenestration, then the clerestory fenestration shading shall be controlled separately from shading serving other vertical fenestration.
2. **Interior and Exterior Horizontal Slats.** To qualify for a PAF, horizontal slats shall meet the following requirements:
   A. Shall be installed adjacent to vertical fenestration on east- or west-facing facades with Window Wall Ratios between 20 and 30 percent, and extend to the entire height of the vertical fenestration.
   B. Exterior horizontal slats shall be level or sloped downwards from fenestration. Interior horizontal slats shall be level or sloped upwards from fenestration.
   C. Shall have a projection factor as specified in Table 140.3-E. The projection factor is calculated using EQUATION 140.3-E.
   D. Shall have a minimum Distance Factor of 0.3. The distance factor is calculated using EQUATION 140.3-E.

      EXCEPTION to Section 140.3(d)2D: Where it is documented that existing adjacent structures or natural objects within view of the vertical fenestration block direct sunlight onto the vertical fenestration between 8 a.m. and 5 p.m. for less than 500 daytime hours per year.

   E. Shall have a minimum Visible Reflectance of 0.50 when tested as specified in ASTM E903.
   F. Shall be opaque.

      EXCEPTION to Section 140.3(d)2F: Horizontal slats with a Visible Transmittance of 0.03 or less when tested as specified in ASTM E1175.

   G. Shall be permanently mounted and not adjustable.

H. Shall extend beyond each side of the window jamb by a distance equal to or greater than their horizontal projection.

EXCEPTION to Section 140.3(d)2H: Where the slats are located entirely within the vertical fenestration's rough opening or a fin is located at the window jambs and extends vertically the entire height of the window jamb and extends horizontally the entire depth of the projection.

I. Shall be shown on the plans with the dimensions for the slat projection and slat spacing as specified in EQUATION 140.3-E.

J. Shall have a conspicuous factory installed label permanently affixed and prominently located on an attachment point of the device to the building envelope, stating the following: "NOTICE: Removal of this device will require re-submittal of compliance documentation to the enforcement agency responsible for compliance with California Title 24, Part 6".

3. **Interior and Exterior Light Shelves.** To qualify for a PAF, light shelves shall meet the following requirements:

A. Where there is vertical fenestration area below the light shelf, both interior and exterior light shelves shall be installed.

B. Shall be installed adjacent to clerestory fenestration on south-facing facades with Window Wall Ratios greater than 30 percent. The head height of the light shelves shall be no more than one foot below the finished ceiling. The clerestory fenestration shall meet the requirements of Section 140.3(d)1.

C. Shall be level or sloped based on their installation. Exterior light shelves shall be level or sloped downwards from fenestration. Interior light shelves shall be level or sloped upwards from fenestration.

D. Shall have a projection factor of the applicable value as specified in Table 140.3-E. The light shelf projection factor is calculated using EQUATION 140.3-E.

E. Shall have a minimum Distance Factor of 0.3. The distance factor is calculated using EQUATION 140.3-E.

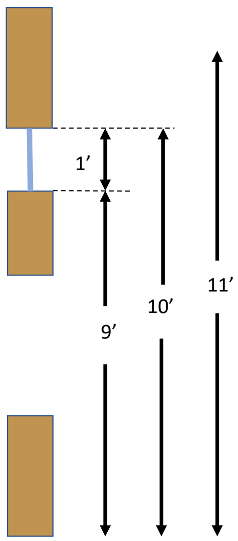
EXCEPTION to Section 140.3(d)3E: Where it is documented that existing adjacent structures or natural objects within view of the vertical fenestration block direct sunlight onto the vertical fenestration between 8 a.m. and 5 p.m. for less than 750 daytime hours per year.

F. Shall have a top surface with a minimum Visible Reflectance of 0.50 when tested as specified in ASTM E903.

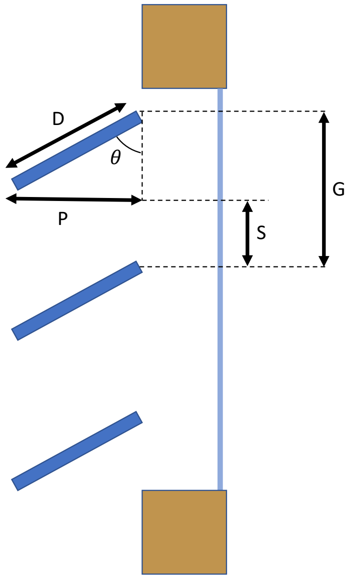
EXCEPTION to Section 140.3(d)3F: Where an exterior light shelf is installed greater than two feet below the clerestory sill.

G. Shall extend beyond each side of the window jamb by a distance equal to or greater than their horizontal projection.

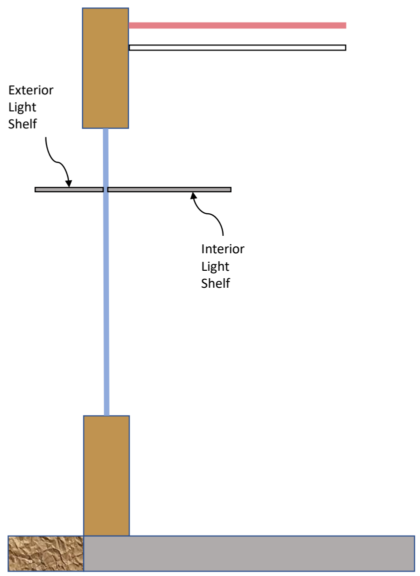
H. Shall be shown on the plans with the dimensions for the light shelf projection and light shelf spacing as specified in EQUATION 140.3-E.



Clerestory – To qualify for a lighting power adjustment factor, clerestory fenestration must meet the requirements of Section 140.6(d)1.
Source: California Energy Commission



Horizontal Slats – To qualify for a lighting power adjustment factor, horizontal slats must meet the requirements of Section 140.6(d)2.
Source: California Energy Commission



Lighting Shelves – To qualify for a lighting power adjustment factor, lighting shelves must meet the requirements of Section 140.6(d)2.
Source: California Energy Commission

TABLE 140.3-E **Daylighting Devices**

DAYLIGHTING DEVICE	ORIENTATION OF THE VERTICAL FENESTRATION	PROJECTION FACTOR
Horizontal Slats	East or West	2.0 to 3.0
Interior Light Shelf	South	1.0 to 2.0
Interior Light Shelf	South	0.25 to 1.25

EQUATION 140.3-E PROJECTION AND DISTANCE FACTOR CALCULATION

Projection Factor = Projection / Spacing

Distance Factor = $D / (H_{AS} \times \text{Projection Factor})$

Where:

Projection = The horizontal distance between the base edge and the projected edge of the slat or light shelf.

Spacing = For horizontal slats, the vertical distance between the projected edge of a slat to the base edge of the slat below

For interior light shelves, the vertical distance between the projected edge of the light shelf and head of the clerestory fenestration above it.

For exterior light shelves, the vertical distance between the projected edge of the light shelf and sill of the vertical fenestration below it.

D = Distance between the existing structure or nature object and the fenestration

H_{AS} = Height difference between the top of the existing structure or nature object and the bottom of the fenestration

NOTE: The base edge is the edge of a slat or light shelf that is adjacent to the vertical fenestration. The projected edge is the opposite edge from the base edge.

CHANGE SIGNIFICANCE: The purpose of the addition of Section 140.3(d), Table 140.3-E, and Equation 140.3-E is to provide power adjustment factors (PAFs) to daylighting equipment that has the effect of reducing electrical lighting loads by increasing use of natural light. The installation of clerestory fenestration, horizontal slats, and light shelves coupled with automatic daylighting controls serving the associated daylit zones can provide indoor lighting energy savings.

140.4(a) and (b)

Sizing and Equipment Selection, Calculations

CHANGE TYPE: Modification

CHANGE SUMMARY: Space conditioning equipment sizing and load calculation requirements were updated for the inclusion of healthcare facilities into the scope of the Energy Code.

2019 CODE:

(a) **Sizing and Equipment Selection.** Mechanical heating and mechanical cooling equipment serving healthcare facilities shall be sized to meet the design heating and cooling loads as calculated according to the subsection (b). Mechanical heating and mechanical cooling equipment serving high-rise residential buildings, hotel/motel buildings and nonresidential buildings other than healthcare facilities, shall be the smallest size, within the available options of the desired equipment line, necessary to meet the design heating and cooling loads of the building, as calculated according to Subsection (b).

[…]

(b) **Calculations.** In making equipment sizing calculations under Subsection (a), all of the following rules shall apply:

~~1. **Methodology.** The methodologies, computer programs, inputs, and assumptions approved by the Commission shall be used.~~

~~2~~1. **Heating and cooling loads.** Heating and cooling system design loads shall be determined in accordance with the procedures described in subsection A or B below:

A. For systems serving high-rise residential buildings, hotel/motel buildings, and nonresidential buildings other than healthcare facilities, the method in the 2017 ASHRAE Handbook, Fundamentals shall be used~~Volume,~~ or as specified in a method approved by the Commission.

B. For system serving healthcare facilities the method in the *California Mechanical Code* shall be used.

~~3~~2. **Indoor design conditions.** Indoor design temperature and humidity conditions for ~~general~~ comfort applications shall be determined in accordance with subsection A or B below:

A. For systems serving high-rise residential buildings, hotel/motel buildings, and nonresidential buildings other than healthcare facilities, ASHRAE Standard 55 or the 2017 ASHRAE Handbook, Fundamentals Volume, ~~Chapter 8,~~ except that winter humidification and summer dehumidification shall not be required.

B. For system serving healthcare facilities the method in Section 320.0 of the *California Mechanical Code* shall be used.

~~4~~3. **Outdoor design conditions.** Outdoor design conditions shall be selected in accordance with subsection A or B below:

A. For systems serving high-rise residential buildings, hotel/motel buildings, and nonresidential buildings other than healthcare facilities the design conditions from Reference Joint Appendix JA2 shall be used, which is based on data from the ASHRAE Climatic Data for Region X. Heating design temperatures shall be no lower than the Heating Winter Median of Extremes values. Cooling design temperatures shall be no greater than the 0.5 percent Cooling Dry Bulb and Mean Coincident Wet Bulb values.

B. For system serving healthcare facilities the method in Section 320.0 of the *California Mechanical Code* shall be used.

EXCEPTION to Section 140.4(b)~~4~~3: Cooling design temperatures for cooling towers shall be no greater than the 0.5 percent Cooling Design Wet bulb values.

~~5~~4. **Ventilation.** Outdoor air ventilation loads shall be calculated using the ventilation rates required in Section 120.1(c)3.

~~6~~5. **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.

6~~7~~. **Lighting.** Lighting heating and cooling loads shall be based on actual design lighting levels or power densities as specified in Section 140.6.

7~~8~~. **People.** Occupant density shall be based on the expected occupancy of the building and shall be the same as determined under Section 120.1(~~b~~c)3A~~2B~~, if used. Sensible and latent heat gains shall be as listed in the 2017~~05~~ ASHRAE Handbook- Fundamentals, Chapter 18.~~30, Table 1.~~

8~~9~~. **Process loads.** Loads caused by a process shall be based upon actual information on the intended use of the building.

9~~10~~. **Miscellaneous equipment.** Equipment loads other than process loads shall be calculated using design data compiled from one or more of the following sources:

A. Actual information based on the intended use of the building; or

B. Published data from manufacturer's technical publications or from technical societies, such as the ASHRAE Handbook, Applications Volume; or

C. Other data based on the designer's experience of expected loads and occupancy patterns.

10~~11~~. **Internal heat gains.** Internal heat gains may be ignored for heating load calculations.

11~~12~~. **Safety factor.** Calculated ~~D~~design loads based on 140.4(b)1 through 10 may be increased by up to 10 percent to account for unexpected loads or changes in space usage.

12~~13~~. **Other loads.** Loads such as warm-up or cool-down shall be calculated from principles based on the ~~heat~~ thermal capacity of the building and its contents, the degree of setback, and desired recovery time; or may be assumed to be no more than 30 percent for heating and 10 percent for cooling of the steady-state design loads. In addition, the steady-state load may include a safety factor in accordance with Section 140.4(b)11~~12~~.

CHANGE SIGNIFICANCE: Healthcare facilities were added to the scope of the 2019 Energy Code. They have many unique mechanical design requirements to meet the many complex needs of patient care. The changes in this section were needed to ensure that the Energy Code does not conflict with other code requirements related to healthcare facilities.

Changes in this section relieve healthcare facility designers from the requirement to use the smallest size mechanical equipment within the desired equipment line to meet heating and cooling loads. The *California Mechanical Code* already addresses load calculations for healthcare facilities, so language was added to direct designers to the methods described there. For systems serving high-rise residential buildings, hotel/motel buildings, and nonresidential buildings other than healthcare facilities, designers are directed to the methods described in the 2017 ASHRAE Handbook, Fundamentals. Although the new language does not add or change existing design and sizing calculations for healthcare facilities, it does continue to require the calculations to be performed.

140.4(c)

Fan Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: The modification to this section aligns space conditioning fan system requirements more closely with the fan system power allowances of ASHRAE 90.1-2016.

2019 CODE:

(c) **~~Power Consumption of~~ Fans Systems.** Each fan system having a total fan system motor nameplate horsepower exceeding 5 hp used for space conditioning shall meet the requirements of Items 1, 2, ~~3~~ and ~~4~~3 below. Total fan system power demand equals the sum of the power demand of all fans in the system that are required to operate at design conditions in order to supply air from the heating or cooling source to the conditioned space, and to return it back to the source or to exhaust it to the outdoors.~~; however, total fan system power demand need not include (i) the additional power demand caused solely by air treatment or filtering systems with final pressure drops more than 245 pascals or one-inch water column (only the energy accounted for by the amount of pressure drop that is over 1 inch may be excluded), or (ii) fan system power caused solely by exempt process loads~~.

~~1. **Constant volume fan systems.** The total fan power index at design conditions of each fan system with total horsepower over 25 hp shall not exceed 0.8 watts per cfm of supply air.~~

1. **Fan Power Limitation.** At design conditions each fan system shall not exceed the allowable fan system power of option 1 or 2 as specified in Table 140.4-A

TABLE 140.4-A Fan Power Limitation

	LIMIT	CONSTANT VOLUME	VARIABLE VOLUME
Option 1: Fan system motor nameplate hp	Allowable motor nameplate hp	hp ≤ $cfm_s \times 0.0011$	hp ≤ $cfm_s \times 0.0015$
Option 2: Fan system bhp	Allowable fan system bhp	bhp ≤ $cfm_s \times 0.00094 + A$	bhp ≤ $cfm_s \times 0.0013 + A$

cfm_s = maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute

hp = maximum combined motor nameplate horsepower for all fans in the system

bhp = maximum combined fan-brake horsepower for all fans in the system

A = sum of (PD × cfm_D/4131)

PD = each applicable pressure drop adjustment from Table 140.4-B, in inches of water

cfm_D = the design airflow through each applicable device from Table 140.4-B, in cubic feet per minute

TABLE 140.4-B Fan Power Limitation Pressure Drop Adjustment

DEVICE	ADJUSTMENT CREDITS
Return or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms	0.5 in. of water
Return and/or exhaust airflow control devices	0.5 in. of water
Exhaust filters, scrubbers, or other exhaust treatment	The pressure drop of device calculated at fan system design condition
Particulate Filtration Credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2 × clean filter pressure drop at fan system design condition
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition
Biosafety cabinet	Pressure drop of device at fan system design condition
Energy recovery device, other than coil runaround loop	For each airstream [(2.2 × Energy Recovery Effectiveness) – 0.5] in. of water
Coil runaround loop	0.6 in. of water for each airstream
Exhaust systems serving fume hoods	0.35 in. of water

2. **Variable air volume (VAV) systems.**

~~A. The total fan power index at design conditions of each fan system with total horsepower over 25 hp shall not exceed 1.25 watts per cfm of supply air; and~~

~~B~~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 Section140.4(c)2CB. 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~~C~~. 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 setpoint is reset lower until one zone damper is nearly wide open.

~~3. **Air-treatment or filtering systems.** For systems with air-treatment or filtering systems, calculate the total adjusted fan power index using Equation 140.4-A:~~

~~EQUATION 140.4-A ADJUSTED TOTAL FAN POWER INDEX~~

~~Adjusted total fan power index = Fan power index × Fan Adjustment~~

~~Fan Adjustment =~~ $1-\left(\frac{SP_a-1}{SP_f}\right)$

~~WHERE:~~

~~SPa= Air pressure drop across the air-treatment or filtering system.~~

~~SPf= Total pressure drop across the fan.~~

~~4~~3. **Fractional HVAC Motors for Fans.** HVAC motors for fans that are less than 1 hp and $^{1}/_{12}$ hp or greater shall be electronically-commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with NEMA Standard MG 1-2006 at full load rating conditions. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of a varying motor speed.

EXCEPTION 1 to Section 140.4(c)~~4~~3: Motors in fan-coils and terminal units that operate only when providing heating to the space served.

EXCEPTION 2 to Section 140.4(c)~~4~~3: Motors in space conditioning equipment certified under Section 110.1 or 110.2.

EXCEPTION 1 to 140.4(c): Fan system power caused solely by process loads.

EXCEPTION 2 to 140.4(c): Systems serving healthcare facilities.

CHANGE SIGNIFICANCE: The modifications to this section set new fan power limits for fan systems over 5 horsepower. The new requirement is in direct alignment with the fan power limits of ASHRAE 90.1-2016, which result in energy savings due to higher efficiency fan systems. This modification allows two options for fan system design. Option 1 calculates the maximum horsepower based on design airflow and total nameplate horsepower. Option 2 is based on design airflow and break horsepower, which includes adjustments to account for special filtering (or other devices) in the airstream that increase the static pressure the fan must overcome.

CHANGE TYPE: Clarification and Addition

CHANGE SUMMARY: Language in Exception 1 to Section 140.4(d) was incorporated directly into the space-conditioning zone controls requirements language of this section, and an exception was added for healthcare facilities.

140.4(d)

Space-Conditioning Zone Controls

2019 CODE:

(d) **Space-conditioning Zone Controls.** Each space-conditioning zone shall have controls designed in accordance with 1 or 2:

1. Each space-conditioning zone shall have controls that prevent:
   - ~~1.~~A. Reheating; and
   - ~~2.~~B. Recooling; and
   - ~~3.~~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
2. Zones served by variable air-volume systems that are designed and controlled to reduce, to a minimum, the volume of reheated, recooled, or mixed air are allowed only if the controls meet all of the following requirements:
   - A. For each zone with direct digital controls (DDC):
     - i. The volume of primary air that is reheated, recooled or mixed air supply shall not exceed the larger of:
       - a. 50 percent of the peak primary airflow; or
       - b. The design zone outdoor airflow rate as specified by Section 120.1(c)3.
     - ii. The volume of primary air in the deadband shall not exceed the larger of:
       - a. 20 percent of the peak primary airflow; or
       - b. The design zone outdoor airflow rate as specified by Section 120.1(c)3.
     - iii. The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint no higher than 95ºF while the airflow is maintained at the deadband flow rate.
     - iv. The second stage of heating consists of modulating the airflow rate from the deadband flow rate up to the heating maximum flow rate.
   - B. For each zone without DDC, the volume of primary air that is reheated, re-cooled, or mixed air supply shall not exceed the larger of the following:
     - i. 30 percent of the peak primary airflow; or
     - ii. The design zone outdoor airflow rate as specified by Section 120.1(c)3.

~~**EXCEPTION 1 to Section 140.4(d):** Zones served by variable air-volume systems that are designed and controlled to reduce, to a minimum, the volume of reheated, recooled, or mixed air are allowed only if the controls meet all of the following requirements:~~

~~A. For each zone with direct digital controls (DDC):~~

~~i. The volume of primary air that is reheated, recooled or mixed air supply shall not exceed the larger of:~~

~~a. 50 percent of the peak primary airflow; or~~

~~b. The design zone outdoor airflow rate as specified by Section 120.1.~~

~~ii. The volume of primary air in the deadband shall not exceed the larger of:~~

~~a. 20 percent of the peak primary airflow; or~~

~~b. The design zone outdoor airflow rate as specified by Section 120.1.~~

~~iii. The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint no higher than 95°F while the airflow is maintained at the dead band flow rate.~~

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

~~B. For each zone without DDC, the volume of primary air that is reheated, re-cooled, or mixed air supply shall not exceed the larger of the following:~~

~~i. 30 percent of the peak primary airflow; or~~

~~ii. The design zone outdoor airflow rate as specified by Section 120.1.~~

EXCEPTION ~~2~~1 to Section 140.4(d): Zones with special pressurization relationships or cross-contamination control needs.

EXCEPTION ~~3~~2 to Section 140.4(d): 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 ~~4~~3 to Section 140.4(d): 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 ~~5~~4 to Section 140.4(d): Zones with a peak supply-air quantity of 300 cfm or less.

EXCEPTION 5 to Section 140.4(d): Systems serving healthcare facilities.

CHANGE SIGNIFICANCE: This section has been updated by incorporating Exception 1 language directly into the section language to improve the clarity of the space-conditioning zone control requirements for reheating and recooling.

Exception 5 has been added to this section to exempt licensed healthcare facilities from compliance with these space-conditioning zone control design requirements. This exception is necessary because licensed healthcare facilities are being brought into the scope of the Energy Code for the first time, but this section has been identified as having the potential to interfere with the primary health and safety responsibilities of healthcare facilities, since healthcare facilities have strict ventilation design requirements necessary for infection control. Future code cycles may remove this exception based on more detailed analysis and/or partial exceptions tailored specifically for healthcare facilities.

140.4(e)

Economizers

CHANGE TYPE: Addition

CHANGE SUMMARY: Chilled-water cooling systems without a fan and chilled-water cooling systems that use induced airflow were added to the scope of this section.

2019 CODE:

(e) **Economizers.**

1. Each cooling air handler that has a design total mechanical cooling capacity over 54,000 Btu/hr<u>, or chilled-water cooling systems without a fan or that use induced airflow that has a cooling capacity greater than the systems listed in Table 140.4-C,</u> 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 ~~as calculated in accordance with a method approved by the Commission,~~ at outside air temperatures of 50°F dry-bulb and 45°F wet-bulb and below.

EXCEPTION 1 to Section 140.4(e)1: Where special outside air filtration and treatment, for the reduction and treatment of unusual outdoor contaminants, makes compliance infeasible.

EXCEPTION 2 to Section 140.4(e)1: Where the use of outdoor air for cooling will affect other systems, such as humidification, dehumidification, or supermarket refrigeration systems, so as to increase overall building TDV energy use.

EXCEPTION 3 to Section 140.4(e)1: Systems serving high-rise residential living quarters and hotel/motel guest rooms.

EXCEPTION 4 to Section 140.4(e)1: Where comfort cooling systems have the cooling efficiency that meets or exceeds the cooling efficiency improvement requirements in TABLE 140.4-<u>D</u>~~A~~.

EXCEPTION 5 to Section 140.4(e)1: Fan systems primarily serving computer rooms. See Section 140.9(a) for computer room economizer requirements.

<u>**EXCEPTION 6 to Section 140.4(e)1:** Systems design to operate at 100 percent outside air at all times.</u>

TABLE 140.4-C Chilled Water System Cooling Capacity

Climate Zones	Total Building Chilled Water System Capacity, Minus Capacity of the Cooling units with Air Economizers	
	Building Water-Cooled Chilled Water System	Air-Cooled Chilled Water Systems or District Chilled Water Systems
15	≥ 960,000 Btu/h (280 kW)	≥ 1,250,000 Btu/h (365 kW)
1-14	≥ 720,000 Btu/h (210 kW)	≥ 940,000 Btu/h (275 kW)
16	≥ 1,320,000 Btu/h (385 kW)	≥ 1,720,000 Bu/h (505 kW)

[...]

3. Systems that include a water economizer to meet Section 140.4(e)1 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.

CHANGE SIGNIFICANCE: Section 140.4(e)1 and Table 140.4-C – The purpose of this change is to extend the economizing requirement to chilled-water mechanical systems that do not incorporate an indoor supply air fan system for cooling. Table 140.4-C is a new table that lists the system capacities where water economizing is feasible and applicable to the new requirements.

The reference in Section 140.4(e)1B to an equipment sizing calculation method approved by the Commission was removed to eliminate redundancy. Section 140.4(b) already details the calculation method.

Exception 6 to Section 140.4(e)1 was added for intrinsically economizing systems to prevent installation of economizing equipment in circumstances where it will provide no added benefit.

Section 140.4(e)2 – Sections 140.4(e)3, 4, and 5 were consolidated into Section 140.4(e)2 to keep the requirements for air economizers in one section.

Section 140.4(e)3 – This new section adds requirements for chilled water economizing systems to eliminate or highly reduce the impact of the pumping power needed for an added heat exchanger, and piping of a water economizer system.

140.4(f)

Supply Air Temperature Reset Controls

CHANGE TYPE: Modification and Addition

CHANGE SUMMARY: Restrictive language was removed, and an exception to the supply air temperature reset control requirements was added for healthcare facilities.

2019 CODE:

(f) **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~~, such as interior zones,~~ shall be designed for the airflows resulting from the fully reset supply air temperature. Supply air temperature reset controls shall be:

1. In response to representative building loads or to outdoor air temperature; and
2. At least 25 percent of the difference between the design supply-air temperature and the design room air temperature.

EXCEPTION 1 to Section 140.4(f): Systems that meet the requirements of Section 140.4(d)<u>1</u>, without using Exception 1 ~~or 2~~to that section.

EXCEPTION 2 to Section 140.4(f): Where supply-air temperature reset would increase overall building energy use.

EXCEPTION 3 to Section 140.4(f): Systems supplying zones in which specific humidity levels are required to satisfy ~~exempt~~ process loads. Computer Rooms or other spaces with only IT equipment may not use this exception.

<u>**EXCEPTION 4 to Section 140.4(f):** Systems serving healthcare facilities.</u>

CHANGE SIGNIFICANCE: Section 140.4(f) – The removal of the language "such as interior zones" removes an example that is not intended to be regulated, and thereby removes any potential confusion.

Exception 1 to Section 140.4(f) – The change to this exception is needed to align with the change to Section 140.4(d) that moved its first exception into the section language, and renumbered previous exceptions.

Exception 4 to Section 140.4(f) – This exception exempts licensed healthcare facilities from supply air temperature reset control requirements. This is necessary because this section has been identified as having the potential to interfere with strict ventilation design requirements necessary for infection control of healthcare facilities.

140.4(g)

Electric Resistance Heating

CHANGE TYPE: Modification

CHANGE SUMMARY: Redundant language was removed from an exception, and a new exception was added to allow emergency backup heating systems to have electric resistance heating.

2019 CODE:

(g) **Electric Resistance Heating.** Electric resistance heating systems shall not be used for space heating.

[…]

> **EXCEPTION 5 to Section 140.4(g):** Where an electric resistance heating system serves an entire building that is not a high-rise residential or hotel/motel building; and has a conditioned floor area no greater than 5,000 square feet; and has no mechanical cooling; and is in an area where natural gas is not currently available. ~~and an extension of a natural gas system is impractical, as determined by the natural gas utility.~~
>
> **EXCEPTION 6 to Section 140.4(g):** heating systems serving as emergency backup to gas heating equipment.

CHANGE SIGNIFICANCE: Exception 5 to Section 140.4(g) – The 2019 Energy Code added a definition for "natural gas availability." As a result, the language in this exception was shortened.

Exception 6 to Section 140.4(g) – This exception was added to allow emergency backup space heating systems to use electric resistance heating. This avoids prohibiting equipment that will only be used for an extremely limited time, and only during emergency situations where the ability to operate on electric resistance may provide specific benefits.

140.4(h)

Heat Rejection Systems

CHANGE TYPE: Addition

CHANGE SUMMARY: The language and paragraph structure in this section was reorganized, and a prescriptive pump efficiency requirement was added for cooling towers with a pumping capacity of 900 gallons per minute (gpm) or more.

2019 CODE:

(h) **Heat Rejection Systems.**~~1.~~ ~~**Scope.**~~ ~~Subsection 140.4(h) applies to~~ ~~h~~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~~.~~:

[…]

5. **Cooling tower efficiency.** Axial fan, open-circuit cooling towers serving condenser water loops for chilled water plants with a total of 900 gpm or greater, shall have a rated efficiency of no less than 60 gpm/hp when rated in accordance with the conditions as listed in Table 110.2-G.

 EXCEPTION 1 to Section 140.4(h)5: Replacement of existing cooling towers that are inside an existing building or on an existing roof.

 EXCEPTION 2 to Section 140.4(h)5: Cooling towers serving buildings in Climate Zone 1 or 16.

CHANGE SIGNIFICANCE: Section 140.4(h) – The main purpose of the changes to this section are to add a prescriptive efficiency requirement of 60 gpm/hp for cooling towers with a pumping capacity over 900 gpm. The language and the paragraph structure of this section were modified to simplify and add clarity.

Exception 1 to Section 140.4(h)5 – This exception was added for the replacement of existing towers located inside or on the roof of an existing building because of the physical limitations that may exist with existing structures to accommodate a larger and heavier tower.

Exception 2 to Section 140.4(h)5 – This exception was added for Climate Zones 1 and 16, where it is not cost effective to install these more expensive higher efficient cooling towers.

140.4(j)

Limitation of Air Cooled Chillers

CHANGE TYPE: Modification

CHANGE SUMMARY: An exception for chillers approved by the Commission was removed to eliminate redundancy, and an exception for healthcare facilities was added.

2019 CODE:

(j) **Limitation of Air-Cooled Chillers.** Chilled water plants shall not have more than 300 tons provided by air-cooled chillers.

EXCEPTION 1 to Section 140.4(j): Where the water quality at the building site fails to meet manufacturer's specifications for the use of water-cooled chillers.

EXCEPTION 2 to Section 140.4(j): Chillers that are used to charge a thermal energy storage system with a design temperature of less than 40° ~~degrees~~ F (4° ~~degrees~~ C).

~~**EXCEPTION 3 to Section 140.4(j):** Air cooled chillers with minimum efficiencies approved by the Commission pursuant to Section 10-109(d).~~

EXCEPTION 3 to Section 140.4(j): Systems serving healthcare facilities.

CHANGE SIGNIFICANCE: Exception 3 to Section 140.4(j) – This exception for chillers approved by the Commission was removed because it was redundant. Section 10-109 of the Administrative Code (Part 1) lays out a general framework for determining "alternate component packages," and applies to the entirety of the Energy Code.

Exception 3 to Section 140.4(j) – An exception for healthcare facilities is added because this section has been identified as either having the potential to interfere with the primary health and safety responsibilities of healthcare facilities, or the potential to not be cost effective when applied to a healthcare facility.

140.4(k)4

Hydronic System Measures

CHANGE TYPE: Modification

CHANGE SUMMARY: An exception for healthcare facilities was added for chilled and hot water temperature reset controls for hydronic systems.

2019 CODE:

(k) **Hydronic System Measures**

[...]

4. **Chilled and Hot Water Temperature Reset Controls.** Systems with a design capacity exceeding 500,000 Btu/hr supplying chilled or heated water shall include controls that automatically reset supply water temperatures as a function of representative building loads or outside air temperature.

   EXCEPTION 1 to Section 140.4(k)4: Hydronic systems that use variable flow to reduce pumping energy in accordance with Section 140.4(k)1.

   EXCEPTION 2 to Section 140.4(k)4: Systems serving healthcare facilities.

   [...]

CHANGE SIGNIFICANCE: The purpose of this new exception is to exempt licensed healthcare facilities from compliance with the chilled and hot water temperature reset controls requirements for hydronic systems. This exception is necessary because healthcare facilities have specific hot and chilled water needs to support health and safety. This requirement has been identified as having the potential to interfere with the health and safety of patients.

140.4(l)

Air Distribution System Duct Leakage Sealing

CHANGE TYPE: Modification

CHANGE SUMMARY: This section was restructured for the addition and isolation of unique healthcare facility duct sealing requirements.

2019 CODE:

(l) **Air Distribution System Duct Leakage Sealing.** Duct systems shall be sealed in accordance with 1 or 2 below:

1. Systems serving high-rise residential buildings, hotel/motel buildings and nonresidential buildings other than healthcare facilities, the duct system shall be sealed to a leakage rate not to exceed 6 percent of the nominal air handler airflow rate as confirmed through field verification and diagnostic testing, in accordance with the applicable procedures in Reference Nonresidential Appendices NA1 and NA2 if the criteria in Subsections ~~1~~A, ~~2~~B and ~~3~~C below are met:

   ~~1~~A. The duct system provides conditioned air to an occupiable space for a constant volume, single zone, space-conditioning system; and

   ~~2~~B. The space conditioning system serves less than 5,000 square feet of conditioned floor area; and

   ~~3~~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:

   ~~A~~i. Outdoors; or

   ~~B~~ii. In a space directly under a roof that

   a. 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

   b. Has fixed vents or openings to the outside or unconditioned spaces, or

   ~~C~~iii. In an unconditioned crawl space, or

   ~~D~~iv. In other unconditioned spaces.

2. Duct systems serving healthcare facilities shall be sealed in accordance with the *California Mechanical Code.*

CHANGE SIGNIFICANCE: The changes to this section are needed to isolate the unique requirements for duct sealing in healthcare facilities. Healthcare facilities are new to the scope of the Energy Code, but duct sealing requirements for these facilities have been included in the Mechanical Code for some time. The change to this section defers healthcare facility duct sealing requirements to the Mechanical Code while maintaining Energy Code duct sealing requirements for all other building types.

140.4(m)

Fan Control

CHANGE TYPE: Modification

CHANGE SUMMARY: An exception to the fan control requirements in this section was added for healthcare facilities, and Table 140.4-D was changed to Table 140.4-G to account for changes in other sections.

2019 CODE:

(m) **Fan Control.** Each cooling system listed in TABLE 140.4-G~~D~~ shall be designed to vary the indoor fan airflow as a function of load and shall comply with the following requirements:

1. 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.
2. 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 airflow the power draw is no more than 30 percent of the fan power at full fan speed.
3. Systems that include an air side economizer to meet 140.4(e)1 shall have a minimum of two speeds of fan control during economizer operation.

EXCEPTION 1 to Section 140.4(m): Modulating fan control is not required for chilled water systems with all fan motors < 1 HP, or for evaporative systems with all fan motors < 1 HP, if the systems are not used to provide ventilation air and all indoor fans cycle with the load.

EXCEPTION 2 to Section 140.0(m): Systems serving healthcare facilities.

TABLE 140.4-~~D~~G Fan Control Systems

Cooling System Type	Fan Motor Size	Cooling Capacity
DX cooling	any	≥ 65,000 Btu/hr
Chilled water and evaporative	≥ $^1/_4$ HP	any

CHANGE SIGNIFICANCE: An exception to the fan control requirements of this section is added for licensed healthcare facilities. This section has been identified as having the potential to interfere with the primary health and safety responsibilities of healthcare facilities which have strict ventilation design requirements necessary for infection control.

140.4(n)

Mechanical System Shut-off

CHANGE TYPE: Modification

CHANGE SUMMARY: Exceptions for the mechanical shut-off requirements were added for healthcare facilities and high-rise residential dwelling units.

2019 CODE:

(n) **Mechanical System Shut-off.** Any directly conditioned space with operable wall or roof openings to the outdoors shall be provided with interlock controls that disable or reset the temperature setpoint to 55°F for mechanical heating and disable or reset the temperature setpoint to 90°F for mechanical cooling to that space when any such opening is open for more than 5 minutes.

EXCEPTION 1 to Section 140.4(n): Interlocks are not required on doors with automatic closing devices.

EXCEPTION 2 to Section 140.4(n): Any space without a thermostatic control (thermostat or a space temperature sensor used to control heating or cooling to the space).

<u>**EXCEPTION 3 to Section 140.4(n):** Healthcare facilities.</u>

<u>**EXCEPTION 4 to Section 140.4(n):** High-rise residential dwelling units.</u>

CHANGE SIGNIFICANCE: Exception 3 to Section 140.4(n) – This exception exempts licensed healthcare facilities from compliance with the mechanical space conditioning system shut-off requirements. This exception is necessary because this section has been identified as having the potential to interfere with the strict ventilation design requirements in healthcare facilities necessary for infection control.

Exception 4 to Section 140.4(n) – This exception exempts high-rise residential dwelling units from compliance with the mechanical space conditioning system shut-off requirements. The analysis for this requirement focused on commercial spaces and did not include high-rise residential spaces for this control scheme.

140.6(a)1

Calculation of Adjusted Indoor Lighting Power, Two Interlocked Systems

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: Terminology within Section 140.6 was updated, and an exception which was no longer necessary was removed.

2019 CODE:

SECTION 140.6 – PRESCRIPTIVE REQUIREMENTS FOR INDOOR LIGHTING

A building complies with this section if:

i. The Calculation of ~~Actual~~ Adjusted Indoor Lighting Power of all proposed building areas combined, calculated under Subsection (a) is no greater than the Calculation of Allowed Indoor Lighting Power, Specific Methodologies calculated under Subsection (c); and

ii. The Calculation of Allowed Indoor Lighting Power, General Rules comply with Subsection (b); and

iii. General lighting complies with the Automatic Daylighting Controls in Secondary Daylit Zone requirements in Subsection (d).

The prescriptive limits on indoor lighting power are the smaller of the Actual and Allowed Indoor Lighting Power values determined in accordance with item i.

(a) **Calculation of ~~Actual~~ Adjusted Indoor Lighting Power.** The ~~actual~~adjusted indoor Lighting Power of all proposed building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building; subject to the applicable adjustments under Subdivisions 1 through ~~3~~ 4 of this subsection and the requirements of Subdivision 4 of this subsection.

EXCEPTION to Section 140.6(a): Up to 0.3 watts per square foot of portable lighting for office areas shall not be required to be included in the calculation of actual indoor Lighting Power.

1. **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 ~~actual~~Adjusted ~~indoor~~ Indoor Lighting Power if:

   A. An Installation Certificate detailing compliance with Section 140.6(a)1 is submitted in accordance with Sections 10-103 and Section 130.4; and

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

   C. The two lighting systems are interlocked with a Nonprogrammable Double-Throw Switch to prevent simultaneous operation of both systems.

   For compliance with Part 6 a Nonprogrammable Double-Throw Switch is an electrical switch commonly called a "single pole double throw" or "three-way" switch that is wired as a selector switch allowing one of two loads to be enabled. It can be a line voltage switch or a low voltage switch selecting between two relays. It cannot be overridden or changed in any manner that would permit both loads to operate simultaneously.

CHANGE SIGNIFICANCE: Section 140.6(a)1 – The purpose of the change to this section and its subsections is to rename the lighting power from "Actual Indoor Lighting Power" to "Adjusted Indoor Lighting Power" to clarify that proposed indoor lighting power can be reduced when utilizing power adjustment factors and the tailored method lighting mounting height adjustment factor. This ensures appropriate distinction between Section 130.0, which determines the lighting power represented by the proposed equipment, and Section 140.6 which applies further adjustments to this value. This change is necessary to improve clarity and consistency of the Energy Code.

140.6(a)2

Calculation of Adjusted Indoor Lighting Power, Reduction of Wattage Through Controls

CHANGE TYPE: Addition

CHANGE SUMMARY: New power adjustment factors for incorporating advanced daylighting measures into building envelope design were added.

2019 CODE:

(a) **Calculation of ~~Actual~~ Adjusted Indoor Lighting Power.** The ~~actual~~adjusted indoor Lighting Power of all proposed building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building; subject to the applicable adjustments under Subdivisions 1 through ~~3~~ 4 of this subsection and the requirements of Subdivision 4 of this subsection.

[…]

2. **Reduction of wattage through controls.** In calculating ~~actual~~Adjusted ~~indoor~~ Indoor Lighting Power, the installed watts of a luminaire providing general lighting in an area listed in TABLE 140.6-A may be reduced by the product of (i) the number of watts controlled as described in TABLE 140.6-A, times (ii) the applicable Power Adjustment Factor (PAF), if all of the following conditions are met:

[…]

L. To qualify for the PAFs for clerestory fenestration, horizontal slats, or light shelves in TABLE 140.6-A, the daylighting design shall meet the requirements in Section 140.3(d). The PAFs shall only apply to lighting in a primary or secondary sidelit daylit zone where continuous dimming daylighting controls meeting the requirements of Section 130.1(d) are installed.

CHANGE SIGNIFICANCE: Section 140.6(a)2L was added to introduce new power adjustment factors for incorporating advanced daylighting measures into the building design. Clerestories, horizontal slats, and light shelves can increase the amount of natural daylighting in a space. Pairing these advanced daylighting features with daylight harvesting controls can reduce energy consumption by automatically reducing electric lighting power when natural daylight is available.

140.6(a)3

Calculation of Adjusted Indoor Lighting Power, Lighting Wattage Excluded

CHANGE TYPE: Clarification, Addition, and Modification

CHANGE SUMMARY: Clarification and addition of healthcare facilities to areas that do not need to include lighting wattage for compliance purposes.

2019 CODE:

(a) **Calculation of ~~Actual~~ Adjusted Indoor Lighting Power.** The ~~actual~~adjusted indoor Lighting Power of all proposed building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building; subject to the applicable adjustments under Subdivisions 1 through ~~3~~ 4 of this subsection and the requirements of Subdivision 4 of this subsection.

[…]

3. **Lighting wattage excluded.** The watts of the following indoor lighting applications may be excluded from ~~actual indoor~~Adjusted Indoor Lighting Power ~~Density~~. (Indoor lighting not listed below shall comply with all applicable nonresidential indoor lighting requirements in Part 6.):

   […]

   E. Lighting installed by the manufacturer in walk-in coolers or freezers, vending machines, food preparation equipment, and scientific and industrial equipment.

   F. In office buildings with medical and clinical areas and healthcare facilities ~~medical and clinical buildings:~~, examination and surgical lights, low-ambient night-lights, and lighting integral to medical equipment, provided that these lighting systems are additions to and separately switched from a general lighting system;

[…]

   V. Lighting connected to a Life Safety Branch or Critical Branch, as specified in Section 517 of the *California Electrical Code.*

CHANGE SIGNIFICANCE: Section 140.6(a)3 – The purpose of the change to the section is to delete "density" from the phrase, "actual indoor lighting power density." Lighting power density refers to watts per square foot and it is used incorrectly in this section to describe lighting power which has the unit of watts. This change is necessary to improve clarity and consistency of the Energy Code.

Section 140.6(a)3E – The purpose of the change to the section is to add "coolers" as part of the phrase "walk-in coolers or freezers," as there are walk-in coolers in addition to walk-in freezers. This change is necessary to maintain consistency between the Energy Code and the Appliance Efficiency Regulations.

Section 140.6(a)3F – The purpose of the change to the section is to modify the existing term "medical and clinical buildings," to "office buildings with medical and clinical areas and healthcare facilities." This change was made to better align with the inclusion of healthcare facilities as covered occupancies under the 2019 Energy Code and exempt them where necessary.

Section 140.6(a)3V – The purpose of the change to this section is to add a subsection for the lighting connected to life safety power or critical branch power in healthcare facilities. This change was made to better align with the inclusion of healthcare facilities as covered occupancies under the 2019 Energy Code and exempt them where necessary.

Getty Images

Walk-in Freezer – Lighting in walk-in freezers and coolers may be excluded from lighting power calculations.

140.6(a)4

Calculation of Adjusted Indoor Lighting Power, Luminaire Classification and Power Adjustment

CHANGE TYPE: Clarification, Addition, and Modification

CHANGE SUMMARY: Power adjustment factors were added for small aperture tunable white and dim-to-warm LED luminaires, and a new subsection to address mounting height adjustments for wall and floor display lighting was added.

2019 CODE:

(a) **Calculation of ~~Actual~~ Adjusted Indoor Lighting Power.** The ~~actual~~adjusted indoor Lighting Power of all proposed building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building; subject to the applicable adjustments under Subdivisions 1 through ~~3~~ 4 of this subsection and the requirements of Subdivision 4 of this subsection.

[…]

4. **Luminaire Classification and Power Adjustment.**
   - A. Luminaire Classification and Power shall be determined in accordance with Section 130.0(c).
   - B. Small Aperture Tunable-White and Dim-to-Warm Luminaires Lighting Power Adjustment. For qualifying small aperture tunable-white and dim-to-warm LED luminaires, the adjusted indoor lighting power of these luminaires shall be calculated by multiplying their maximum rated wattage by 0.75. Qualifying luminaires shall meet all of the following:
     - i. Small Aperture. Qualifying luminaires longer than 18 inches shall be no wider than four inches. Qualifying luminaires with a length of 18 inches or less shall be no wider than eight inches.
     - ii. Color Changing. Qualifying tunable-white luminaires shall be capable of a color change greater than or equal to 2,000 Kelvin correlated color temperature (CCT). Qualifying dim-to-warm luminaires shall be capable of color change greater than or equal to 500 Kelvin CCT.
     - iii. Controls. Qualifying luminaires shall be connected to controls that allows color changing of the luminaires.
   - C. Tailored Method Display Lighting Mounting Height Lighting Power Adjustment. For wall display luminaires or floor display luminaires meeting Tailored Method Section 140.6(c)3G and H and where the bottom of luminaires are 10 feet 7 inches and greater above the finished floor, the adjusted indoor lighting power of these luminaires shall be calculated by multiplying their maximum rated wattage and the appropriated mounting height adjustment factor from TABLE 140.6-E. 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.

   […]

TABLE 140.6-E Tailored ~~Adjustments For~~Wall and Floor Display Mounting Height ~~Above Floor~~ Adjustment Factors~~Factors~~

Height in feet above finished floor and bottom of luminaire(s)	Floor Display or Wall Display – ~~Multiply by~~Mounting Height Adjustment Factor
< ~~12'~~10'-7"	1.00
~~12'~~ 10'-7" to ~~16'~~14'-0"	~~0.87~~0.85
>14'-0" to 18'-0"	0.75
> ~~16'~~18'-0"	~~0.77~~0.70

CHANGE SIGNIFICANCE: Section 140.6(a)4 – The purpose of the change to this section is to add "Adjustment" to the heading to better differentiate it from a similar heading in Section 130.0(c), and make it clear that this section provides a further adjustment to the luminaire power determined in that section. This change clarifies without materially altering the requirements of the Energy Code.

Section 140.6(a)4A – The purpose of the change to this section is to number the subsections. The change clarifies without materially altering the requirements.

Section 140.6(a)4B – The purpose of the change to this section is to add a new subsection for additional lighting power allowed for qualifying small aperture tunable-white and dim-to-warm luminaires. This additional lighting power enables the use of qualifying small aperture tunable-white and dim-to-warm luminaires as the efficacy of these technologies is usually lower than that of LED luminaires with fixed correlated color temperature at this time. This change is necessary to improve clarity and consistency of the Energy Code.

Section 140.6(a)4C – The purpose of the change to this section is to add a new subsection for tailored method wall display lighting and floor display lighting adjustment factors. This section addresses mounting height adjustments to lighting power for wall display lighting and floor display lighting where the bottom of the luminaire is mounted greater than 10 feet, 6 inches above the finished floor. This subsection corresponds to the lighting power allowance requirements in Section 140.6(c)3G and H.

140.6(c)2

Calculation of Allowed Indoor Lighting Power – Specific Methodologies, Area Category Method

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: Language was updated to account for a redesign of Table 140.6-C.

2019 CODE:

(c) **Calculation of Allowed Indoor Lighting Power: Specific Methodologies.** The allowed indoor Lighting Power for each building type, or each primary function area shall be calculated using only one of the methods in Subsection 1, 2 or 3 below as applicable.

[…]

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

A. The Area Category Method shall be used only for primary function areas, as defined in Section 100.1, that are listed in TABLE 140.6-C. For primary function areas not listed, selection of a reasonably equivalent type shall be permitted.

[…]

E. If at the time of permitting for a newly constructed building, a tenant is not identified for a multitenant area, a maximum of 0.4~~0.6~~ watts per square foot shall be allowed for the lighting in each area in which a tenant has not been identified. The area shall be classified as unleased tenant area.

F. Under the Area Category Method, the allowed indoor Lighting-Power for each primary function area is the Lighting Power Density value in TABLE 140.6-C times the square feet of the primary function area. The total allowed indoor ~~L~~ lighting ~~P~~ power density for the building is the sum of all allowed indoor lighting power densities for all areas in the building.

G. In addition to the allowed indoor ~~L~~ lighting ~~P~~ power calculated according to Sections 140.6(c)2~~.~~ A through F, the building may add additional lighting power allowances for qualifying lighting systems as specified in the Qualifying Lighting Systems column ~~specialized task work, ornamental, precision, accent, display, decorative, and white boards and chalk boards, in accordance with the footnotes~~ in TABLE 140.6-C under the following conditions:

i. Only primary function areas having a lighting system as specified in the Qualifying Lighting Systems column ~~footnote next to the allowed Lighting Power Density allotments~~ in TABLE 140.6-C and in accordance with the corresponding footnote of the TABLE shall qualify for the ~~added~~ additional lighting power allowances ~~in accordance with the correlated footnote listed at the bottom of the table~~; and

ii. The additional lighting power allowances shall be used only if the plans clearly identify all applicable task areas and the lighting equipment designed to illuminate these tasks; and

iii. Tasks that are performed less than two hours per day or poor quality tasks that can be improved are not eligible for the additional lighting power allowances; and

iv. The additional lighting power allowances shall not utilize any type of luminaires that are used for general lighting in the building; and

v. The additional lighting power allowances shall not be used when using the Complete Building Method, or when the Tailored Method is used for any area in the building; and

vi. The additional lighting power allowed is the smaller of:

a. The lighting power density listed in the "Allowed Additional Lighting LPD" column ~~applicable footnote~~ in TABLE 140.6-C, times the square feet of the primary function, or

b. The ~~actual~~ Adjusted Indoor Lighting Power of ~~design wattage may be added to~~ the ~~allowed~~ applicable lighting ~~power~~; and

vii. In addition to all other additional lighting power allowed under Sections 140.6(c)2Gi through vi, up to ~~1.5~~1.0 watts per square foot of additional lighting power shall be allowed in a videoconferencing studio, as defined in Section 100.1, provided the following conditions are met:

a. A completed and signed Installation Certificate is prepared and submitted in accordance with Section 130.4(b), specifically detailing compliance with the applicable requirements of Section 140.6(c)2Gvii; and

b. The Videoconferencing Studio is a room with permanently installed videoconferencing cameras, audio equipment, and playback equipment for both audio-based and video-based two-way communication between local and remote sites; and

c. General lighting is switched in accordance with TABLE 130.1-A; and

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

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

[…]

TABLE 140.6-C Area Category Method-Lighting Power Density Values (Watts/ft^2)

Primary Function Area		Allowed Lighting Power Density for General Lighting (W/ft^2)	Additional Lighting Power[1]	
			Qualified Lighting Systems	Additional Allowance (W/ft^2, unless noted otherwise)
Auditorium Area		0.70	Ornamental	0.30
			Accent, display and feature[3]	0.20
Auto Repair / Maintenance Area		0.55	Detailed Task Work[7]	0.20
Audience Seating Area		0.60	Ornamental	0.30
Beauty Salon Area		0.80	Detailed Task Work[7]	0.20
			Ornamental	0.30
Civic Meeting Place Area		1.00	Ornamental	0.30
Classroom, Lecture, Training, Vocational Area		0.70	White or Chalk Board[1]	4.50 W/ft
Commercial/Industrial Storage	Warehouse	0.45	-	-
	Shipping & Handling	0.60	-	-
Convention, Conference, Multipurpose and Meeting Area		0.85	Ornamental	0.30
Copy Room		0.50	-	-
Corridor Area		0.60	-	-
Dining Area	Bar/Lounge and Fine Dining	0.55	Ornamental	0.30
	Cafeteria/Fast Food	0.40		
	Family and Leisure	0.50		
Electrical, Mechanical, Telephone Rooms		0.40	Detailed Task Work[7]	0.20
Exercise/Fitness Center and Gymnasium Area		0.50	-	-
Hotel Function Area		0.85	Ornamental	0.30
Museum Area	Exhibition/ Display	0.60	Accent, display and feature[3]	0.50
	Restoration Room	0.75	Detailed Task Work[7]	0.20
Financial Transaction Area		0.80	Ornamental	0.30
General/Commercial & Industrial Work Area	Low Bay	0.60	Detailed Task Work[7]	0.20
	High Bay	0.65	Detailed Task Work[7]	0.20
	Precision	0.85	Precision Specialized Work[9]	0.70

TABLE 140.6-C Area Category Method-Lighting Power Density Values (Watts/ft^2)

Primary Function Area		Allowed Lighting Power Density for General Lighting (W/ft^2)	Additional Lighting Power[1]	
			Qualified Lighting Systems	Additional Allowance (W/ft^2, unless noted otherwise)
Library	Reading Area	0.80	Ornamental	0.30
	Stacks Area	1.10		
Main Entry Lobby		0.85	Ornamental	0.30
Locker Room		0.45	-	-
Lounge, Breakroom, or Waiting Area		0.65	Ornamental	0.30
Concourse and Atria Area		0.90	Ornamental	0.30
Office Area	> 250 square feet	0.65	Portable lighting for office areas[6]	0.20
	≤ 250 square feet	0.70		
	Open plan office	0.60		
Parking Garage Area	Parking Zone	0.10	First ATM	100 W
			Additional ATM	50 W each
	Dedicated Ramps	0.25	-	-
	Daylight Adaptation Zones[2]	0.50	-	-
Pharmacy Area		1.10	Specialized Task Work[8]	0.35
Retail Sales Area	Grocery Sales	1.05	Accent, display and feature[3]	0.20
			Decorative	0.15
	Retail Merchandise Sales	1.00	Accent, display and feature[3]	0.20
			Decorative	0.15
	Fitting Room	0.60	External Illuminated Mirror[5]	40 W/ea
			Internal Illuminated Mirror[5]	120 W/ea
Theater Area	Motion picture	0.60	Ornamental	0.30
	Performance	1.00		
Kitchen/Food Preparation Area		0.95	-	-
Scientific Laboratory Area		1.00	Specialized Task Work[8]	0.35

TABLE 140.6-C Area Category Method-Lighting Power Density Values (Watts/ft²)

Primary Function Area		Allowed Lighting Power Density for General Lighting (W/ft²)	Additional Lighting Power[1] Qualified Lighting Systems	Additional Lighting Power[1] Additional Allowance (W/ft², unless noted otherwise)
Healthcare Facility and Hospitals	Exam/Treatment Room	1.15	-	-
	Imaging Room	1.00	-	-
	Medical Supply Room	0.55	-	-
	Nursery	0.95	Tunable white or dim-to-warm[10]	0.10
	Nurse's Station	0.75	Tunable white or dim-to-warm[10]	0.10
	Operating Room	1.90	-	-
	Patient Room	0.55	Decorative	0.15
			Tunable white or dim-to-warm[10]	0.10
	Physical Therapy Room	0.85	Tunable white or dim-to-warm[10]	0.10
	Recovery Room	0.90	Tunable white or dim-to-warm[10]	0.10
Laundry Area		0.45	-	-
Religious Worship Area		0.95	Ornamental	0.30
Restrooms		0.65	Accent, display and feature[3]	0.20
			Decorative[4]	0.15
Transportation Function	Baggage Area	0.40	-	-
	Ticketing Area	0.45	Accent, display and feature[3]	0.20
Sports Arena – Playing Area	Class I Facility[13]	2.25	-	-
	Class II Facility[13]	1.45	-	-
	Class III Facility[13]	1.10	-	-
	Class IV Facility[13]	0.75	-	-
Stairwell		0.50	Accent, display and feature[3]	0.20
			Decorative[4]	0.15
Videoconferencing Studio		0.90	Videoconferencing	1.00

TABLE 140.6-C Area Category Method-Lighting Power Density Values (Watts/ft^2)

Primary Function Area		Allowed Lighting Power Density for General Lighting (W/ft^2)	Additional Lighting Power[1]	
			Qualified Lighting Systems	Additional Allowance (W/ft^2, unless noted otherwise)
All other		0.40	-	-
Aging Eye/Low-vision[11]	Main Entry Lobby	0.85	Ornamental	0.30
			Transition Lighting OFF at night[12]	0.95
	Stairwell	0.80	-	-
	Corridor Area	0.80	Decorative[4]	0.15
	Lounge/Waiting Area	0.75	Ornamental	0.30
	Multipurpose Room	0.95	Ornamental	0.30
	Religious Worship Area	1.00	Ornamental	0.30
	Dining	0.80	Ornamental	0.30
	Restroom	0.80	Accent, display and feature[3]	0.20

Footnotes for this table are listed below.

1. White board or chalk board. – Directional lighting dedicated to a white board or chalk board.
2. Daylight Adaptation Zones shall be no longer than 66 feet from the entrance to the parking garage.
3. Accent, display and feature lighting – luminaires shall be adjustable or directional.
4. Decorative lighting – primary function shall be decorative and not to provide general lighting.
5. Illuminated mirrors. Lighting shall be dedicated to the mirror.
6. Portable lighting in office areas includes under shelf or furniture-mounted supplemental task lighting qualifies when controlled by a time clock or an occupancy sensor.
7. Detailed task work – Lighting provides high level of visual acuity required for activities with close attention to small elements and/or extreme close up work.
8. Specialized task work – Lighting provides for small-scale, cognitive or fast performance visual tasks; lighting required for operating specialized equipment associated with pharmaceutical/laboratorial activities.
9. Precision specialized work – Lighting for work performed within a commercial or industrial environment that entails working with low contrast, finely detailed, or fast moving objects.
10. Tunable white luminaires capable of color change greater than or equal to 2000K CCT, or dim-to-warm luminaires capable of color change greater than or equal to 500K CCT, connected to controls that allows color changing of the luminaires.
11. Aging Eye/Low-vision areas can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and are or will be licensed by local or state authorities for either senior long-term care, adult day care, senior support, and/or people with special visual needs.
12. Transition lighting OFF at night. Lighting power controlled by astronomical time clock or other control to shut off lighting at night. Additional LPD only applies to area within 30 feet of an exit. Not applicable to lighting in daylit zones.
13. Class I Facility is used for competition play for 5000 or more spectators. Class II Facility is used for competition play for up to 5000 spectators. Class III Facility is used for competition play for up to 2000 spectators. Class IV Facility is normally used for recreational play and there is limited or no provision for spectators.

TABLE 140.6-C Area Category Method-Lighting Power Density Values (Watts/ft^2)

~~Primary Function Area~~		~~Allowed Lighting Power Density (W/ft^2)~~	~~Primary Function Area~~		~~Allowed Lighting Power Density (W/ft^2)~~
~~Auditorium Area~~		~~1.403~~	~~Library Area~~	~~Reading areas~~	~~1.13~~
~~Auto Repair Area~~		~~0.902~~		~~Stack areas~~	~~1.53~~
~~Beauty Salon Area~~		~~1.7~~	~~Lobby Area~~	~~Hotel lobby~~	~~0.953~~
~~Civic Meeting Place Area~~		~~1.33~~		~~Main entry lobby~~	~~0.953~~
~~Classroom, Lecture, Training, Vocational Areas~~		~~1.25~~	~~Locker/Dressing Room~~		~~0.70~~
~~Commercial and Industrial Storage Areas (conditioned and unconditioned)~~		~~0.60~~	~~Lounge Area~~		~~0.903~~
~~Commercial and Industrial Storage Areas (refrigerated)~~		~~0.7~~	~~Malls and Atria~~		~~0.953~~
~~Convention, Conference, Multipurpose and Meeting Center Areas~~		~~1.23~~	~~Medical and Clinical Care Area~~		~~1.2~~
~~Corridor, Restroom, Stair, and Support Areas~~		~~0.60~~	~~Office Area~~	~~> 250 square feet~~	~~0.75~~
~~Dining Area~~		~~1.03~~		~~≤ 250 square feet~~	~~1.0~~
~~Electrical, Mechanical, Telephone Rooms~~		~~0.552~~	~~Parking Garage Area~~	~~Parking Area 10~~	~~0.14~~
~~Exercise Center, Gymnasium Areas~~		~~1.0~~		~~Dedicated Ramps~~	~~0.30~~
~~Exhibit, Museum Areas~~		~~1.8~~		~~Daylight Adaptation Zones 9~~	~~0.60~~
~~Financial Transaction Area~~		~~1.03~~	~~Religious Worship Area~~		~~1.53~~
~~General Commercial and Industrial Work Areas~~	~~Low bay~~	~~0.92~~	~~Retail Merchandise Sales, Wholesale Showroom Areas~~		~~1.26 and 7~~
	~~High bay~~	~~1.02~~			
	~~Precision~~	~~1.24~~	~~Theater Area~~	~~Motion picture~~	~~0.903~~
~~Grocery Sales Area~~		~~1.26 and 7~~		~~Performance~~	~~1.43~~
~~Hotel Function Area~~		~~1.43~~	~~Transportation Function Area~~	~~Concourse & Baggage~~	~~0.50~~
				~~Ticketing~~	~~1.0~~
~~Kitchen, Food Preparation Areas~~		~~1.2~~	~~Videoconferencing Studio~~		~~1.28~~
~~Laboratory Area, Scientific~~		~~1.41~~	~~Waiting Area~~		~~0.803~~
~~Laundry Area~~		~~0.70~~	~~All other areas~~		~~0.50~~

~~FOOTNOTES FOR TABLE 140.6-C:~~

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

TABLE 140.6-C Area Category Method-Lighting Power Density Values (Watts/ft^2

~~Footnote number~~	~~Type of lighting system allowed~~	~~Allowed lighting power density. (W/ft^2 of task area unless otherwise noted)~~
~~1~~	~~Specialized task work~~	~~0.20 W/ft^2~~
~~2~~	~~Specialized task work~~	~~0.50 W/ft^2~~
~~3~~	~~Ornamental lighting as defined in Section 100.1 and in accordance with Section 140.6.(c)2.~~	~~0.50 W/ft^2~~
~~4~~	~~Precision commercial and industrial work~~	~~1.0 W/ft^2~~
~~5~~	~~Per linear foot of white board or chalk board.~~	~~5.5 W per linear foot~~
~~6~~	~~Accent, display and feature lighting - luminaires shall be adjustable or directional~~	~~0.30 W/ft^2~~
~~7~~	~~Decorative lighting - primary function shall be decorative and shall be in addition to general illumination.~~	~~0.20 W/ft^2~~
~~8~~	~~Additional Videoconferencing Studio lighting complying with all of the requirements in Section 140.6(c)2Gvii.~~	~~1.5 W/ft^2~~
~~9~~	~~Daylight Adaptation Zones shall be no longer than 66 feet from the entrance to the parking garage~~	
~~10~~	~~Additional allowance for ATM locations in Parking Garages. Allowance per ATM.~~	~~200 watts for first ATM location. 50 watt for each additional ATM location in a group.~~

CHANGE SIGNIFICANCE: Section 140.6(c)2A – The purpose of the change to this section is to add a new provision that allows selection of a reasonably equivalent function area type for areas not defined in Table 140.6-C. This change aligns with a similar requirement of ASHRAE 90.1-2016. Federal law (Title 42 of the United States Code, Section 6316(b((2)) grants State and local governments the ability to adopt ASHRAE 90.1-2016 efficiency requirements into the local building codes, given that the building codes do not exceed the minimum energy efficiency requirements of ASHRAE 90.1-2016, and the building codes do not take effect prior to the effective date of the applicable minimum energy efficiency requirements of ASHRAE 90.1-2016. This change is necessary to maintain alignment with ASHRAE 90.1-2016, consistent with the above stated law.

Section 140.6(c)2E – The purpose of the change to this section is to update the lighting power allowance for unleased tenant spaces in multi-tenant areas to 0.4 watts per square foot. This change corresponds to the update of the lighting power allowance in Table 140.6-C. The change clarifies the Energy Code and is necessary to improve clarity and consistency.

Section 140.6(c)2F – The purpose of the change to this section is to change language to "each primary function area," in order to use consistent language in referring to primary function areas. The change clarifies the Energy Code and is necessary to improve clarity and consistency.

Section 140.6(c)2G – The purpose of the change to this section and the subsections is to clarify that the additional "use-it-or-lose" lighting power allowances for qualifying lighting applications are tabulated in a new column within Table 140.6-C. The additional allowances are no longer listed as footnotes to the table. The change clarifies the Energy Code and is necessary to improve clarity and consistency.

Section 140.6(c)2Gvi – The purpose of the change to this section is to modify the subsection as the lighting power information is in the Qualifying Lighting System column of Table 140.6-C, in lieu of the footnotes. The change clarifies the Energy Code and is necessary to improve clarity and consistency.

Section 140.6(c)2Gvii – The purpose of the change to the section is to update the additional lighting power allowance for video conferencing studio lighting to 1.0 watts per square foot. This change corresponds to the update of the lighting power allowance for videoconferencing studio lighting in Table 140.6-C. The change clarifies the Energy Code and is necessary to improve clarity and consistency.

140.6(c)3

Calculation of Allowed Indoor Lighting Power: Specific Methodologies Tailored Method

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: Language was altered to clarify and simplify the requirements for to calculating general lighting power allowance and additional lighting power allowances with the tailored method.

2019 CODE:

(c) **Calculation of Allowed Indoor Lighting Power: Specific Methodologies.** The allowed indoor Lighting Power for each building type, or each primary function area shall be calculated using only one of the methods in Subsection 1, 2 or 3 below as applicable.

[…]

3. **Tailored Method.** Requirements for using the Tailored Method include all of the following:

   A. The Tailored Method shall be used only for primary function areas listed in TABLE 140.6-D, as defined in Section 100.1~~, and for IES allowances listed in Section 140.6(c)3H~~.

   B. Allowed Indoor Lighting Power allotments for general lighting shall be determined according to Section 140.6(c)3~~G or H~~F, as applicable. ~~General lighting shall not qualify for a mounting height multiplier.~~

   C. For compliance with ~~this Item~~Section 140.6(c)3, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in TABLE 140.6-D.

   […]

   E. In addition to the allowed indoor ~~L~~lighting ~~P~~power allotments for general lighting calculated according to Sections 140.6(c)3~~G or H~~F, as applicable, the building may add additional lighting power allowances for wall display lighting, floor display lighting and task lighting, ornamental/special effects lighting, and very valuable display cases lighting according to Sections 140.6(c)~~3I~~ 3G through ~~L~~J.

   ~~F. The general lighting system shall not use narrow beam direction lamps, wall-washer, valance, direct cove, or perimeter linear slot types of lighting systems.~~

   ~~G~~F. Determine allowed indoor ~~L~~lighting ~~P~~power allotments for general lighting for primary function areas listed in TABLE 140.6-D as follows:

      i. Use the General ~~IES~~ ~~Illuminance~~Illumination ~~values~~ Level (Lux) listed in Column 2 of Table 140.6-D to determine the Allowed General Lighting Power Density allotments for the area.

      ii. Determine the room cavity ratio (RCR) for the area. The RCR shall be calculated according to the applicable equation in TABLE 140.6-F.

iii. Find the allowed General Lighting Power Density allotments in TABLE 140.6-G that is applicable to the ~~IES~~ General I~~I~~lluminance ~~value~~ Level (Lux) from Column 2 of Table 140.6-D (as described in Item i.) and the RCR determined in accordance with TABLE 140.6-F (as described in Item ii).

iv. Determine the square feet of the area in accordance with Section 140.6(c)3C and D.

v. Multiply the allowed Lighting Power Density allotment, as determined in accordance with Item iii by the square feet of each primary function area, as determined in accordance with Item iv. The product is the ~~A~~allowed ~~I~~indoor ~~L~~lighting ~~P~~power allotment for general lighting for the area.

~~H. Determine allowed indoor Lighting Power allotments for general lighting for only specific primary function areas NOT listed in TABLE 140.6-D as follows:~~

~~i. Use this Section only to calculate allowed indoor lighting power for general lighting in the following primary function areas. Do not use Section 140.6(c)3H for any primary function areas NOT listed below:~~

~~a. Exercise Center, Gymnasium~~

~~b. Medical and Clinical Care~~

~~c. Police Stations and Fire Stations~~

~~d. Public rest areas along state and federal roadways~~

~~e. Other primary function areas that are listed in neither TABLE 140.6-C nor TABLE140.6-D.~~

~~ii. When calculating allowed indoor Lighting Power allotments for general lighting using Section 140.6(c)3H, the building shall not add additional lighting power allowances for any other use, including but not limited to wall display, floor display and task, ornamental/special effects, and very valuable display case lighting.~~

~~iii. Calculate the allowed indoor Lighting Power for each primary function area in the building as follows:~~

~~a. Determine the illuminance values (Lux) according to the Tenth Edition IES Lighting Handbook (IES HB), using the Recommended Horizontal Maintained Illuminance Targets for Observers 25-65 years old for illuminance.~~

~~b. Determine the room cavity ratio (RCR) for area. The RCR shall be calculated according to the applicable equation in TABLE 140.6-F.~~

~~c. Find the allowed lighting power density in TABLE 140.6-G that is applicable to the illuminance value (Lux) determined in accordance with Item (a) and the RCR determined in accordance with Item (b).~~

d. ~~Determine the square feet of the area. For compliance with this item, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in Item (i). Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a Primary Function Area.~~

e. ~~Multiply the square feet determined in accordance with Item (d), by the allowed lighting power density determined in accordance with item (c). The product is the Allowed Indoor Lighting Power allotment for general lighting for the area.~~

~~I~~G. Determine additional allowed power for wall display lighting according to column 3 of Table 140.6-D for each primary function area as follows:

i. ~~Additional wall display lighting power shall not be available when using Section 140.6(c)3H for determining the Allowed Indoor Lighting Power allotment for general lighting for the area.~~

~~ii~~i. Floor displays shall not qualify for wall display allowances.

~~iii~~ii. Qualifying wall lighting shall:

a. Be mounted within 10 feet of the wall having the wall display. When track lighting is used for wall display, and where portions of that lighting track are more than 10 feet from the wall and other portions are within 10 feet of the wall, portions of track more than 10 feet from the wall shall not be used for the wall display allowance.

b. Be a lighting system type appropriate for wall lighting. Lighting systems appropriate for wall lighting are lighting track adjacent to the wall, wall-washer luminaires, luminaires behind a wall valance or wall cove, or accent light. (Accent luminaires are adjustable or fixed luminaires with PAR, R, MR, AR, or ~~other directional lamp types~~luminaires providing directional display light).

~~iv~~iii. 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 ~~no more than~~ within 2 feet of the ceiling or are taller than 10 feet~~,~~ and (II) are permanently anchored to the floor~~, provided, however, that neither commercial industrial stacks nor industrial storage stacks are permanent full height interior partitions~~.

~~v~~iv. ~~The wall display mounting height multiplier is the applicable factor from TABLE 140.6-E. Mounting height is the distance from the finished floor to the bottom of the luminaire. The wall display mounting height multipliers shall be used to reduce the design watts of the space.~~ For wall display lighting where the bottom of the luminaire is greater than 10 feet 6 inches above the finished floor, the mounting height adjustment factor from TABLE 140.6-E can be used to adjust the installed luminaire wattage as specified in Section 140.6(a)4C.

~~vi~~v. The ~~additional~~ allowed power for wall display lighting shall be the smaller of:

a. ~~The~~ The "~~product of~~ wall display lighting power density" determined in accordance with TABLE 140.6-D, ~~times~~ multiplied by the wall display lengths determined in accordance with Item ~~iv~~iii; ~~or~~ and

b. The ~~actual~~ Adjusted Indoor Lighting P~~p~~ower used for the wall display lighting systems.

vi. Lighting internal to display cases that are attached to a wall or directly adjacent to a wall are counted as wall display lighting as specified in Section 140.6(c)3G. All other lighting internal to display cases are counted as floor display lighting as specified in Section 140.6(c)3H, or as very valuable display case lighting as specified in Section 140.6(c)3J.

~~J~~H. Determine additional allowed power for floor display lighting and task lighting as follows:

~~i. Neither additional allowed power for floor display lighting nor additional allowed power for task lighting shall be available when using Section 140.6(c)3H for determining allowed indoor Lighting Power allotment for general lighting.~~

~~ii~~i. Displays that are installed against a wall shall not qualify for the floor display lighting power allowances.

~~iii~~ii. Lighting internal to display cases that are not attached to a wall and not directly adjacent to a wall, shall be counted as floor display lighting in accordance with Section 140.6(c)~~3J~~3H; or very valuable display case lighting in accordance with Section 140.6(c)3~~Liii and iv~~J.

~~iv~~iii. Additional allowed power for floor display lighting, and additional allowed power for task lighting, may be used by qualifying floor display lighting systems, qualifying task lighting systems, or a combination of both. For floor areas qualifying for both floor display and task lighting power allowances, the additional allowed power shall be used only once for the same floor area, so that the allowance shall not be additive.

~~v~~iv. Qualifying floor display lighting shall:

a. Be mounted no closer than 2 feet to a wall.

b. Consist of only (I) directional ~~lighting~~ lamp types, such as PAR, R, MR, AR; or (II) ~~lighting employing optics~~luminaires providing directional display light ~~from nondirectional lamps~~.

c. If track lighting is used, shall be only track heads that are classified as direction lighting types.

~~vi~~v. Qualifying task lighting shall:

a. Be located immediately adjacent to and capable of illuminating the task for which it is installed.

b. Be of a type different from the general lighting system.

c. Be separately switched from the general lighting system.

~~vii~~vi. If there are illuminated floor displays, floor display lighting power shall be used only if allowed by Column 4 of TABLE 140.6-D.

viii. ~~Additional allowed power for a combination of floor display lighting and task lighting shall be available only for (I) floors having floor displays; or (II) floors not having floor displays but having tasks having illuminance recommendations that appear in the Tenth Edition of the IES Lighting Handbook and that are higher than the general lighting level in column 2 of TABLE 140.6-D.~~ The square footage of floor displays or the square footage of task areas shall be determined in accordance with Section 140.6(c)3C and D, except that any floor area designed to not have floor displays or tasks, such as floor areas designated as a path of egress, shall not be included for the floor display allowance.

~~ix~~viii. For floor display lighting where the bottom of the luminaire is greater than 10.6 feet above the finished floor, multiply the floor display installed watts by the appropriate mounting height adjustment factor from Table 140.6-E to calculate the Adjusted Indoor Lighting Power as specified in Section 140.6(a)4C. ~~For floor display lighting where the bottom of the luminaire is 12 feet or higher above the finished floor, the wattage allowed in column 4 of TABLE 140.6-D may be increased by multiplying the floor display lighting power allowance by the appropriate factor from TABLE 140.6-E Luminaire mounting height is the distance from the finished floor to the bottom of the luminaire.The floor display mounting height multipliers shall be used to reduce the design watts of the space.~~

ix. The ~~additional~~ allowed power for floor display lighting for each applicable area shall be the smaller of:

a. ~~The~~ the ~~product of~~ allowed floor display and task lighting power determined in accordance with Section 140.6(c)~~3Jvii~~ 3Hvi ~~times~~ multiplied by the floor square footage determined in accordance with Section 140.6(c)~~3J~~3Hvii~~viii~~; and ~~or~~

b. The ~~actual power~~Adjusted Indoor Lighting Power used for the floor display lighting systems.

~~K~~I. Determine additional allowed power for ornamental/special effects lighting as follows:

~~i. Additional allowed power for ornamental/special effects lighting shall not be available when using Section 140.6(c)3H for determining general Lighting Power allowances.~~

~~ii~~i. Qualifying ornamental lighting includes luminaires such as chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights and light color panels, when any of those lights are used in a decorative manner that does not serve as display lighting or general lighting.

~~iii~~ii. Additional lighting power for ornamental/special effects lighting shall be used only if allowed by Column 5 of TABLE 140.6-D.

~~iv~~iii. Additional lighting power for ornamental/special effects lighting shall be used only in areas having ornamental/special effects lighting. The square footage of the floor area shall be determined in accordance with Section 140.6(c)3C and D, and it shall not include floor areas not having ornamental/special effects lighting.

~~v~~iv. The additional ~~additional~~ allowed power for ornamental/special effects lighting for each applicable area shall be the smaller of:

a. ~~The~~ The the product of the "allowed ornamental/special effects lighting power" determined in accordance with Section 140.6(c)~~3Kiii~~3Iii, ~~times~~ multiplied by the floor square footage determined in accordance with Section 140.6(c)~~3Kiv~~3Iiii; ~~or~~ and

b. ~~The actual power~~The Adjusted Indoor Lighting Power of allowed ornamental/special effects lighting.

~~L~~J. Determine additional allowed power for very valuable display case lighting as follows:

~~i. Additional allowed power for very valuable display case lighting shall not be available when using Section 140.6(c)3H for determining general Lighting Power allowances.~~

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

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

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

~~v~~iv. If there is qualifying very valuable display case lighting, in accordance with Section 140.6(c)~~3Liii~~3Jii, the smallest of the following separate lighting power for display cases presenting very valuable display items is permitted:

a. The product of the area of the primary function and ~~0.80~~0.55 watt per square foot; or

b. The product of the area of the display case and ~~12~~ 8 watts per square foot; or

c. The ~~actual~~ Adjusted Indoor Lighting ~~power~~ Power of lighting for very valuable displays.

TABLE 140.6-D Tailored Method Lighting Power Allowances

1 Primary Function Area	2 General Illumination Level (Lux)	3 Wall Display Lighting Power Density (W/ft)	4 Allowed Combined Floor Display Power and Task Lighting Power Density (W/ft^2)	5 Additional Ornamental/Special Effect Lighting Power Density (W/ft^2)
Auditorium area	300	~~2.25~~3.00	~~0.3~~0.20	~~0.5~~0.40
~~Civic meeting place~~	~~300~~	~~3.15~~	~~0.2~~	~~0.5~~
Convention, conference, multipurpose, and meeting center areas	300	~~2.50~~2.00	~~0.4~~0.35	~~0.5~~0.40
Dining areas	200	~~1.50~~1.25	~~0.6~~0.50	~~0.5~~0.40
Exhibit, museum areas	150	~~15.0~~11.50	~~1.2~~0.80	~~0.5~~0.40
~~Financial transaction area~~	300	~~3.15~~	~~0.2~~	~~0.5~~
~~Grocery store area~~	500	~~8.00~~	~~0.9~~	~~0.5~~
Hotel area:				
~~Hotel function Area~~Ballroom/Events	400	~~2.25~~1.80	~~0.2~~0.12	~~0.5~~0.40
~~Lobby Area:~~				~~0.5~~0.40
~~Hotel l~~Lobby	200	~~3.15~~3.50	0.20	~~0.5~~0.40
Main entry lobby	200	~~0~~3.50	0.20	~~0~~0.40
~~Lounge area~~	~~200~~	~~7.00~~	~~0~~	~~0.5~~
~~Malls and Atria~~	~~300~~	~~3.50~~	~~0.5~~	~~0.5~~0.40
Religious worship area	300	~~1.50~~1.30	~~0.5~~0.40	~~0.5~~0.40
Retail sales				
Grocery	600	6.80	0.70	0.40
~~Retail~~ merchandise sales, and showroom areas	~~400~~500	~~14.00~~11.80	~~1.0~~0.80	~~0.5~~0.40
Theater Area:				
Motion picture	200	~~3.00~~2.00	~~0~~0.20	~~0.5~~0.40
Performance arts	200	~~6.00~~7.50	~~0~~0.20	~~0.5~~0.40
~~Transportation function area~~	~~300~~	~~3.15~~	~~0.3~~	~~0.5~~
~~Waiting area~~	~~300~~	~~3.15~~	~~0.2~~	~~0.5~~

TABLE 140.6-F Room Cavity Ratio (RCR) Equations

1
Determine the Room Cavity Ratio for Table 140.6-G using one of the following equations.
Room cavity ratio for rectangular rooms $$RCR = \cancel{5}\ \frac{5 \times H \times (L + W)}{L + W}$$
Room cavity ratio for irregular-shaped rooms $$RCR = \frac{2.5 \times H \times P}{A}$$
Where: L =Length of room; W = Width of room; H =Vertical distance from the work plane to the centerline of the lighting fixture; P = Perimeter of room, and A = Area of room

TABLE 140.6-G Tailored Method General Lighting Power Allowed — ~~Illuminance Level (LUX) Power Density Values (Watts/Ft²)~~By Illumance and Room Cavity Ratio

General Illuminance Level (lux)a	General Lighting Power Density (W/ft²) for the following RCR values[b]values[b]			
	RCR ≤ 2.0	RCR > 2.0 and ≤ 3.5	RCR > 3.5 and ≤ 7.0	RCR > 7.0
~~50~~	~~0.18~~	~~0.22~~	~~0.32~~	~~0.46~~
~~100~~	~~0.30~~	~~0.38~~	~~0.56~~	~~0.84~~
150	0.40	0.45	0.60	00.75
200	~~0.48~~0.45	~~0.64~~0.55	~~0.88~~0.75	~~1.34~~1.00
300	~~0.64~~0.65	~~0.82~~0.80	~~1.12~~1.00	~~1.76~~1.40
400	~~0.78~~0.75	~~0.98~~0.95	~~1.34~~1.25	~~2.08~~1.50
500	0.90	~~1.10~~1.05	~~1.52~~1.45	~~2.32~~1.85
600	1.08	1.24	1.64	2.38
a Illuminance values from Column 2 of Table 140.6-D.				
b RCR values are calculated using applicable equations in Table 140.6-F.				
~~600~~	~~1.06~~	~~1.26~~	~~1.74~~	~~2.60~~
~~700~~	~~1.24~~	~~1.46~~	~~1.82~~	~~2.96~~
~~800~~	~~1.44~~	~~1.70~~	~~2.28~~	~~3.30~~
~~900~~	~~1.66~~	~~2.00~~	~~2.64~~	~~3.74~~
~~1000~~	~~1.84~~	~~2.20~~	~~2.90~~	~~4.06~~

CHANGE SIGNIFICANCE: Section 140.6(c)3A – The purpose of the change to this subsection is to delete the primary function area reference to Illuminating Engineering Society (IES) allowance listed in Section 140.6(c)3H as the subsection specifying the IES references is removed from the Energy Code. The change clarifies the requirements of the Energy Code and is necessary to improve clarity and consistency.

Section 140.6(c)3B – The purpose of the changes to this section is to renumber the reference to subsection 140.6(c)3F due to changes to other subsections within Section 140.6(c).

Language which excluded general lighting from utilizing mounting height adjustment factors was also removed and relocated. This language has been relocated to Section 140.6(a)4C. This change is necessary to improve clarity and consistency.

Section 140.6(c)3E – The purpose of the change to this section is to add "lighting" to the section as appropriate. The change clarifies the Energy Code and is necessary to improve clarity and consistency.

Section 140.6(c)3F (existing) – The purpose of the changes to this section is to remove a restriction that is generally redundant with the definition of "general lighting," and that is unnecessarily technology specific. Although directional light sources are most commonly used for wall, floor, and display lighting, there are scenarios where directional light sources are used as general illumination sources. The change has the substantive effect of allowing the use of these technologies for providing general lighting and is necessary both to ensure that the provisions of the Energy Code are technology neutral and to avoid unnecessarily restricting approaches to the design of general lighting systems.

Section 140.6(c)3H (existing) – The purpose of the deletion of the existing Section 140.6(c)3H is to remove provisions for calculating general lighting power allowance for specific primary function areas not listed in Table 140.6-D. For primary function areas not listed in Table 140.6-D, a new provision that allows selection of a reasonably equivalent area type is specified in Section 140.6(c)2A, making this section redundant. The changes here clarify the Energy Code and is necessary to improve clarity and consistency.

Section 140.6(c)3F – The purpose of the change to the section and subsections is to modify the term from "IES Illumination values" to "General Illumination Level" to correspond to changes in Table 140.6-D. The change clarifies the Energy Code and is necessary to improve the code's clarity and consistency. Modifications were also made to existing language by adding "General" to the terms in the subsection, changing them to "General Lighting" and "General Illuminance Level." This change corresponds to changes in Table 140.6-D.

Section 140.6(c)3G – The purpose of the change to this section is to renumber the subsections, as there are subsections being deleted and new subsections added.

Section 140.6(c)3Gi – The purpose of the change to this section is to delete the subsection reference to Section 140.6(c)3H as the provisions in Section 140.6(c)3H have been removed.

Section 140.6(c)3Giib – The purpose of the change to this section is to clarify the types of lighting permitted, as accent luminaires can also be luminaires providing directional display light.

Section 140.6(c)3Giii – The purpose of the change to this section is to clarify the permanent full height interior partitions qualification requirement for the use of additional lighting power for wall display lighting.

Section 140.6(c)3Giv – The purpose of the change to this section is to clarify the subsection requirement on how to use the mounting height adjustment factor for wall display lighting luminaires mounted above certain height.

Section 140.6(c)3Gv – The purpose of the change to this section is to clarify the requirement on how to determine the allowed power for wall display lighting.

Section 140.6(c)3Gvi – The purpose of the change to this section is to clarify that lighting integral to display cases can serve and qualify as wall display lighting, provided the display case is attached or adjacent to a wall.

Section 140.6(c)3H – The purpose of the change to this section is to renumber the subsections, as subsections were deleted, and new subsections were added.

Section 140.6(c)3Hi – The purpose of the change to this section is to delete the subsection as the reference to Section 140.6(c)3H no longer exists.

Section 140.6(c)3Hii – The purpose of the change to this section is to clarify that lighting integral to display cases that are not attached or adjacent to a wall should be counted as floor display case lighting. Section numbers were also updated corresponding to changes in the section and subsection numbering as appropriate.

Section 140.6(c)3Hvii – The purpose of the change to this section is to delete the allowance of using IES and Table 140.6-D for determination of additional lighting power for a combination of floor display lighting and task lighting. This corresponds to the change in Section 140.6(c)2A, and is aligned with ASHRAE 90.1-2016 which allows one to choose a reasonably equivalent type to the primary function area in the standard, and design to that lighting power density.

Section 140.6(c)3Hviii – The purpose of the change to this section is to clarify the subsection requirement on how to use the mounting height adjustment factor for floor display lighting luminaires mounted above certain heights.

Section 140.6(c)3Hix – The purpose of the change to this section is to reword the text to more clearly articulate how to determine the allowed power for floor display lighting.

Section 140.6(c)3I – The purpose of the change to this section is to renumber the subsections, as subsections were deleted, and new subsections were added.

Section 140.6(c)3Ii – The purpose of the change to this section is to delete the subsection as the reference to Section 140.6(c)3H no longer exists.

Section 140.6(c)3J – The purpose of the change to this section is to renumber the subsections, as subsections were deleted, and new subsections were added.

Section 140.6(c)3J – The purpose of the change to this section is to delete the subsection as the reference to Section 140.6(c)3H no longer exists.

140.6(d)

Automatic Daylighting Controls in Secondary Daylit Zones

CHANGE TYPE: Clarification, Addition, and Modification

CHANGE SUMMARY: Code language related to secondary sidelit zones was modified for clarity, and new exceptions were added.

2019 CODE:

(d) **Automatic Daylighting Controls in Secondary Daylit Zones.** All luminaires providing general lighting that is in, or partially in a Secondary Sidelit Daylit Zone ~~as defined in Section 130.1(d)1C~~, and that is not in a Primary Sidelit Daylit Zone shall:

1. Be controlled independently from all other luminaires by automatic daylighting controls that meet the applicable requirements of Section 110.9; and
2. Be controlled in accordance with the applicable requirements in Section 130.1(d)~~2~~; and
3. All Secondary Sidelit Daylit Zones shall be shown on the plans submitted to the enforcing agency.

EXCEPTION 1 to Section 140.6(d): Luminaires in Secondary Sidelit Daylit Zone(s) in ~~areas~~ <u>an enclosed space in which the combined total general lighting power in Secondary Daylit Zone(s)</u> ~~where the total wattage of general lighting~~ is less than 120 ~~Watts~~<u>watts, or where the combined total general lighting power in Primary and Secondary Daylit Zone(s) is less than 240 watts.</u>

EXCEPTION 2 to Section 140.6(d): Luminaires in parking garages complying with Section 130.1(d)3.

<u>**EXCEPTION 3 to Section 140.6(d):** Areas adjacent to vertical glazing below an overhang, where there is no vertical glazing above the overhang and where the ratio of the overhang projection to the overhang rise is greater than 1.5 for South, East and West orientations, or where the ratio of the overhang projection to the overhang rise is greater than 1 for North orientations.</u>

<u>**EXCEPTION 4 to Section 140.6(d):** 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.</u>

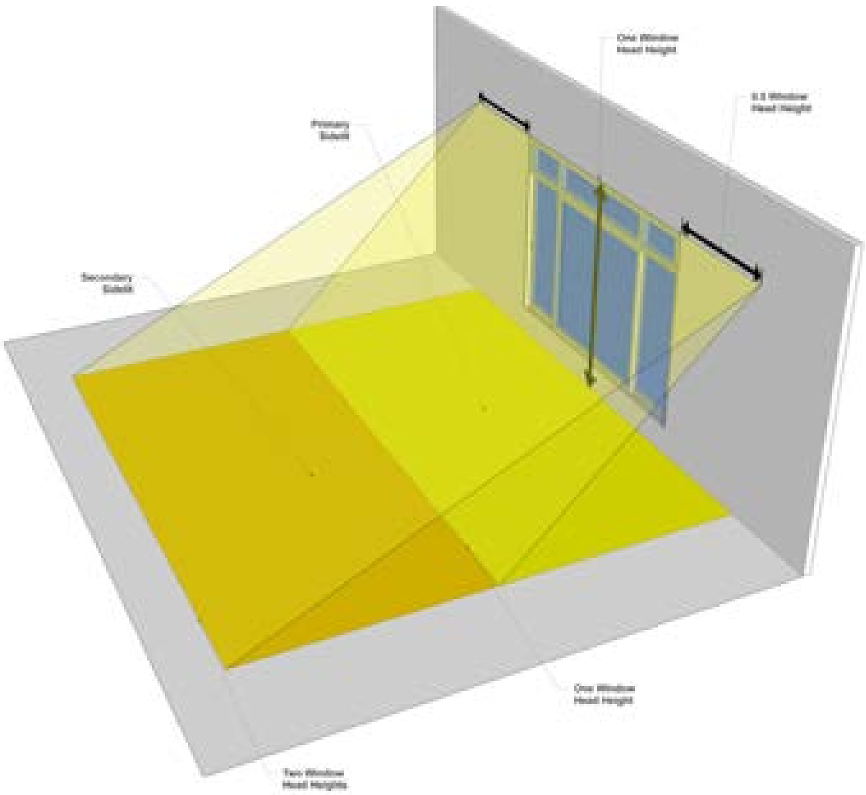
<u>**EXCEPTION 5 to Section 140.6(d):** Luminaires in sidelit daylit zones in retail merchandise sales and wholesale showroom areas.</u>

CHANGE SIGNIFICANCE: Section 140.6(d) – Outdated references to daylit zone definitions were removed from this section. The relevant definitions are now located in Section 100.1, the definitions section of the Energy Code. A second reference to daylighting requirements was also changed to reflect that section's renumbering. Lastly, exceptions were added to address circumstances where daylighting may not be effective.

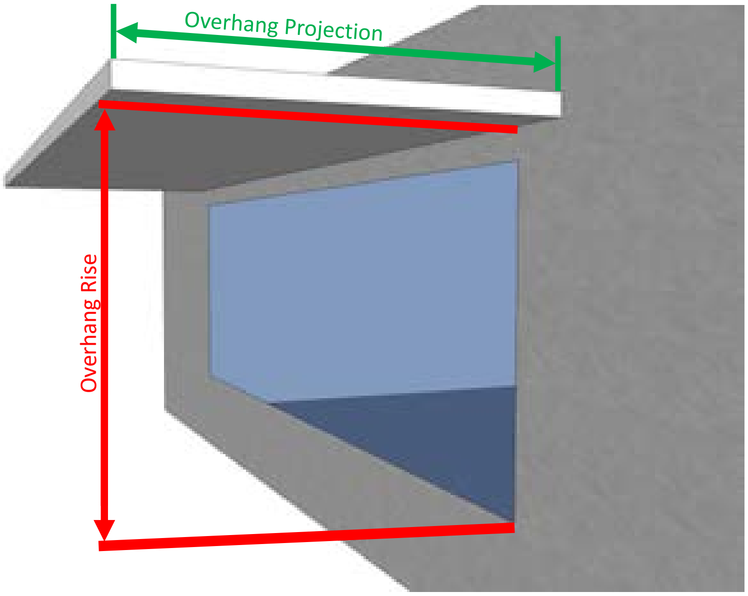
Exception 1 to Section 140.6(d) – The purpose of modifying this exception is to address scenarios where automatic daylighting controls are required in secondary sidelit daylit zones, but not required in primary sidelit daylit zones. The exception now exempts control requirements for secondary sidelit daylit zones if the combined general lighting power in primary and secondary sidelit daylit zones is less than 240 watts.

Exception 3 to Section 140.6(d) – The purpose of adding this exception is to address scenarios with limited access to direct sunlight. In buildings with large overhangs which block direct access to sunlight, sidelit daylit zones will receive a significantly reduced amount of daylighting. Adding Exception 3 was necessary to prevent daylighting controls from being installed where daylighting may not be utilized effectively.

Exception 5 to Section 130.1(d) – The purpose of adding this exception is to address the need for uniform lighting in merchandise sales and wholesale showroom areas. This exception is necessary to address concerns regarding lighting gradients where merchandise is displayed in a sidelit daylit zone.



Sidelit Daylit Zones – The secondary sidelit daylit zone is the dark yellow rectangle in this illustration.
Source: California Energy Commission



Overhangs – Overhangs can limit the amount of daylight that enters a space. For South, East, and West-facing fenestration, if the overhang projection-to-rise ratio is 1.5 or greater, the area adjacent to that fenestration is exempt from the daylighting control requirements. For north-facing fenestration, these areas are exempt if the overhang projection-to-rise ratio is 1.0 or greater. This is detailed in Exception 3 to Section 140.6(d) of the Energy Code.
Source: California Energy Commission

Tables 140.7-A and 140.7-B

Lighting Power Allowances

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: Outdoor lighting power allowance tables were updated with reduced lighting power density (LPD) values that reflect LED lighting as the new prescriptive baseline.

2019 CODE:

TABLE 140.7-A GENERAL HARDSCAPE LIGHTING POWER ALLOWANCE

~~Type of Power Allowance~~	~~Lighting Zone 0~~	~~Lighting Zone 1~~	~~Lighting Zone 22~~	~~Lighting Zone 32~~	~~Lighting Zone 4~~
~~Area Wattage Allowance (AWA)~~	~~No allowance~~[1]	~~0.020 W/ft²~~	~~0.030 W/ft²~~	~~0.040 W/ft²~~	~~0.050 W/ft²~~
~~Linear Wattage Allowance (LWA)~~		~~0.15 W/lf~~	~~0.25 W/lf~~	~~0.35 W/lf~~	~~0.45 W/lf~~
~~Initial Wattage Allowance (IWA)~~		~~340 W~~	~~450 W~~	~~520 W~~	~~640 W~~

Type of Power Allowance	Lighting Zone 0[3]	Lighting Zone 1[3]	Lighting Zone 2[3]		Lighting Zone 3[3]		Lighting Zone 4[3]
	Asphalt/ Concrete	Asphalt/ Concrete	Asphalt	Concrete[2]	Asphalt	Concrete[2]	Asphalt/ Concrete
Area wattage allowance (AWA)		0.018 W/ft²	0.023 W/ft²	0.025 W/ft²	0.025 W/ft²	0.03 W/ft²	0.03 W/ft²
Linear Wattage Allowance (LWA)	No allowance[1]	0.15 W/lf	0.17 W/lf	0.4 W/lf	0.25 W/lf	0.4 W/lf	0.35 W/lf
Initial wattage allowance (IWA)		180 W	250 W	250 W	350 W	350 W	400 W

1. Continuous lighting is explicitly prohibited in Lighting Zone 0. A single luminaire of 15 Watts or less may be installed at an entrance to a parking area, trail head, fee payment kiosk, outhouse, or toilet facility, as required to provide safe navigation of the site infrastructure. Luminaires installed shall meet the maximum zonal lumen limits as specified in Section 130.2(b).
2. Where greater than 50% of the paved surface of a parking lot is finished with concrete. This does not extend beyond the parking lot, and does not include any other General Hardscape areas.
3. Narrow band spectrum light sources with a dominant peak wavelength greater than 580 nm – as mandated by local, state, or federal agencies to minimize the impact on local, active professional astronomy or nocturnal habitat of specific local fauna – shall be allowed a 2.0 lighting power allowance multiplier.

TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS. All area and distance measurements in plan view unless otherwise noted.

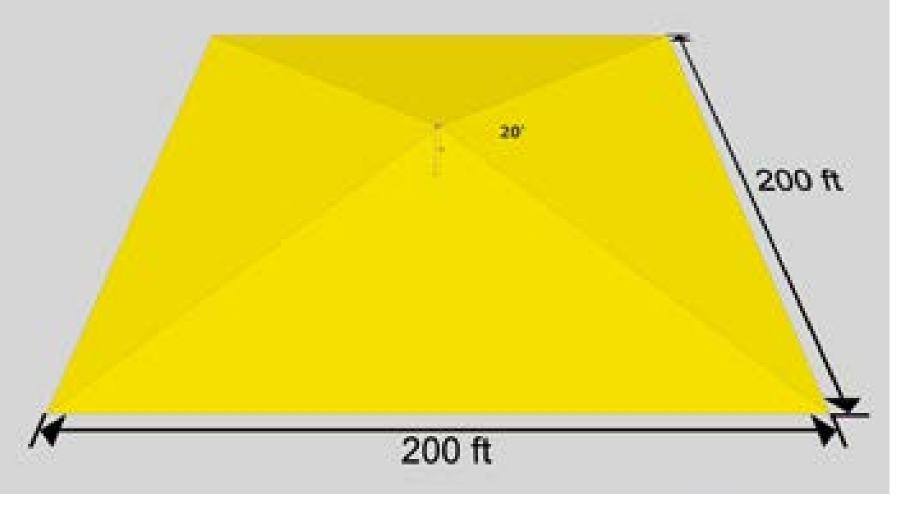
Lighting Application	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
WATTAGE ALLOWANCE PER APPLICATION. Use all that apply as appropriate.					
Building Entrances or Exits. Allowance per door. Luminaires qualifying for this allowance shall be within 20 feet of the door.	Not applicable	~~15~~ 9 watts	~~25~~ 15 watts	~~35~~ 19 watts	~~45~~ 21 watts
Primary Entrances to Senior Care Facilities, Police Stations, ~~Hospitals~~Healthcare Facilities, Fire Stations, and Emergency Vehicle Facilities. Allowance per primary entrance(s) only. Primary entrances shall provide access for the general public and shall not be used exclusively for staff or service personnel. This allowance shall be in addition to the building entrance or exit allowance above. Luminaires qualifying for this allowance shall be within 100 feet of the primary entrance.	Not applicable	~~45~~ 20 watts	~~80~~ 40 watts	~~120~~ 57 watts	~~130~~ 60 watts
Drive Up Windows. Allowance per customer service location. Luminaires qualifying for this allowance shall be within 2 mounting heights of the sill of the window.	Not applicable	~~40~~ 16 watts	~~75~~ 30 watts	~~125~~ 50 watts	~~200~~ 75 watts
Vehicle Service Station Uncovered Fuel Dispenser. Allowance per fueling dispenser. Luminaires qualifying for this allowance shall be within 2 mounting heights of the dispenser.	Not applicable	~~120~~ 55 watts	~~175~~ 77 watts	~~185~~ 81 watts	~~330~~ 135 watts
ATM Machine Lighting. Allowance per ATM machine. Luminaires qualifying for this allowance shall be within 50 feet of the dispenser.	Not applicable	~~250~~ 100 watts for first ATM machine, ~~70~~ 35 watts for each additional ATM machine.			
WATTAGE ALLOWANCE PER UNIT LENGTH (W/linear ft). May be used for one or two frontage side(s) per site.					
Outdoor Sales Frontage. Allowance for frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. Luminaires qualifying for this allowance shall be located between the principal viewing location and the frontage outdoor sales area.	Not applicable	No Allowance	~~22.5~~11 W/linear ft	~~36~~ 19 W/linear ft	~~45~~ 25 W/linear ft
WATTAGE ALLOWANCE PER HARDSCAPE AREA (W/ft²). May be used for any illuminated hardscape area on the site.					
Hardscape Ornamental Lighting. Allowance for the total site illuminated hardscape area. Luminaires qualifying for this allowance shall be rated for 100 watts or less as determined in accordance with Section 130.0(d), and shall be post-top luminaires, lanterns, pendant luminaires, or chandeliers.	Not applicable	No Allowance	~~0.02~~0.007 W/ft²	~~0.04~~0.013 W/ft²	~~0.06~~0.019 W/ft²

TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS. All area and distance measurements in plan view unless otherwise noted.

Lighting Application	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
WATTAGE ALLOWANCE PER SPECIFIC AREA (W/ft^2). Use as appropriate, provided that none of the following specific applications shall be used for the same area.					
Building Facades. Only areas of building façade that are illuminated shall qualify for this allowance. Luminaires qualifying for this allowance shall be aimed at the façade and shall be capable of illuminating it without obstruction or interference by permanent building features or other objects.	Not applicable	No Allowance	~~0.18~~0.100 W/ft^2	~~0.35~~0.170 W/ft^2	~~0.50~~0.225 W/ft^2
Outdoor Sales Lots. Allowance for uncovered sales lots used exclusively for the display of vehicles or other merchandise for sale. Driveways, parking lots or other nonsales areas shall be considered hardscape areas even if these areas are completely surrounded by sales lot on all sides. Luminaires qualifying for this allowance shall be within 5 mounting heights of the sales lot area.	Not applicable	~~0.164~~ 0.060 W/ft^2	~~0.555~~0.210 W/ft^2	~~0.758~~0.280 W/ft^2	~~1.285~~ 0.485 W/ft^2
Vehicle Service Station Hardscape. Allowance for the total illuminated hardscape area less area of buildings, under canopies, off property, or obstructed by signs or structures. Luminaires qualifying for this allowance shall be illuminating the hardscape area and shall not be within a building, below a canopy, beyond property lines, or obstructed by a sign or other structure.	Not applicable	~~0.014~~ 0.006 W/ft^2	~~0.155~~ 0.068 W/ft^2	~~0.308~~ 0.138 W/ft^2	~~0.485~~ 0.200 W/ft^2
Vehicle Service Station Canopies. Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy.	Not applicable	~~0.514~~ 0.220 W/ft^2	~~1.005~~ 0.430 W/ft^2	~~1.300~~ 0.580 W/ft^2	~~2.200~~ 1.010 W/ft^2
Sales Canopies. Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy.	Not applicable	No Allowance	~~0.655~~ 0.470 W/ft^2	~~0.908~~ 0.622 W/ft^2	~~1.135~~ 0.740 W/ft^2
Nonsales 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	~~0.084~~ 0.057 W/ft^2	~~0.205~~ 0.137 W/ft^2	~~0.408~~ 0.270 W/ft^2	~~0.5850~~ 0.370 W/ft^2
Guard Stations. Allowance up to 1,000 square feet per vehicle lane. Guard stations provide access to secure areas controlled by security personnel who stop and may inspect vehicles and vehicle occupants, including identification, documentation, vehicle license plates, and vehicle contents. Qualifying luminaires shall be within 2 mounting heights of a vehicle lane or the guardhouse.	Not applicable	~~0.154~~ 0.081 W/ft^2	~~0.355~~ 0.176 W/ft^2	~~0.708~~ 0.325 W/ft^2	~~0.985~~ 0.425 W/ft^2
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 two mounting heights of the student pick-up/drop-off zone.	Not applicable	No Allowance	~~0.12~~ 0.056 W/ft^2	~~0.45~~ 0.200 W/ft^2	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 two mounting heights of the hardscape area of outdoor dining.	Not applicable	~~0.014~~ 0.004 W/ft^2	~~0.135~~ 0.030 W/ft^2	~~0.240~~ 0.050 W/ft^2	~~0.400~~ 0.075 W/ft^2
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	~~0.007~~ 0.004 W/ft^2	~~0.009~~ 0.005 W/ft^2	~~0.019~~ 0.010 W/ft^2	No Allowance

CHANGE SIGNIFICANCE: Tables 140.7-A and -B – The purpose of the changes to these tables are to update outdoor lighting power allowance values, basing them on LED lighting technologies for all outdoor lighting applications (Table 140.7-A and Table 140.7-B). LED lighting technology is continuing to become more efficient, and associated costs are continuing to drop, making this LED lighting technology cost effective under the 2019 Energy Code Cycle. Updating these values is necessary to reduce the wasteful, uneconomic, inefficient, and unnecessary consumption of energy.

Table 140.7-A – This table has been redesigned to show asphalt and concrete hardscape lighting power allowances for each lighting zone in the body of the table. Concrete hardscape allowances were previously noted in the footnotes to the table. Any hardscape surface that is not asphalt must use the concrete allowances.



Illuminated Hardscape Area – This is defined as the improved area within a square pattern around each luminaire with each side ten times the luminaire mounting height with the luminaire in the middle of the pattern.
Source: California Energy Commission

140.8(b)

Alternate Lighting Sources

CHANGE TYPE: Modification

CHANGE SUMMARY: Language relating to sign lighting was updated in response to changes to referenced standard ANSI C82.6-2015.

2019 CODE:

SECTION 140.8 – PRESCRIPTIVE REQUIREMENTS FOR SIGNS

This section 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.

[…]

(b) **Alternate Lighting Sources.** The sign shall comply if it is equipped only with one or more of the following light sources:

1. High pressure sodium lamps; or
2. 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 ~~measured output wattage to the lampreference~~ lamp power divided by the ~~measured operating input wattage~~ballast input power when tested according to ANSI C82.6-~~2005~~2015.

   […]

CHANGE SIGNIFICANCE: Section 140.8(b)2 – The purpose of the change to this section is to update the reference to ANSI C82.6 to its most current version and to update the terminology used in the section for consistency with the updated ANSI standard. This change is necessary to keep pace with updates to industry standards.

140.9(a)

Prescriptive Requirements for Computer Rooms

CHANGE TYPE: Modification

CHANGE SUMMARY: Fault detection diagnostics (FDD) requirements were added to the existing economizer requirements for computer rooms, and an exemption from all requirements in this section was added for healthcare facilities.

2019 CODE:

(a) **Prescriptive Requirements for Computer Rooms.** Space conditioning systems serving a computer room with a power density greater than 20 W/ft^{2}shall comply with this section by being designed with and having constructed and installed a cooling system that meets the requirements of Subsections 1 through 6.

1. **Economizers.** Each individual cooling system primarily serving computer rooms shall include either:
   - A. An integrated air economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 55°F dry-bulb/50°F wet-bulb and below<u>, and be equipped with a fault detection and diagnostic system as specified by Section 120.2(i);</u> or
   - B. An integrated water economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 40°F dry-bulb/35°F wet-bulb and below.

   [...]

<u>**EXCEPTION to Section 140.9(a):** Computer rooms located in healthcare facilities.</u>

CHANGE SIGNIFICANCE: The purpose of this change is to require computer rooms that incorporate an air economizer to comply with the Fault Detection and Diagnostics (FDD). Air economizers serving a computer room suffer from the same operational deficiencies as air economizers serving other space types, and would equally benefit from having on board FDD.

The new exception exempts licensed healthcare facilities from compliance with the prescriptive requirements for computer rooms. This is necessary because this section has been identified as having the potential to interfere with health and safety requirements for technology and computer rooms in healthcare facilities.

Getty Images

Computer Rooms – Computer rooms located in healthcare facilities are exempt from the 2019 Energy Code.

140.9(b)

Prescriptive Requirements for Kitchens

CHANGE TYPE: Modification

CHANGE SUMMARY: An exception from the requirements in this section was added for healthcare facilities.

2019 CODE:

(b) **Prescriptive Requirements for Commercial Kitchens.**

[…]

EXCEPTION to Section 140.9(b): healthcare facilities.

CHANGE SIGNIFICANCE: The purpose of this exception is to exempt licensed healthcare facilities from compliance with commercial kitchen exhaust requirements. This section has been identified as having the potential to interfere with the strict ventilation design requirements necessary for infection control. Future code cycles may remove this exception based on more detailed analysis, add partial exceptions tailored specifically for healthcare, or both.

140.9(c)

Prescriptive Requirements for Laboratory and Factory Exhaust Systems

CHANGE TYPE: Modification and Addition

CHANGE SUMMARY: This section was expanded to add new requirements for factory exhaust systems.

2019 CODE:

(c) **Prescriptive Requirements for Laboratory and Factory Exhaust Systems~~exhaust systems.~~**

1. **Airflow Reduction Requirements.** For buildings with laboratory exhaust systems where the minimum circulation rate to comply with code or accreditation standards is 10 ACH or less, the design exhaust airflow shall be capable of reducing zone exhaust and makeup airflow rates to the regulated minimum circulation rate, or the minimum required to maintain pressurization requirements, whichever is larger. Variable exhaust and makeup airflow shall be coordinated to achieve the required space pressurization at varied levels of demand and fan system capacity.

   EXCEPTION 1 to Section 140.9(c)1: Laboratory exhaust systems serving zones where constant volume is required by the Authority Having Jurisdiction, facility Environmental Health & Safety department or other applicable code.

   EXCEPTION 2 to Section 140.9(c)1: New zones on an existing constant volume exhaust system.

2. **Exhaust System Transfer Air.** Conditioned supply air delivered to any space with mechanical exhaust shall comply with the requirements of Section 140.4(o).

3. **Fan System Power Consumption.** All newly installed fan exhaust systems serving a laboratory or factory greater than 10,000 CFM, shall meet subsection A and either B, C, or D:

   A. System shall meet all discharge requirements in ANSI Z9.5-2012.

   B. The exhaust fan system power shall not exceed 0.85 watts per cfm of exhaust air for systems with air filtration, scrubbers, or other air treatment devices. For all other exhaust fan systems the system power shall not exceed 0.65 watts per cfm of exhaust air. Exhaust fan system power equals the sum of the power of all fans in the exhaust system that are required to operate at normal occupied design conditions in order to exhaust air from the conditioned space to the outdoors. Exhaust air does not include entrained air, but does include all exhaust air from fume hoods, hazardous exhaust flows, or other manifolded exhaust streams.

   EXCEPTION to Section 140.9(c)3B: Laboratory exhaust systems where applicable local, state, or federal exhaust treatment requirements specify installation of air treatment devices that cause more than 1 in. of water pressure drop.

   C. The volume flow rate at the stack shall vary based on the measured 5-minute averaged wind speed and wind direction obtained from a calibrated local anemometer.

i. At least two anemometers shall be installed in a location that experiences similar wind conditions to the free stream environment above the exhaust stacks and be at a height that is outside the wake region of nearby structures.

ii. Look-up tables shall be used to define the required exhaust volume flow rate, as a function of at least eight wind speeds and eight wind directions, to maintain downwind concentrations below health and odor limits, as defined by the 2018 American Conference of Governmental Industrial Hygienists Threshold Limit Values and Biological Exposure Indices, for all detectable contaminants, or as defined by applicable local, state, or federal jurisdictions, if more stringent.

iii. Wind speed/direction sensors shall be certified by the manufacturer to be accurate within plus or minus 40 fpm (0.2 m/s) and 5.0 degrees 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.

iv. Upon detection of anemometer and/or signal failure, the system shall reset the exhaust volume flow rate to the value needed to maintain downwind concentrations below health and odor limits for all detectable contaminants at worst-case wind conditions and shall report the fault to an Energy Management Control System or fault management application which automatically provides notification of the fault to a remote system provider. The system shall have logic that automatically checks for anemometer failure by the following means.

a. If any anemometer has not been calibrated within the manufacturer's recommended calibration period, the sensor has failed.

b. During unoccupied periods the system compares the readings of all anemometers. If any anemometer is more than 30% above or below the average reading for a period of 4 hours, the anemometer has failed.

v. Before an occupancy permit is granted for a laboratory or process facility subject to Section 140.9(c)3C, the applicable equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7.16. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.16.

D. The volume flow rate at the stack shall vary based on the measured contaminant concentration in the exhaust plenum from a calibrated contaminant sensor installed within each exhaust plenum.

i. A contaminant-event threshold shall be established based on maintaining downwind concentrations below health and odor limits for all detectable chemicals at worst-case wind conditions, as defined by the 2018 American Conference of Governmental Industrial Hygienists Threshold Limit Values and Biological Exposure Indices, or as defined by applicable local, state, or federal jurisdictions, if more stringent.

ii. At least two contaminant concentration sensors shall be Photo Ionization Detectors (PID) certified by the manufacturer to be accurate within plus or minus 5% when measured at sea level and 25°C, factory calibrated, and certified by the manufacturer to require calibration no more frequently than once every 6 months.

iii. Upon detection of sensor and/or signal failure, the system shall reset the exhaust volume flow rate to the value needed to maintain downwind concentrations below health and odor limits for all detectable contaminants at worst-case wind conditions and shall report the fault to an Energy Management Control System or fault management application which automatically provides notification of the fault to a remote system provider. The system shall have logic that automatically checks for sensor failure by the following means.

a. If any sensor has not been calibrated within the manufacturer's recommended calibration period, the sensor has failed.

b. During unoccupied periods the system compares the readings of all sensors. If any sensor is more than 30% above or below the average reading for a period of 4 hours, the sensor has failed.

iv. Before an occupancy permit is granted for a laboratory or process facility subject to Section 140.9(c)3D, the applicable equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7.16. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.16.

4. **Fume Hood Automatic Sash Closure.** Variable air volume laboratory fume hoods with vertical only sashes located in fume hood intensive laboratories, as described in Table 140.9-B, shall have an automatic sash closure system that complies with the following:

A. The automatic sash closure system shall be capable of the following:

i. The automatic sash closure system shall have a dedicated zone presence sensor that detects people in the area near the fume hood sash and automatically closes the sash within 5 minutes of no detection.

ii. The automatic sash closure system shall have controls to prevent the sash from automatic closing when a force of no more than 10 lbs is detected.

iii. The automatic sash closure system shall be equipped with an obstruction sensor that prevents the sash from automatic closing with obstructions in the sash opening. Obstruction sensor shall be capable of sensing transparent materials such as laboratory glassware.

iv. The automatic sash closure system shall be capable of being configured in a manual open mode where once the sash is closed, detection of people in the area near the fume hood by the zone presence sensor does not open the fume hood sash.

B. Fume Hood Automatic Sash Closure Acceptance. Before an occupancy permit is granted for the fume hoods subject to 140.9(c)4, the equipment and systems shall be certified as meeting the Acceptance Requirement for Code Compliance as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.17.

Table 140.9-B Fume Hood Intensive Laboratories

Occupied Minimum Ventilation ACH	≤ 4	> 4 and ≤ 6	> 6 and ≤ 8	> 8 and ≤ 10	> 10 and ≤ 12	> 12 and ≤ 14
Hood Density (linear feet per 10,000 ft^3 of laboratory space	≥ 6	≥ 8	≥ 10	≥ 12	≥ 14	≥ 16

EXCEPTION to Section 140.9(c): healthcare facilities.

CHANGE SIGNIFICANCE: The scope of this section now includes factory exhaust systems in addition to laboratory exhaust systems. Requirements have been added for exhaust system transfer air [Section 140.9(c)2], fan system power consumption [Section 140.9(c)3], and fume hood automatic sash closure [Section 140.9(c)4].

Exception to Section 140.9(c) – The purpose of this exception is to exempt licensed healthcare facilities from compliance with laboratory exhaust system requirements. This section has been identified as having the potential to interfere with the strict ventilation design requirements necessary for infection control. Future code cycles may remove this exception based on more detailed analysis, add partial exceptions tailored specifically for healthcare, or both.

Section 140.9(c)1 – Airflow Reduction Requirements. A title was added to this paragraph and it was numbered to accommodate the additional requirements of this section. The efficiency requirements in this subsection have not changed from the 2016 Energy Code.

Section 140.9(c)2 – Exhaust System Transfer Air. This new section limits the amount of conditioned air supplied to a space with mechanical exhaust by taking advantage of available transfer air. By using transfer air, the amount of air that needs to be conditioned is reduced, thus saving energy.

Section 140.9(c)3 – Fan System Power Consumption. Newly installed laboratory and factory exhaust systems greater than 10,000 CFM must meet the discharge requirements of ANSI Z9.5, and one of three prescriptive pathways to reduce fan system power. The prescriptive pathways are based on either fan system efficacy (watts/cfm), variable volume stack flow rate based on wind speed at the stack, or variable volume stack flow rate based on exhaust contaminant concentration.

Section 140.9(c)3 – Fume Hood Automatic Sash Closure. Fume hood intense laboratories with variable air volume HVAC systems and vertical fume hood sashes are prescriptively required to install automatic sash closure systems. For this measure, fume hood intensive means the air change rate of the space is driven by the fume hood exhaust and not the minimum ventilation requirements. The automatic closure system must be triggered by zone presence sensors within 5 minutes of vacancy. The system must have sash closure safeguards and must have a manual open mode. This measure saves energy by reducing laboratory exhaust air and makeup air conditioning.

PART 6

Nonresidential, High-Rise Residential and Hotel/Motel Occupancies—Additions, Alterations, and Repairs

Subchapter 6

Subchapter 6 identifies which sections of the Energy Code apply to additions and alterations to existing nonresidential, high-rise residential, hotel/motel buildings, and covered processes. This subchapter also identifies specific variances from the previous sections of the Energy Code for additions and alterations to these buildings and systems. All requirements for additions and alterations to these existing buildings are defined within Section 141.0, and this section refers to other applicable sections of the Energy Code, depending on the scope of work. Applicable requirements for additions and alterations to existing covered processes are found in Section 141.1. ■

141.0

Additions, Alterations, and Repairs to Existing Nonresidential, High-rise Residential, and Hotel/Motel Buildings, to Existing Outdoor Lighting, and to Internally and Externally Illuminated Signs

141.0(a)

Additions

141.0(a)1 and 2

Prescriptive Approach and Performance Approach

141.0(b)

Alterations

141.0(b)2A NOTE

Prescriptive Approach, Fenestration Alterations

141.0(b)2C

Prescriptive Approach, New or Replacement Space-Conditioning Systems or Components

141.0(b)2E

Prescriptive Approach, Altered Space-Conditioning Systems

141.0(b)2I – K

Prescriptive Approach, Altered Indoor Lighting Systems

141.1

Requirements for Covered Processes in Additions, Alterations to Existing Nonresidential, High-Rise Residential, And Hotel/Motel Buildings

141.0

Additions, Alterations and Repairs to Existing Nonresidential„ High-rise Residential, and Hotel/Motel Buildings, to Existing Outdoor Lighting, and to Internally and Externally Illuminated Signs

CHANGE TYPE: Modification

CHANGE SUMMARY: An exception was added to exclude alterations to healthcare facilities from the Energy Code.

2019 CODE:

SECTION 141.0 – ADDITIONS, ALTERATIONS AND REPAIRS TO EXISTING NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL BUILDINGS, TO EXISTING OUTDOOR LIGHTING, AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

Additions, alterations, and repairs to existing nonresidential, high-rise residential, and hotel/motel buildings, existing outdoor lighting for these occupancies, and internally and externally illuminated signs, shall meet the requirements specified in Sections 100.0 through 110.10, and 120.0 through 130.5 that are applicable to the building project, and either the performance compliance approach (energy budgets) in Section 141.0(a)2 (for additions) or 141.0(b)3 (for alterations), or the prescriptive compliance approach in Section 141.0(a)1 (for additions) or 141.0(b)2 (for alterations), for the Climate Zone in which the building is located. Climate zones are shown in Figure 100.1-A.

Covered process requirements for additions, alterations and repairs to existing nonresidential, high-rise residential, and hotel/motel buildings are specified in Section 141.1.

EXCEPTION to Section 141.0: Alterations to healthcare facilities are not required to comply with this Section.

[…]

CHANGE SIGNIFICANCE: The purpose of this exception is to exempt alterations and repairs to licensed healthcare facilities from compliance with this code section. This exception is necessary because licensed healthcare facilities are being brought into the scope of the Energy Code for the first time, but applying the alteration requirements in this section to licensed healthcare facilities has been identified as potentially not being cost effective. Future code cycles may remove this exception based on more detailed analysis, add partial exceptions tailored specifically for healthcare, or both.

141.0(a)1 and 2

Additions, Prescriptive Approach and Performance Approach

CHANGE TYPE: Clarification

CHANGE SUMMARY: Section 120.8 is not applicable to additions, and thus was removed from this section.

2019 CODE:

(a) **Additions.** Additions shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The envelope and lighting of the addition; any newly installed space-conditioning system, electrical power distribution system, or water-heating system; any addition to an outdoor lighting system; and any new sign installed in conjunction with an indoor or outdoor addition shall meet the applicable requirements of Sections 110.0 through <u>120.7, 120.9 through</u> 130.5, and Sections 140.2 through 140.9.
2. **Performance approach.**

   A. The envelope and indoor lighting in the conditioned space of the addition, and any newly installed space-conditioning system, electrical power distribution system, or water-heating system, shall meet the applicable requirements of Sections 110.0 through <u>120.7, 120.9 through</u> 130.5; and

   […]

CHANGE SIGNIFICANCE: Section 120.8 was removed from the sections referenced for the prescriptive and performance approach for additions. This was done to clarify that the commissioning requirements of Section 120.8 do not apply to additions. To the extent Section 120.8 could have been read as applying to additions to existing buildings, this change has the substantive effect of limiting commissioning requirements to newly constructed buildings. The change otherwise clarifies without materially altering the requirements in the Energy Code.

141.0(b)2A Note

Alterations, Prescriptive Approach Fenestration Alterations

CHANGE TYPE: Addition and Clarification

CHANGE SUMMARY: A note was added to provide distinction between fenestration alterations and repairs.

2019 CODE:

(b) **Alterations.** Alterations to components of existing nonresidential, high-rise residential, ~~or~~ hotel/motel ~~buildings~~, or relocatable public school buildings, ~~or~~ including alterations made in conjunction with a change in building occupancy to a nonresidential, high-rise residential, or hotel/motel occupancy ~~are not subject to Subsection (a) and~~ shall meet item 1, and either Item 2 or 3 below:

[…]

2. **Prescriptive approach.** The altered components of the envelope, or space conditioning, lighting, electrical power distribution and water heating systems, and any newly installed equipment serving the alteration, shall meet the applicable requirements of Sections 110.0 through 110.9, Sections 120.0 through 120.6, and Sections 120.9 through 130.5.

   […]

   A. Fenestration alterations other than repair and those subject to Section 141.0(b)2 shall meet the requirements below:

      i. Vertical fenestration alterations shall meet the requirements in Table 141.0-A.

      ii. Added vertical fenestration shall meet the requirements of TABLE 140.3-B, C, or D.

      iii. All altered or newly installed skylights shall meet the requirements of TABLE 140.3-B, C or D.

      EXCEPTION 1 to Section 141.0(b)2Ai: ~~Replacing~~ <u>In an alteration, where</u> 150 square feet or less of the entire building's vertical fenestration <u>is replaced,</u> RSHGC and VT requirements of TABLE 141.0-A shall not apply.

      EXCEPTION 2 to Section 141.0(b)2Aii: In an alteration, where 50 square feet or less of vertical fenestration is added, RSHGC and VT requirements of TABLE 140.3-B, C or D shall not apply.

      EXCEPTION 3 to Section 141.0(b)2Aiii: In an alteration, where 50 square feet or less of skylight is added, SHGC and VT requirements of TABLE 140.3-B, C or D shall not apply.

   <u>**NOTE:** Glass replaced in an existing sash and frame or sashes replaced in an existing frame are considered repairs. In these cases, Section 141.0(c) requires that the replacement be at least equivalent to the original in performance.</u>

TABLE 141.0-A ALTERED VERTICAL FENESTRATION MAXIMUM *U*-FACTOR AND MAXIMUM RSHGC

Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
U-factor	0.47	0.47	0.58	0.47	0.58	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47
RSHGC	0.41	0.31	0.41	0.31	0.41	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.41
VT	See TABLE 140.3-B, C, and D for all climate zones															

CHANGE SIGNIFICANCE: The purpose of the changes to Section 141.0(b)2A is to correct grammar, and to add a note providing distinction between an alteration and a repair. The note matches language found in the low-rise residential alterations section, Section 150.2(b)1B, and in the definition of the term "Fenestration Repair" in Section 100.1. These changes clarify without materially altering the requirements.

141.0(b)2C

Alterations, Prescriptive Approach, New or Replacement Space-Conditioning Systems or Components

CHANGE TYPE: Addition

CHANGE SUMMARY: A pressure drop allowance was added for filtration devices that are added as part of a new or replacement space-conditioning system or component alteration.

2019 CODE:

(b) **Alterations.** Alterations to components of existing nonresidential, high-rise residential, ~~or~~ hotel/motel ~~buildings~~, or relocatable public school buildings, ~~or~~ including alterations made in conjunction with a change in building occupancy to a nonresidential, high-rise residential~~,~~ or hotel/motel occupancy ~~are not subject to Subsection~~ (a) and shall meet item 1, and either Item 2 or 3 below:

[…]

2. **Prescriptive approach.** The altered components of the envelope, or space conditioning, lighting, electrical power distribution and water heating systems, and any newly installed equipment serving the alteration, shall meet the applicable requirements of Sections 110.0 through 110.9, Sections 120.0 through 120.6, and Sections 120.9 through 130.5.

   […]

   C. **New or Replacement Space-Conditioning Systems or Components** other than new or replacement space-conditioning system ducts shall meet the requirements of Section 140.4 applicable to the systems or components being altered. For compliance with Section 140.4(c)1, additional fan power adjustment credits are available as specified in Table 141.0-D.

Table 141.0-D Fan Power Limitation Pressure Drop Adjustment

DEVICE	ADJUSTMENT CREDITS
Particulate Filtration Credit: MERV 9 through 12	0.5 in. of water
Particulate Filtration Credit: MERV 13 through 15	0.9 in. of water

CHANGE SIGNIFICANCE: The purpose of this change is to provide a pressure drop credit to allow additional fan power that may be needed to support the inclusion of filtration devices. This change is needed to promote the use of filtration devices in nonresidential alterations where MERV 13 filtration is not required. MERV 13 filtration is only required for a nonresidential alteration when the entire system, including the ducts, are replaced.

141.0(b)2E

Alterations, Prescriptive Approach, Altered Space-Conditioning Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: Reference locations for demand response and duct sealing requirements for altered space-conditioning systems were changed due to reorganization of the code.

2019 CODE:

(b) **Alterations.** Alterations to <u>components of</u> existing nonresidential, high-rise residential, ~~or~~ hotel/motel ~~buildings~~, or relocatable public school buildings, ~~or~~ <u>including</u> alterations <u>made</u> in conjunction with a change in building occupancy to a nonresidential, high-rise residential, or hotel/motel occupancy ~~are not subject to Subsection (a)~~ and shall meet item 1, and either Item 2 or 3 below:

[…]

2. **Prescriptive approach.** The altered components of the envelope, or space conditioning, lighting, electrical power distribution and water heating systems, and any newly installed equipment serving the alteration, shall meet the applicable requirements of Sections 110.0 through 110.9, Sections 120.0 through 120.6, and Sections 120.9 through 130.5.

   […]

   E. **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:

      i. For all altered units where the existing thermostat does not comply with ~~Reference Joint Appendix JA5~~<u>the requirements for demand responsive controls specified in Section 110.12</u>, the existing thermostat shall be replaced with a <u>demand responsive</u> thermostat that complies with ~~Reference Joint Appendix JA5~~<u>Section 110.12</u>. All newly installed space-conditioning systems requiring a thermostat shall be equipped with a demand responsive thermostat that complies with ~~Reference Joint Appendix JA5~~<u>Section 110.12;</u> and

      ii. 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 Sections 140.4(l)1, ~~2 and 3~~, as confirmed through field verification and diagnostic testing, in accordance with the applicable procedures for duct sealing of altered existing duct systems as specified in Reference Nonresidential Appendix NA2, and conforming to the applicable leakage compliance criteria in Section 141.0(b)2D.

   EXCEPTION 1 to Section 141.0(b)2Eii: Duct Sealing. Buildings altered so that the duct system no longer meets the criteria of Sections 140.4 (l)1, ~~2, and 3~~ are exempt from the requirements of Subsection 141.0(b)2Eii.

EXCEPTION 2 to Section 141.0(b)2Eii: Duct Sealing. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in the Reference Nonresidential Appendix NA2 are exempt from the requirements of Subsection 141.0(b)2Eii.

EXCEPTION 3 to Section 141.0(b)2Eii: Duct Sealing. Existing duct systems constructed, insulated or sealed with asbestos are exempt from the requirements of Subsection 141.0(b)2Eii.

CHANGE SIGNIFICANCE: Section 141.0(b)2E – The purpose of the changes is to reference Section 110.12, Mandatory Requirements for Demand Management, and Section 140.4(l)1, Air Distribution System Duct Leakage Sealing. Section 110.12 was added to consolidate all requirements relating to demand responsive controls. Duct leakage requirements were moved and consolidated into Section 140.4(l)1.

141.0(b)2I – K

Alterations, Prescriptive Approach Altered Indoor Lighting Systems

CHANGE TYPE: Modification, Clarification

CHANGE SUMMARY: Existing language was condensed, and thresholds and control requirements were standardized across all types of indoor lighting system alterations.

2019 CODE:

(b) **Alterations.** Alterations to components of existing nonresidential, high-rise residential, ~~or~~ hotel/motel ~~buildings~~, or relocatable public school buildings, ~~or~~ including alterations made in conjunction with a change in building occupancy to a nonresidential, high-rise residential, or hotel/motel occupancy ~~are not subject to Subsection (a) and~~ shall meet item 1, and either Item 2 or 3 below:

[…]

2. **Prescriptive approach.** The altered components of the envelope, or space conditioning, lighting, electrical power distribution and water heating systems, and any newly installed equipment serving the alteration, shall meet the applicable requirements of Sections 110.0 through 110.9, Sections 120.0 through 120.6, and Sections 120.9 through 130.5.

   […]

   I. **Altered Indoor Lighting Systems.** Alterations to indoor lighting systems that include 10% or more of the luminaires serving an enclosed space shall meet the requirements of i, ii, or iii below:

      i. The alteration shall comply with the indoor lighting power requirements specified in Section 140.6 and the lighting control requirements specified in Table 141.0-F;

      ii. The alteration shall not exceed 80% of the indoor lighting power requirements specified in Section 140.6, and shall comply with the lighting control requirements specified in Table 141.0-F; or

      iii. The alteration shall be a one-for-one luminaire alteration within a building or tenant space of 5,000 square feet or less, the total wattage of the altered luminaires shall be at least 40% lower compared to their total pre-alteration wattage, and the alteration shall comply with the lighting control requirements specified in Table 141.0-F.

      Alterations to indoor lighting systems shall not prevent the operation of existing, unaltered controls, and shall not alter controls to remove functions specified in Section 130.1.

      Alterations to lighting wiring are considered alterations to the lighting system. Alterations to indoor lighting systems are not required to separate existing general, floor, wall, display, or ornamental lighting on shared circuits or controls. New or completely replaced lighting circuits shall comply with the control separation requirements of Section 130.1(a)3 and 130.1(c)1D.

EXCEPTION 1 to Section 141.0(b)2I. Alteration of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded as specified in Section 140.6(a)3.

EXCEPTION 2 to Section 141.0(b)2I. Any enclosed space with only one luminaire.

EXCEPTION 3 to Section 141.0(b)2I. Any alteration that would directly cause the disturbance of asbestos, unless the alteration is made in conjunction with asbestos abatement.

EXCEPTION 4 to Section 141.0(b)2I. Acceptance testing requirements of Section 130.4 are not required for alterations where lighting controls are added to control 20 or fewer luminaires.

EXCEPTION 5 to Section 141.0(b)2I. Any alteration limited to adding lighting controls or replacing lamps, ballasts, or drivers.

EXCEPTION 6 to Section 141.0(b)2I. One-for-one luminaire alteration of up to 50 luminaires either per complete floor of the building or per complete tenant space, per annum.

~~**Entire Luminaire Alterations.** Entire luminaire alterations shall meet the following requirements:~~

~~i. For each enclosed space, alterations that consist of either (a) removing and reinstalling a total of 10 percent or more of the existing luminaires; or (b) replacing or adding entire luminaires; or (c) adding, removing, or replacing walls or ceilings along with any redesign of the lighting system, shall meet the lighting power allowance in Section 140.6, and the altered luminaires shall meet the applicable requirements in Table 141.0-E; or~~

~~ii. For alterations where existing luminaires are replaced with new luminaires, and that do not include adding, removing, or replacing walls or ceilings along with redesign of the lighting system, the replacement luminaires in each office, retail, and hotel occupancy shall have at least 50 percent, and in all other occupancies at least 35 percent, lower rated power at full light output compared to the existing luminaires being replaced, and shall meet the requirements of Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B.~~

~~**EXCEPTION 1 to Section 141.0(b)2I.** Alteration of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded as specified in Section 140.6(a)3.~~

~~**EXCEPTION 2 to Section 141.0(b)2I.** In an enclosed space where two or fewer luminaires are replaced or reinstalled.~~

~~**EXCEPTION 3 to Section 141.0(b)2I.** Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.~~

~~**EXCEPTION 4 to Section 141.0(b)2I.** Acceptance testing requirements of Section 130.4 are not required for alterations where lighting controls are added to control 20 or fewer luminaires.~~

J. **Reserved.**~~**Luminaire Component Modifications.** Luminaire component modifications in place that include replacing the ballasts or drivers and the associated lamps in the luminaire, permanently changing the light source of the luminaire, or changing the optical system of the luminaire, where 70 or more existing luminaires are modified either on any single floor of a building or, where multiple tenants inhabit the same floor, in any single tenant space, in any single year, shall not prevent or disable the operation of any multi-level, shut-off, or daylighting controls, and shall:~~

i. ~~Meet the lighting power allowance in Section 140.6 and comply with Table 141.0-E; or~~

ii. ~~In office, retail, and hotel occupancies have at least 50 percent, and in all other occupancies have at least 35 percent, lower rated power at full light output as compared to the original luminaires prior to being modified, and meet the requirements of Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B.~~

~~Lamp replacements alone and ballast replacements alone shall not be considered a modification of the luminaire provided that the replacement lamps or ballasts are installed and powered without modifying the luminaire.~~

~~**EXCEPTION 1 to Section 141.0(b)2J.** Modification of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded by Section 140.6(a)3.~~

~~**EXCEPTION 2 to Section 141.0(b)2J.** In an enclosed space where two or fewer luminaires are modified.~~

~~**EXCEPTION 3 to Section 141.0(b)2J.** Modifications that would directly cause the disturbance of asbestos, unless the modifications are made in conjunction with asbestos abatement.~~

~~**EXCEPTION 4 to Section 141.0(b)2J.** Acceptance testing requirements of Section 130.4 are not required for modifications where lighting controls are added to control 20 or fewer luminaires.~~

K. **Reserved.**~~**Lighting Wiring Alterations.** For each enclosed space, wiring alterations that add a circuit feeding luminaires; that replace, modify, or relocate wiring between a switch or panelboard and luminaires; or that replace lighting control panels, panelboards, or branch circuit wiring; shall:~~

i. ~~meet the lighting power allowance in Section 140.6;~~

ii. ~~meet the requirements in Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)3, and 130.1(c)4;~~

iii. ~~for each enclosed space, be wired to create a minimum of one step between 30-70 percent of lighting power or meet Section 130.1(b); and~~

iv. ~~for each enclosed space where wiring alterations include 10 or more luminaires that provide general lighting within~~

~~the primary sidelit daylit zone or the skylit daylit zone, meet the requirements of 130.1(d).~~

~~**NOTE:** As specified in Section 141.0(b)2I, alterations that include adding, removing, or replacing walls or ceilings resulting in redesign of the lighting system shall meet the requirements of Table 141.0-E.~~

~~**EXCEPTION 1 to Section 141.0(b)2K.** Alterations strictly limited to addition of lighting controls.~~

~~**EXCEPTION 2 to Section 141.0(b)2K.** In an enclosed space where wiring alterations involve two or fewer luminaires.~~

~~**EXCEPTION 3 to Section 141.0(b)2K.** Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.~~

~~**EXCEPTION 4 to Section 141.0(b)2K.** Acceptance testing requirements of Section 130.4 are not required for wiring alterations where lighting controls are added to control 20 or fewer luminaires.~~

~~**TABLE 141.0-E Control Requirements for Entire Luminaire Alterations**~~

~~Control requirements that shall be met~~	~~Resulting lighting power, compared to the lighting power allowance specified in Section 140.6(c)2, Area Category Method~~	
	~~Lighting power is ≤ 85% of allowance~~	~~Lighting power is > 85% to 100% of allowance~~
~~Section 130.1(a)1, 2, and 3 Area Controls~~	~~Yes~~	~~Yes~~
~~Section 130.1(b) Multi-Level Lighting Controls – only for alterations to general lighting of enclosed spaces 100 square feet or larger with a connected lighting load that exceeds 0.5 watts per square foot~~	~~For each enclosed space, minimum one step between 30-70 percent of lighting power regardless of luminaire type, or meet Section 130.1(b)~~	~~Yes~~
~~Section 130.1(c) Shut-Off Controls~~	~~Yes~~	~~Yes~~
~~Section 130.1(d) Automatic Daylight Controls~~	~~Not Required~~	~~Yes~~
~~Section 130.1(e) Demand Responsive Controls – only for alterations > 10,000 ft^2 in a single building, where the alteration also changes the area of the space, or changes the occupancy type of the space, or increases the lighting power~~	~~Not Required~~	~~Yes~~

TABLE 141.0-F Control Requirements for Indoor Lighting System Alterations

Control Specifications		Projects complying with Section 141.0(b)2Ii	Projects complying with Sections 141.0(b)2Iii and 141.0(b)2Iiii	
Manual Area Controls		130.1(a)1	Required	Required
		130.1(a)2	Required	Required
		130.1(a)3	Only required for new or completely replaced circuits	Only required for new or completely replaced circuits
Multilevel Controls		130.1(b)	Required	Not Required
Automatic Shut Off Controls		130.1(c)1	Required; 130.1(c)1D only required for new or completely replaced circuits	Required; 130.1(c)1D only required for new or completely replaced circuits
		130.1(c)2	Required	Required
		130.1(c)3	Required	Required
		130.1(c)4	Required	Required
		130.1(c)5	Required	Required
		130.1(c)6	Required	Required
		130.1(c)7	Required	Required
		130.1(c)8	Required	Required
Daylighting Controls		130.1(d)	Required	Not Required
Demand Responsive Controls		130.1(e)	Required	Not Required

CHANGE SIGNIFICANCE: Section 141.0(b)2I, J, K, and Table 141.0-E – Unnecessary distinctions between different types of alterations to a nonresidential building's indoor lighting system were eliminated for clarity. Control requirements for lighting system alterations were also standardized to simplify requirements and their applicability. An exception was also altered to limit the applicability of the lighting alteration requirements to spaces with two or more luminaires. Limits were also added to the simplified alteration requirements for projects when existing installed lighting power can be reduced significantly.

Sections 141.0(b)2I, J, and K were merged

Indoor lighting alterations are no longer separated into three distinct types (entire luminaire alteration, luminaire component modification, and lighting wiring alteration). These three sections were condensed into a single section titled "Altered Indoor Lighting Systems," which encompasses any indoor lighting alteration where 10 percent or more of the luminaires in an enclosed space are altered.

This change simplifies and clarifies the requirements by standardizing the threshold for triggering indoor lighting system alterations for all project types, and by standardizing the associated lighting control requirements for all types of indoor lighting alterations.

Indoor lighting alteration compliance pathway utilizing 80 percent or less of the allowed lighting power

The indoor lighting alteration compliance pathway for utilizing 85 percent or less of allowed indoor lighting power has changed. Under the 2016 Energy Code, projects with proposed lighting power of 85 percent or less of the allowed lighting power were subject to less stringent control requirements. Under the 2019 Energy Code, the 85 percent threshold has been reduced to 80 percent of the allowed lighting power. The requirement for bi-level lighting controls has been removed to account for this change, which substantially reduces the allowed wattage for projects utilizing this compliance pathway.

Indoor lighting alteration compliance pathway utilizing the reduction of existing lighting power

The compliance pathway for reduction to the existing lighting power is now limited to buildings or tenant spaces that are 5,000 square feet or less, and only for one-for-one luminaire alterations. Larger remodeling projects or more extensive lighting system alterations can no longer use this compliance pathway. This ensures that projects where detailed plans with square foot information for each space is available make use of those plans, rather than basing compliance on the existing lighting, which can vary significantly between buildings.

Projects using this compliance pathway are now required to install partial-OFF controls in corridors, stairwells, and library book stack aisles. This is necessary to ensure compliance with Section 1008 of the *California Building Code*'s requirement to provide means of egress illumination.

Under the 2016 Energy Code, projects could utilize this compliance pathway if the proposed lighting power reduction from existing was at least 35 percent in most space types, and at least 50 percent in office, hotel, motel, and retail spaces. To simplify these requirements, all spaces are now required to demonstrate at least a 40 percent reduction compared to replaced luminaires.

Exception to indoor lighting alteration requirements for spaces with no more than one luminaire

The 2016 exception to indoor lighting alterations for spaces with two or fewer luminaires was found to exempt larger spaces than was intended. The exception was drafted with an assumption of luminaires using fluorescent lamps, however LED luminaires are available in several form factors that illuminate significantly larger spaces than fluorescent luminaires. For this reason, this exception was reduced to spaces with a single luminaire to preserve its intent.

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Lighting Alterations – Requirements for these alterations have been modified for simplicity.

141.1

Requirements for Covered Processes in Additions, Alterations to Existing Nonresidential, High-Rise Residential, And Hotel/Motel Buildings

CHANGE TYPE: Clarification

CHANGE SUMMARY: A minimum exhaust system flow rate was added for laboratory and process facility exhaust systems to exclude smaller systems from the requirements of this section.

2019 CODE:

SECTION 141.1 – REQUIREMENTS FOR COVERED PROCESSES IN ADDITIONS, ALTERATIONS TO EXISTING NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL BUILDINGS

Covered processes in additions or alterations to existing buildings that will be nonresidential, high-rise residential, and hotel/motel occupancies shall comply with the applicable subsections of Section 120.6 and 140.9.

<u>**Lab and Process Facility Exhaust Systems.** All newly installed fan systems for a laboratory or process facility exhaust system greater than 10,000 CFM shall meet the requirements of Section 140.9(c).</u>

NOTE: For alterations that change the occupancy classification of the building, the requirements of Section 141.1 apply to the occupancy that will exist after the alterations.

[…]

CHANGE SIGNIFICANCE: The purpose of the change is to exclude smaller exhaust systems from the requirements for additions and alterations. This change is necessary to avoid requirements which may not be cost effective for smaller systems.

PART **7**

Low-Rise Residential Buildings—Mandatory Features and Devices

Subchapter 7

Subchapter 7 identifies mandatory requirements strictly for low-rise residential buildings. Subchapter 7 consists solely of Section 150.0. All measures in this section are mandatory and cannot be traded away via the performance approach. These measures establish a minimum level of energy efficiency for multiple building features of low-rise residential buildings, including measures related to energy efficiency and to indoor air quality. ■

150.0

Mandatory Features and Devices

150.0(c)

Wall Insulation

150.0(d)

Raised Floor Insulation

150.0(e)

Installation of Fireplaces, Decorative Gas Appliances, and Gas Logs

150.0(j)

Insulation for Piping and Tanks

150.0(j)2

Water piping, solar water-heating system piping, and space conditioning system line insulation thickness and conductivity

150.0(j)3

Insulation Protection

150.0(k)

Residential Lighting

150.0(k)1

Luminaire Requirements

TABLE 150.0-A

Classification of High Efficacy Light Sources

150.0(k)2

Interior Lighting Switching Devices and Controls

150.0(k)3

Outdoor Lighting

150.0(k)4

Internally Illuminated Address Signs

150.0(k)6

Interior Common Areas of Low-rise Multifamily Residential Buildings

150.0(m)

Air-Distribution and Ventilation System Ducts, Plenums, and Fans

150.0(m)1

CMC Compliance

150.0(m)10

Porous Inner Core Flex Duct

150.0(m)12

Air Filtration

150.0(m)13B

Single Zone Central Forced Air Systems; Airflow Rate and Fan Efficacy

150.0(m)13C

Space Conditioning System Airflow Rate and Fan Efficacy; Zonally Controlled Central Forced Air Systems

150.0(m)13D

Space Conditioning System Airflow Rate and Fan Efficacy; Small Duct High Velocity Forced Air Systems

150.0(n)

Water Heating System

150.0(o)

Requirements for Ventilation and Indoor Air Quality

150.0(o)1

Amendments to ASHRAE 62.2

150.0(o)2

Field Verification and Diagnostic Testing

150.0(c)
Wall Insulation

CHANGE TYPE: Modification and Clarification

CHANGE SUMMARY: Mandatory wall insulation requirements were increased for 2 × 6 wood-framed walls and masonry walls in newly constructed low-rise residential buildings, and clarified language.

2019 CODE:

(c) **Wall Insulation.** Opaque portions of above grade walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the following requirements ~~of Items 1, 2, 3 and 4 below~~:

1. 2 × 4 inch framing shall have an overall assembly *U*-factor not exceeding U-0.102~~, equivalent to an installed R-value of 13 in a wood framed assembly~~.

   EXCEPTION to Section 150.0(c)1: Existing walls already insulated to a *U*-factor not exceeding U-0.110 or already insulated between framing members with insulation having an installed thermal resistance of R-11 or greater.

2. 2 × 6 inch or greater framing shall have an overall assembly *U*-factor not exceeding U~~-0.074~~0.071 ~~or an installed R-value of 19 in a wood framed assembly~~.
3. Opaque nonframed assemblies shall have an overall assembly *U*-factor not exceeding U-0.102~~, equivalent to an installed R-value of 13 in a wood framed assembly~~.
4. Bay or Bow Window roofs and floors shall be insulated to meet the wall insulation requirements of TABLE 150.1-A or B.
5. Masonry walls shall be insulated to meet the wall insulation requirements of TABLE 150.1-A or B.
6. In wood framed assemblies, compliance with *U*-factors may be demonstrated by installing wall insulation with an R-value of 13 in 2 × 4 assemblies, and 20 in 2 × 6 assemblies.

CHANGE SIGNIFICANCE: In 1978, California's first Energy Code required basic levels of insulation. Insulation is a primary focus in the 2019 Energy Code. New low-rise residential homes will gain additional energy savings from building component technology and installation best practices. The increased mandatory insulation levels in Section 150.0(c)6 for 2 × 6 wood-framed walls will require a higher density batt, or alternative insulation materials to achieve R-20 within the 2 × 6 cavity.

The 2016 Energy Code's prescriptive insulation requirements for masonry walls have now become the mandatory insulation requirements for mass walls under the 2019 Energy Code. These insulation requirements are as follows:

For mass walls with insulation installed on the interior side of the wall:

- Climate Zones 1–15
  - Minimum R-13 continuous insulation, or maximum *U*-factor of 0.077.

- Climate Zone 16
    - Minimum R-17 continuous insulation, or maximum *U*-factor of 0.059.

For mass walls with insulation installed on the exterior side of the wall:

- Climate Zones 1–15
    - Minimum R-8 continuous insulation, or maximum *U*-factor of 0.125.
- Climate Zone 16
    - Minimum R-13 continuous insulation, or maximum *U*-factor of 0.077.

It's important to note that these mandatory wall insulation requirements are for portions of walls that are above grade, not below.

150.0(d)

Raised Floor Insulation

CHANGE TYPE: Clarification

CHANGE SUMMARY: This change clarifies how wood frame assemblies can demonstrate *U*-factor compliance.

2019 CODE:

(d) **Raised-floor Insulation.** Raised floors separating conditioned space from unconditioned space or ambient air shall have an overall assembly *U*-factor not exceeding U-0.037. ~~or~~ In a wood framed assembly, compliance with the U-factor may be demonstrated by installing insulation with an ~~installed~~ *R*-value of 19 or greater ~~in a wood framed assembly~~.

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

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

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

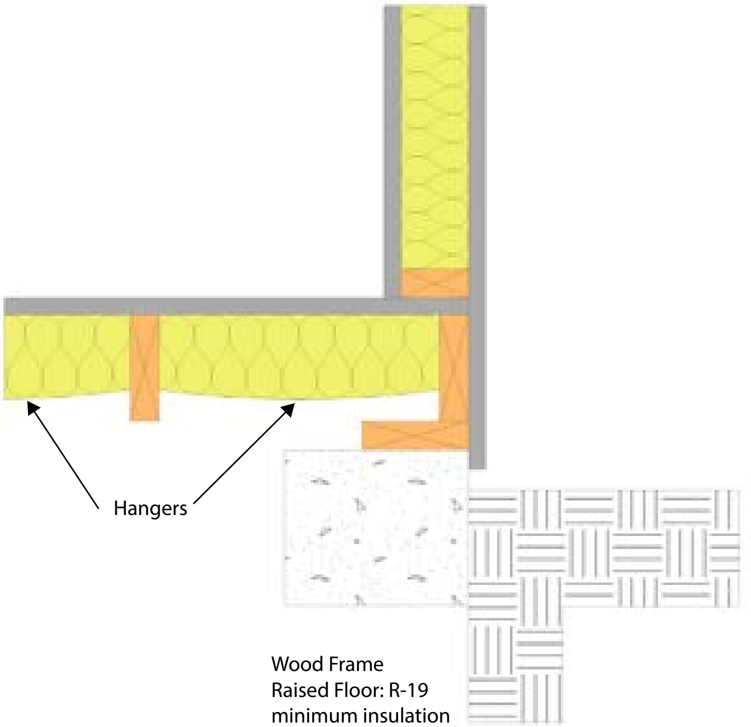
C. Vents between the crawl space and outside air are fitted with automatically operated louvers that are temperature actuated; and

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

CHANGE SIGNIFICANCE: The first change to this section clarifies that wood-framed assemblies may have installed insulation with an *R*-value of 19 or greater between framing members. This is equivalent to the *U*-factor specification.

The second change updates the exception to Section 150.0(d). The 2019 Energy Code has separated the prescriptive compliance requirements for single-family and multifamily residential buildings. Table 150.1-B spells out the prescriptive requirements for multifamily buildings.

Note: Unheated concrete raised-floors do not have a mandatory insulation requirement, but do have prescriptive *U*-factor requirements that vary by climate zone. Heated slab floors must meet the mandatory insulation requirements of Section 110.8(g).



Raised Floor Insulation – R-19 is the mandatory minimum insulation requirement for wood-framed raised floors. Alternatively, a maximum assembly *U*-factor of 0.037 satisfies the mandatory insulation requirement of Section 150.0(d). In this illustration, hangers are used to hold insulation in place.
Source: California Energy Commission, 2019 Residential Compliance Manual

150.0(e)

Installation of Fireplaces, Decorative Gas Appliances, and Gas Logs

CHANGE TYPE: Modification

CHANGE SUMMARY: Fireplace pilot light and venting requirements were deleted from this section because they are duplicated in Section 110.5 of the Energy Code, and in Section 4.503 of the CALGreen Code.

2019 CODE:

(e) **Installation of Fireplaces, Decorative Gas Appliances and Gas Logs.**

~~1.~~ 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:

~~A~~1. Closeable metal or glass doors covering the entire opening of the firebox; and

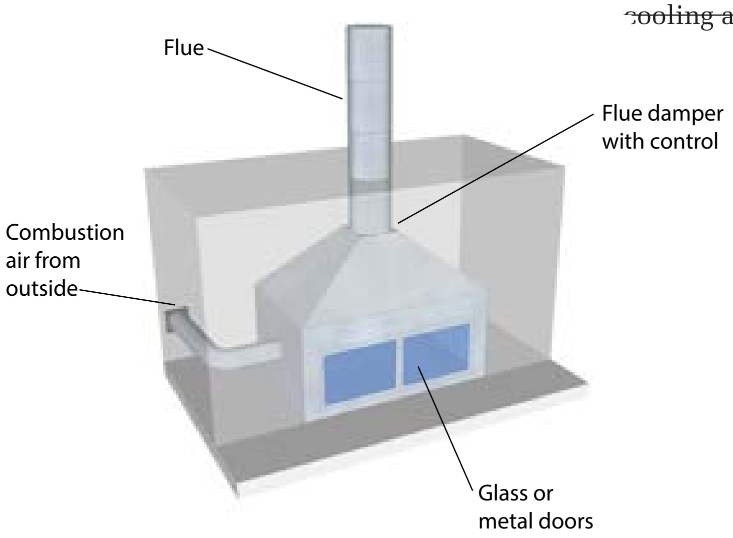
~~B~~2. A combustion air intake to draw air from the outside of the building, which is at least 6 square inches in area and is equipped with a readily accessible, operable, and tight-fitting damper or combustion-air control device; and

EXCEPTION to Section 150.0(e)1B: 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.

~~C~~3. A flue damper with a readily accessible control.

EXCEPTION to Section 150.0(e)1C: 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.

~~2. Continuous burning pilot lights and the use of indoor air for cooling a firebox jacket, when that indoor air is vented to the outside of the building, are prohibited.~~



Gas Fireplace – The *CALGreen Code* requires that gas fireplaces be direct-vent sealed combustion type. The Energy Code also requires that these fireplaces have closeable metal or glass doors.
Source: California Energy Commission, 2016 Residential Compliance Manual

CHANGE SIGNIFICANCE: The measures in this section reduce inefficient and unnecessary fuel consumption by masonry and factory-built fireplaces, and gas logs. The changes streamline the Energy Code by striking the redundant requirements that are found in two other code sections.

Section 4.503 of the *CALGreen Code* states "any installed gas fireplace shall be a direct-vent sealed combustion type." This health-related requirement limits infiltration and harmful emissions associated with gas fireplaces and decorative gas appliances. Due to advances in fireplace technology, the "direct-vent sealed-combustion" design has improved safety and convenience. Reduced infiltration and air leakage are benefits when the fireplace is not operating; which is the majority of the time in most homes.

150.0(j)2

Insulation for Piping and Tanks, Water Piping, Solar Water-heating System Piping, and Space Conditioning System Line Insulation Thickness and Conductivity

CHANGE TYPE: Modification

CHANGE SUMMARY: Pipe insulation requirements for certain pipes of solar hot water heating systems were added, and references to the Plumbing Code and Section 120.3(c) of the Energy Code were added to simplify language and create consistency.

2019 CODE:

(j) **~~Water System Piping and~~ Insulation for Piping~~,~~ and Tanks, ~~and Cooling System Lines~~.**

[…]

2. **Water piping, solar water-heating system piping, and ~~cooling~~ space conditioning system line insulation thickness and conductivity.** Piping shall be insulated ~~to the thicknesses~~ as follows:
   - A. All domestic hot water piping shall be insulated as specified in Section 609.11 of the *California Plumbing Code*. In addition, the following piping conditions shall have a minimum insulation wall thickness of 1 inch or a minimum insulation R-value of 7.7:~~All domestic hot water system piping conditions listed below, whether buried or unburied, must be insulated and the insulation thickness shall be selected based on the conductivity range in TABLE 120.3-A and the insulation level shall be selected from the fluid temperature range based on the thickness requirements in TABLE 120.3-A:~~
     - i. The first 5 feet (1.5 meters) of hot and cold water pipes from the storage tank.
     - ii. All hot water piping with a nominal diameter ~~of~~ equal to or greater than $^3/_4$ inch (19 millimeter) ~~or larger~~and less than 1 inch.
     - iii. All hot water piping with a nominal diameter less than $^3/_4$ inch that is:
       - a. ~~a~~Associated with a domestic hot water recirculation system; ~~regardless of the pipe diameter~~
       - b. From the heating source to the kitchen fixtures~~.~~;
       - c. From the heating source to a storage tank or between storage tanks; or
       - d. Buried below grade.
     - ~~iv. Piping from the heating source to storage tank or between tanks.~~
     - ~~v. Piping buried below grade.~~
     - ~~vi. All hot water pipes from the heating source to the kitchen fixtures.~~
   - ~~B. In addition to insulation requirements, all domestic hot water pipes that are buried below grade must be installed in a water proof and non-crushable casing or sleeve.~~

B.~~C.~~ Pipinge for ~~cooling~~space conditioning systems ~~lines~~, solar water-heating system collector loop, and ~~shall be insulated as specified in Subsection A. D~~distribution piping for steam and hydronic heating systems, shall meet the requirements ~~in~~ of Section 120.3(c).~~TABLE 120.3-A.~~

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

~~**EXCEPTION 2 to Section 150.0(j)2:** Piping that serves process loads, gas piping, cold domestic water piping, condensate drains, roof drains, vents, or waste piping.~~

EXCEPTION ~~3~~ 2 to Section 150.0(j)2: Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. ~~Metal p~~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 butt securely against all framing members.

EXCEPTION ~~4~~ 3 to Section 150.0(j)2: Piping installed in interior or exterior walls shall not be required to have pipe insulation if all of the requirements are met for compliance with Quality Insulation Installation (QII) as specified in the Reference Residential Appendix RA3.5.

EXCEPTION ~~5~~ 4 to Section 150.0(j)2: Piping ~~installed~~ surrounded with a minimum of 1 inch of~~in attics~~ wall insulation, 2 inches of crawl space insulation, or 4 inches of attic insulation, ~~with a minimum of 4 inches (10 cm) of attic insulation on top of the piping~~ shall not be required to have pipe insulation.

~~**NOTE:** Where the Executive Director approves a water heater calculation method for particular water heating recirculation systems, piping insulation requirements are those specified in the approved calculation method.~~

CHANGE SIGNIFICANCE: Section 150.0(j)2A – The changes to this section require compliance with Section 609.11 of the Plumbing Code. Section 609.11 of the Plumbing Code requires minimum insulation for all hot water piping based on pipe thickness. The changes also require additional insulation or wall thickness requirements, and includes an R-value reference for compliance convenience.

Section 150.0(j)2Ai – The insulation requirements of this section now only apply to the first 5 feet of cold-water piping from the water storage tank.

Sections 150.0(j)2Aii and iii – These changes address several types of hot water pipes that are less than 1 inch in diameter.

Section 150.0(j)2B and C – These changes standardize insulation protection requirements between residential and nonresidential piping, and simplify the requirements by referencing a single Section 120.3(c) for all requirements. Section 150.0(j)2B formerly required a noncrushable casing or sleeve for buried hot water piping. That requirement has moved to

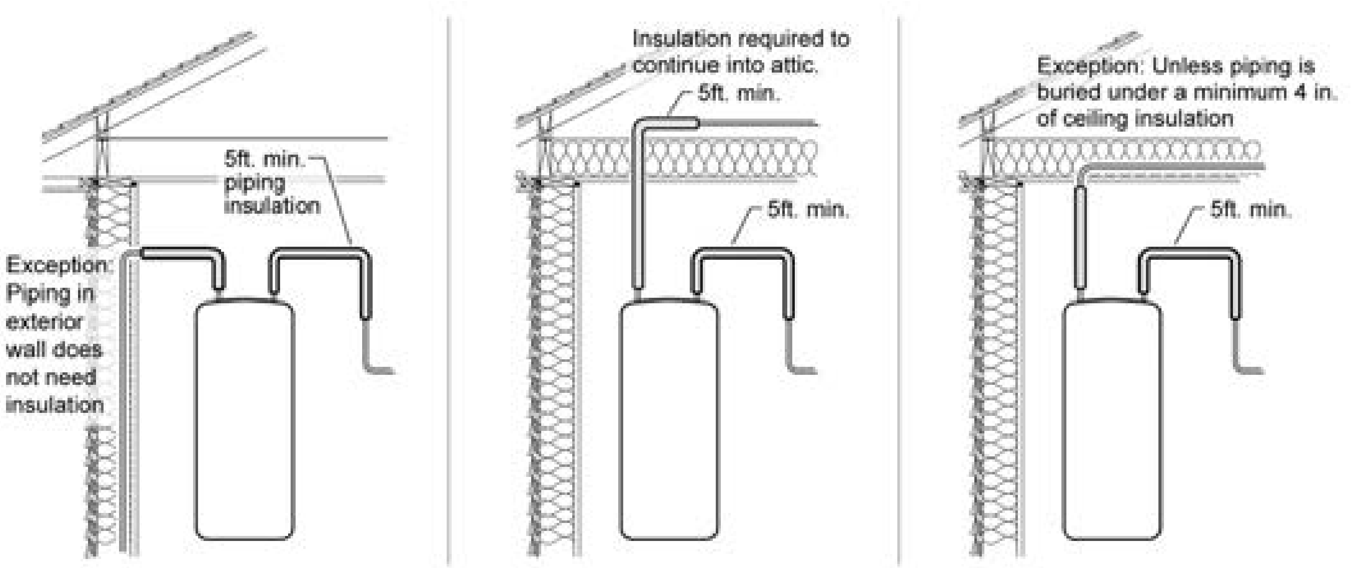
Section 120.3(c). Additionally, the change in Section 150.0(j)2B clarifies that insulation requirements for solar system piping are identical to those for traditional water heating systems.

The term "space conditioning systems" replaces "cooling systems" to clarify that heat pumps performing space heating are also subject to Section 120.3(c). Refrigerant line insulation is required for heat pumps operating exclusively in a heating mode. The requirements are identical to those for heat pumps that operate in both heating and cooling modes.

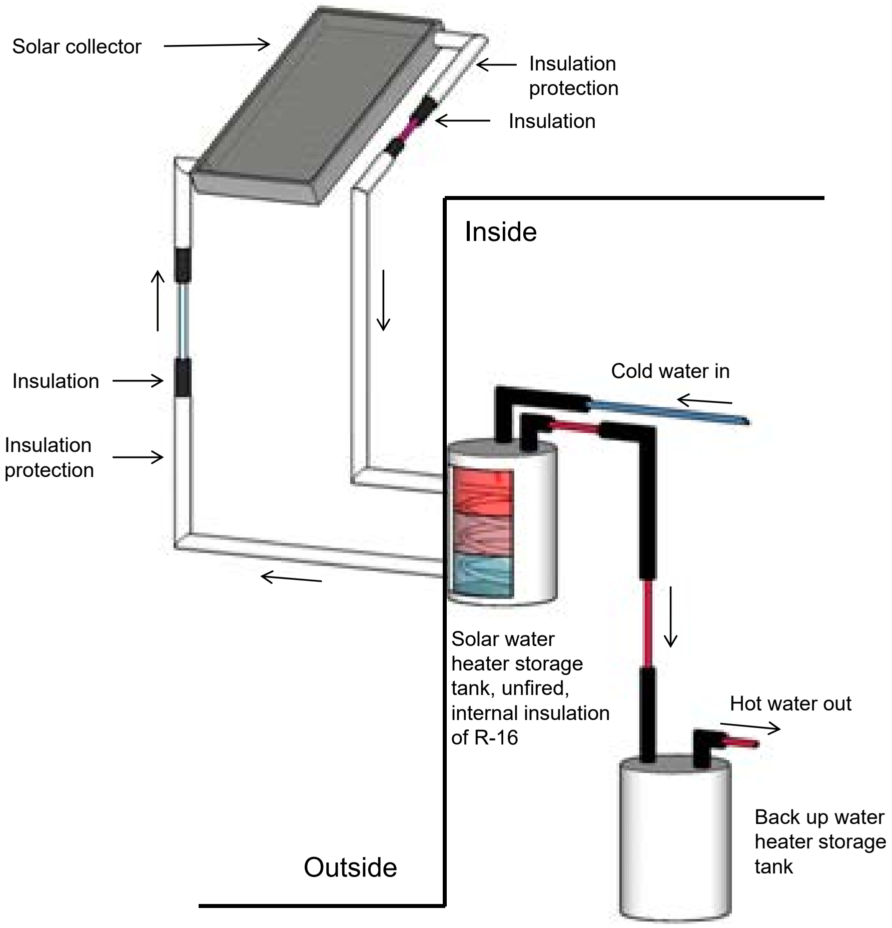
Exception 2 to Section 150.0(j)2–This exception was removed as it was a redundant exception. This section already states the types of piping to which it applies. It also clarifies the prior language that listed specific types of piping that were not covered by this code section.

Exception 5 to Section 150.0(j)5–This change clarifies when cavity insulation can be considered to provide the same benefit as other pipe insulation requirements. The change reduces the amount of insulation required to meet this exception. It also expands the application to crawl-space and wall insulation, as well as to attic insulation.

The "note" in Section 150.0(j) has been deleted to reduce confusion. It did not possess regulatory effect.



Pipe Insulation – Pipes embedded in insulation in walls, and piping in ceilings where buried under at least 4 inches of insulation, are not required to be insulated.
Source: California Energy Commission, 2019 Residential Compliance Manual



Solar Water Heating System – The solar water heating collector loop (illustrated on the left, or "outside" area) must be insulated under the 2019 Energy Code. This insulation must also be protected from damage due to sunlight, moisture, equipment maintenance, and wind, where applicable, per Sections 150.0(j)3 and 120.3(b) of the Energy Code.

Source: Hamed Amouzgar, California Energy Commission, Blueprint Newsletter – Issue 121

150.0(j)3

Insulation for Piping and Tanks, Insulation Protection

CHANGE TYPE: Modification

CHANGE SUMMARY: The requirements for protecting pipe insulation have been moved to Section 120.3(b).

2019 CODE:

(j) **~~Water System Piping and~~ Insulation for Piping~~,~~ and Tanks~~, and Cooling System Lines~~.**

[…]

3. **Insulation Protection.** Pipe insulation shall meet the insulation protection requirements of Section 120.3(b).~~Insulation outside conditioned space shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind. Protection includes but is not limited to the following:~~

   ~~A. Insulation exposed to weather shall be installed with a cover suitable for outdoor service, including but not limited to aluminum, sheet metal, painted canvas, or plastic cover. The cover shall be water retardant and provides shielding from solar radiation that can cause degradation of the material.~~

   ~~B. Insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall have a Class I or Class II vapor retarder.~~

CHANGE SIGNIFICANCE: This change simplifies the Energy Code by standardizing insulation protection requirements between residential and nonresidential buildings. By referencing Section 120.3(b), it moves low-rise residential piping insulation protection requirements into the section of mandatory requirements for nonresidential, high-rise residential and hotel/motel buildings.

Section 120.3(b) addresses conditions that damage pipe insulation, and allowable ways to protect the insulation. If hot water piping insulation is exposed to weather, it must be protected from physical damage, UV deterioration, and moisture. It also prohibits adhesive tape as an insulation cover because removing the tape will damage the integrity of the original insulation during preventive maintenance.

Pipe Insulation Protection – Insulation must be protected from damage due to sunlight, moisture, equipment maintenance, and wind, according to Section 120.3(b) of the Energy Code.
Source: Airex Manufacturing, Inc.

150.0(k)1

Residential Lighting, Luminaire Requirements

CHANGE TYPE: Clarification, Modification, and Addition

CHANGE SUMMARY: Changes were made for clarity, to modify, and add expectations for specific light applications.

2019 CODE:

(k) **Residential Lighting.**

1. **Luminaire Requirements.**

A. **Luminaire Efficacy.~~:~~** All installed luminaires shall meet the requirements~~be high-efficacy~~ in ~~accordance with~~ TABLE 150.0-A.

[…]

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

[…]

v. Shall not contain screw base sockets.~~; and~~

~~vi. Shall contain light sources that comply with Reference Joint Appendix JA8, including the elevated temperature requirements, and that are marked "JA8-2016-E" as specified in Reference Joint Appendix JA8~~.

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

E. **Night Lights, Step Lights and Path Lights.** ~~Permanently installed night lights and night lights integral to installed luminaires or exhaust fans shall be rated to consume no more than five watts of power per luminaire or exhaust fan as determined in accordance with Section 130.0(c).~~ Night lights, step lights and path lights shall not be required to comply with Table 150.0-A or be controlled by vacancy sensors provided they are rated to consume no more than 5 watts of power and emit no more than 150 lumens.

[…]

G. **Screw based luminaires.** Screw based luminaires shall ~~meet all of the following requirements:~~

~~i. The luminaires shall not be recessed downlight luminaires in ceilings; and~~

~~ii. The luminaires shall~~ contain lamps that comply with Reference Joint Appendix JA8; ~~and~~

~~iii. The installed lamps shall be marked with "JA8-2016" or "JA8-2016-E" as specified in Reference Joint Appendix JA8~~.

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

H. **Light Sources in Enclosed or Recessed Luminaires.** Lamps and other separable light sources that are not compliant with the JA8 elevated temperature requirements, including mark~~ed~~ing requirements, ~~“JA8-2016-E”~~ shall not be installed in enclosed or recessed luminaires.

I. **Light Sources in Drawers, Cabinets, and Linen Closets.** Light sources internal to drawers, cabinetry or linen closets shall not be required to comply with Table 150.0-A or be controlled by vacancy sensors provided that they are rated to consume no more than 5 watts of power and emit no more than 150 lumens, and are equipped with controls that automatically turn the lighting off when the drawer, cabinet or linen closet is closed.

CHANGE SIGNIFICANCE: Section 150.0(k)1A – Unnecessary terms were removed from this section for clarity. This change does not materially alter the requirements of the Energy Code.

Section 150.0(k)1C – This change removed 2016 Code language that required all light sources in recessed downlight applications to comply with the elevated temperature requirements of Reference Joint Appendix JA8 (JA8). This was not intended to apply to inseparable light sources, and thus has been removed. Language in Section 150.0(k)1H has been modified to address when these light sources are required to comply with the elevated temperature requirements. Only separable light sources are subject to elevated temperature requirements.

Section 150.0(k)1D – “Fluorescent Lamps” was added to the title of this section to clarify that the electronic ballast requirements are intended for these lamp types. This does not materially change the requirements of the Energy Code.

Section 150.0(k)1E – Step lights and path lights have been added to the scope of this section. Duplicative language has been removed for clarity. New language excludes night lights, step lights, and path lights, from the high efficacy (and JA8) requirements of Table 150.0-A, and from the vacancy control requirements if they meet the following criteria:

1. Are rated to consume no more than 5 watts of power, and
2. Emit no more than 150 lumens.

Note that both criteria must be met for these light sources to be excluded from the high efficacy (and JA8) requirements of Table 150.0-A, and from the control requirements.

Section 150.0(k)1G – The purpose of the changes to this section is to simplify the Energy Code’s language on the requirements for screw based light sources. Previous duplicative language was removed. Language disallowing screw based (separable) light sources from being installed in recessed applications already exists in Section 150.0(k)1H. Language requiring the labeling of screw based light sources already exists in JA8.

Section 150.0(k)1H – The purpose of the changes to this section is to clarify the intent of the elevated temperature requirements for residential light sources. The intent is to only apply the elevated temperature testing and labeling requirements to separable light sources, not inseparable light sources. Separable light sources have shown premature degradation when installed in enclosed and recessed applications, which typically have higher operating temperatures. For this reason, these separable light sources must be tested to show that they can achieve their expected life and performance under environments with higher temperatures when installed in recessed or enclosed applications. Inseparable light sources, like LED trim kits, are not subject to these elevated temperature requirements.

Section 150.0(k)1I–This section was added to simplify requirements for efficient light sources in drawers, cabinets, and linen closets. New language excludes these from the high efficacy (and JA8) requirements of Table 150.0-A, and from the vacancy control requirements if they meet the following criteria:

1. Are rated to consume no more than 5 watts of power; and
2. Emit no more than 150 lumens; and
3. Are equipped with controls that automatically turn the lighting off when the drawer, cabinet, or linen closet is closed.

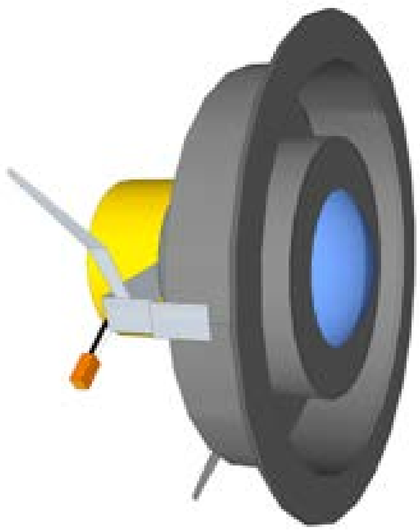
Note that all three criteria must be met for these light sources to be excluded from the high efficacy (and JA8) requirements of Table 150.0-A.


Getty Images

Screw Base LED Light Sources – When used in residential applications, screw base LED light sources must be certified to JA8.
Source: California Energy Commission


Getty Images

Step Lights – Step lights, night lights, and path lights are not subject to JA8 or vacancy sensor control requirements if they consume no more than 5 watts of power and emit no more than 150 lumens



LED Trim Kit – These light sources are considered inseparable and are not subject to the elevated temperature requirements of Section 150.0(k)1H.
Source: Jose Perez, California Energy Commission, Blueprint Newsletter – Issue 122

Table 150.0-A

Classification of High Efficacy Light Sources

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: This table was modified to simplify language and increase clarity.

2019 CODE:

TABLE 150.0-A Classification of High Efficacy Light Sources

~~Luminaires installed with only the lighting technologies in this table shall be classified as high efficacy~~ HIGH-EFFICACY LIGHT SOURCES Light sources shall comply with one of the columns below:	
Light sources in this column other than those installed in ceiling recessed downlight luminaires are classified as high efficacy and are **not** required to comply with Reference Joint Appendix JA8.	Light sources in this column ~~shall be~~ are only considered to be high efficacy if they are certified to the Commission as High Efficacy Light Sources in accordance with Reference Joint Appendix JA8 and be marked as ~~meeting~~ required by JA8.
1. Pin-based linear fluorescent or compact fluorescent light sources using electronic ballasts. 2. Pulse-start metal halide light sources. 3. High pressure sodium light sources. ~~4. GU-24 sockets containing light sources other than LEDs.~~ [a,b] ~~5~~4. Luminaires with hardwired high frequency generator and induction lamp. ~~6~~5. ~~Inseparable SSL luminaires that are~~LED light sources installed outdoors. ~~7~~6. Inseparable SSL luminaires containing colored light sources that are installed to provide decorative lighting.	8. All light sources installed in ceiling recessed downlight luminaires. Note that ceiling recessed downlight luminaires shall not have screw bases regardless of lamp type as described in Section 150.0(k)1C. ~~9. GU-24 sockets containing LED light sources.~~ ~~10~~9. Any light source not otherwise listed in this table ~~and certified to the Commission as complying with Joint Appendix 8~~.

~~Notes:~~
~~a. GU-24 sockets containing light sources such as compact fluorescent lamps and induction lamps.~~
~~b. California Title 20 Section 1605(k)3 does not allow incandescent sources to have a GU-24 base.~~

CHANGE SIGNIFICANCE: The purpose of the changes to this table are to do the following:

- Improve phrasing
- Remove redundant phrasing
- Remove obsolete references to GU-24 sockets
- Expand Item 6 to apply to all LED sources and not solely to insepa-rable luminaires

This change has the substantive effect of allowing outdoor LED lamps to forego JA8 testing and associated requirements, and of requiring GU-24 socketed lighting to be considered identical to all other lighting. These changes are necessary to avoid applying JA8 requirements in situations where they will have negligible benefit, and to remove an inconsistency of treating the same lighting technology differently depending on its socket or connection type.

150.0(k)2

Residential Lighting, Interior Lighting Switching Devices and Controls

CHANGE TYPE: Clarification, Modification, and Addition

CHANGE SUMMARY: Changes were made for clarity, to modify, and add control requirements for specific light applications.

2019 CODE:

(k) **Residential Lighting.**

[…]

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

[…]

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

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

C. ~~Luminaires~~ Lighting shall ~~be switched with~~have readily accessible wall-mounted controls that ~~permit~~ allow the ~~luminaires~~ lighting to be manually ~~switched~~ turned ON and OFF.

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

[…]

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

[…]

G. An Energy Management Control System (EMCS) may be used to comply with ~~dimmer~~ control requirements in Section 150.0(k) if at a minimum it provides the functionality of ~~a dimmer~~the specified controls in accordance with Section 110.9, meets the installation certificate requirements in Section 130.4, meets the EMCS requirements in Section 130.~~5~~0(~~f~~e), and complies with all other applicable requirements in Section 150.0(k)2.

~~H. An Energy Management Control System (EMCS) may be used to comply with vacancy sensor requirements in Section 150.0(k) if at a minimum it provides the functionality of a vacancy sensor in accordance with Section 110.9, meets the installation certificate requirements in Section 130.4, the EMCS requirements in Section 130.5(f), and complies with all other applicable requirements in Section 150.0(k)2.~~

[…]

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

~~K~~J. ~~Dimmers or vacancy sensors shall control all luminaires required to have light sources compliant with~~Luminaires that are or contain light sources that meet Reference Joint Appendix JA8 requirements for dimming, and that are not controlled by occupancy or vacancy sensors, shall have dimming controls.

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

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

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

CHANGE SIGNIFICANCE: Section 150.0(k)2B – The purpose of the changes to this section is to remove the unnecessary term "switched." Digital controls do not include "switches," and this language could have been interpreted to disallow digital controls. Also removed was "extended period of time" from the exception to this section. "Extended period of time" is not defined and was removed for simplicity. These changes do not materially alter the requirements of the Energy Code.

Section 150.0(k)2C – Language relating to manual control requirements was reworked for clarity, and to allow different technologies to comply with the Energy Code's requirements without confusion. An exception was also added for ceiling fans with lights that use remote controls to satisfy the control requirements of this section.

Section 150.0(k)2E – The purpose of the change to this section was to add occupancy sensors to the list of controls that shall not have bypasses that override their controls.

Section 150.0(k)2G and H – The purpose of the changes to these sections was to merge G with the 2016 language of H. These changes clarify without materially altering the requirements of the Energy Code.

Section 150.0(k)2I – The changes to this section update its numbering, and allow installing occupancy sensors in these applications as long as they are programed to operate in manual-on mode. Vacancy sensors are, by definition, occupancy sensors that only turn on via manual-on control. An automatic-on occupancy sensor that has been reprogrammed to only turn on via manual-on control satisfies the intent of this section.

Section 150.0(k)2J – This language was restructured for clarity. The intent of this language is to require all JA8 light sources to be controlled by one of the following:

1. An auto-on occupancy sensor; or
2. A (manual-on) vacancy sensor; or
3. A dimmer.

Most residential lighting already has to be on an occupancy or vacancy sensor, so in the event that a JA8 light source is installed and it is not already controlled by one of these controls, it must then be controlled by a dimmer. Ultimately, all indoor general lighting LED light sources must be controlled by one of the 3 controls listed above, except for light sources in closets less than 70 square feet, and light sources in hallways.

Section 150.0(k)2K – The purpose of the changes to this section is to clarify its intent and narrow its scope to the interaction between under-cabinet lighting and ceiling-mounted general lighting. This change clarifies without materially altering the requirements of the Energy Code.

150.0(k)3

Residential Lighting, Outdoor Lighting

CHANGE TYPE: Clarification

CHANGE SUMMARY: This section was restructured to simplify code language for outdoor lighting.

2019 CODE:

(k) **Residential Lighting.**

[…]

3. **Residential Outdoor Lighting.** In addition to meeting the requirements of Section 150.0(k)1A, luminaires providing residential outdoor lighting shall meet the following requirements, as applicable:

   A. For single-family residential buildings, outdoor lighting permanently mounted to a residential building~~,~~ or to other buildings on the same lot~~,~~ 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 switch that ~~does not override to ON~~permits the automatic actions of ~~Items~~ items ii or iii below; and

      ii. Controlled by a photocell and either a motion sensor or an automatic time switch control~~. Controls that override to ON shall not be allowed unless the override automatically reactivates the motion sensor within 6 hours~~; or

      iii. Controlled by an ~~one of the following methods:~~

      ~~a. Photocontrol and automatic time switch control. Controls that override to ON shall not be allowed unless the override shall automatically return the photocontrol and automatic time switch control to its normal operation within 6 hours.; or~~

      ~~b. A~~astronomical time clock control.

      Controls that override to ON shall not be allowed unless the override ~~shall~~ automatically returns the ~~astronomical clock to~~automatic control to its normal operation within 6 hours. An ~~and which is programmed to automatically turn the outdoor lighting OFF during daylight hours; or~~

      ~~c. E~~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.~~which meets all of the following requirements:~~

      ~~At a minimum provides the functionality of an astronomical time clock in accordance with Section 110.9; meets the Installation Certification requirements in Section 130.4; does not have an override or bypass switch that allows the luminaire to be always ON; and, is programmed to automatically turn the outdoor lighting OFF during daylight hours.~~

B. For low-rise ~~multifamily~~ residential buildings with four or more dwelling units, outdoor lighting for private patios, entrances, balconies, ~~and~~ porches; and ~~outdoor lighting for~~ residential parking lots and ~~residential~~ carports with less than eight vehicles per site shall comply with ~~one of the following requirements~~either:

   i. ~~Shall comply with~~ Section 150.0(k)3A; or

   ii. ~~Shall comply with t~~The applicable requirements in Sections 110.9, 130.0, 130.2, 130.4, 140.7 and 141.0.

C. For low-rise residential buildings with four or more dwelling units, any outdoor lighting for residential parking lots or carports with a total of eight or more vehicles per site and any outdoor lighting not regulated by Section 150.0(k)3B ~~or 150.0(k)3D~~ shall comply with the applicable requirements in Sections 110.9, 130.0, 130.2, 130.4, 140.7 and 141.0.

~~D. Outdoor lighting for residential parking lots and residential carports with a total of eight or more vehicles per site shall comply with the applicable requirements in Sections 110.9, 130.0, 130.2, 130.4, 140.7 and 141.0~~.

CHANGE SIGNIFICANCE: The purpose of the changes to this section is to restructure and simplify code language. The changes to this section do not materially alter the requirements.

150.0(k)4

Residential Lighting, Internally Illuminated Address Signs

CHANGE TYPE: Clarification

CHANGE SUMMARY: Language for internally illuminated address signs was simplified for clarity.

2019 CODE:

(k) **Residential Lighting.**

[…]

4. **Internally illuminated address signs.** Internally illuminated address signs shall <u>either</u>:
   - A. Comply with Section 140.8; or
   - B. ~~Shall c~~<u>C</u>onsume no more than 5 watts of power ~~as determined according to Section 130.0(c)~~.

CHANGE SIGNIFICANCE: The purpose of the changes to this section is to simplify phrasing and remove an unnecessary reference to a different section. These changes clarify without materially altering the requirements of the Energy Code.

150.0(k)6

Residential Lighting, Interior Common Areas of Low-rise Multifamily Residential Buildings

CHANGE TYPE: Clarification

CHANGE SUMMARY: Language relating to lighting in common areas was altered for clarity.

2019 CODE:

(k) **Residential Lighting.**

[…]

6. **Interior Common Areas of Low-rise ~~Multi-Family~~Multifamily Residential Buildings.**
   A. In a low-rise multifamily residential building where the total interior common area in a single building equals 20 percent or less of the floor area, permanently installed lighting for the interior common areas in that building shall ~~be high efficacy luminaires~~<u>comply with Table 150.0-A</u> and <u>be</u> controlled by an occupant sensor.
   B. In a low-rise multifamily residential building where the total interior common area in a single building equals more than 20 percent of the floor area, permanently installed lighting <u>for the interior common areas</u> in that building shall:
      i. Comply with the applicable requirements in Sections 110.9, 130.0, 130.1, 140.6 and 141.0; and
      ii. Lighting installed in corridors and stairwells shall be controlled by occupant sensors that reduce the lighting power in each space by at least 50 percent. The occupant sensors shall be capable of turning the light fully on and off from all designed paths of ingress and egress.

CHANGE SIGNIFICANCE: The purpose of the changes to this section is to correct punctuation and improve phrasing of the Energy Code. The changes clarify without materially altering the requirements of the Energy Code.

150.0(m)1

Air-Distribution and Ventilation System Ducts, Plenums and Fans; CMC Compliance

CHANGE TYPE: Clarification and Addition

CHANGE SUMMARY: Two new exceptions address ducts in interior wall cavities (where space for insulation is extremely limited), and ducts that are intentionally directly exposed to the space they are conditioning.

2019 CODE:

(m) **Air-Distribution and Ventilation System Ducts, Plenums, and Fans.**

1. **CMC Compliance.**

A. All air-distribution system ducts and plenums, including, but not limited to, mechanical closets and air-handler boxes, shall ~~be installed, sealed and insulated to~~ 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.

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

i. a minimum installed level of R-6.0 ~~(or any higher level required by CMC Section 605.0)~~, or

ii. a minimum installed level of R-4.2 when <u>the duct system is located</u> entirely in conditioned space as confirmed through field verification and diagnostic testing in accordance with the requirements of Reference Residential Appendix RA3.1.4.3.8.

<u>**EXCEPTION 1 to Section 150.0(m)1B:** Portions of the duct system located in wall cavities are not required to be insulated if the following conditions are met:</u>

<u>i. The cavity, duct or plenum is located entirely inside the building's thermal envelope as confirmed by visual inspection.</u>

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

<u>**EXCEPTION 2 to Section 150.0(m)1B:** Portions of the duct system completely exposed and surrounded by directly conditioned space are not required to be insulated.</u>

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

D. 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.

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

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

CHANGE SIGNIFICANCE: This section contains requirements for *California Mechanical Code* compliance. For clarity, unnecessary language has been removed and the subsections have been renumbered.

Two exceptions were added to exclude ducts from insulation requirements when inside of interior wall cavities, and for ducts that are directly exposed to the space which they are conditioning. Energy savings are not significantly increased by requiring additional insulation in these scenarios.

Getty Images

Ducts Completely Exposed to Directly Conditioned Space – Portions of ducts that are completely exposed and surrounded by directly conditioned space are not required to be insulated under the 2019 Energy Code.

150.0(m)10

Air-Distribution and Ventilation System Ducts, Plenums, and Fans; Porous Inner Core Flex Duct

CHANGE TYPE: Modification

CHANGE SUMMARY: Flexible ducts with porous inner cores are allowed when they have internal insulating features.

2019 CODE:

(m) **Air-Distribution and Ventilation System Ducts, Plenums, and Fans.**

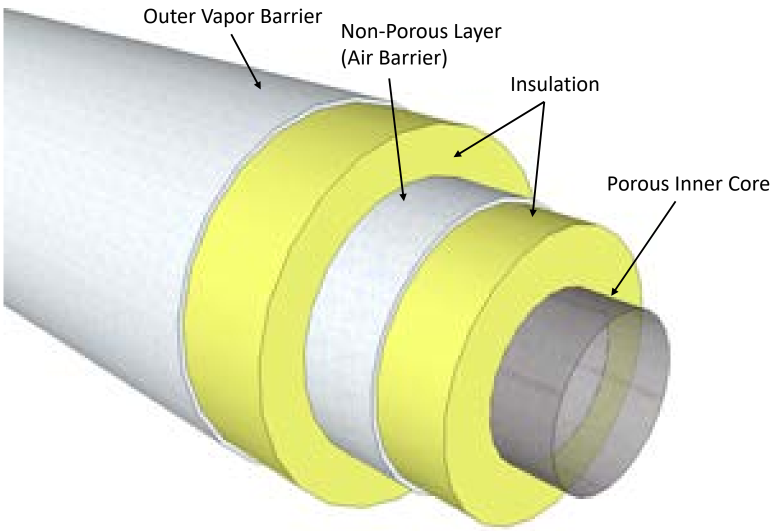
[…]

10. **Porous Inner Core Flex Duct.** Flexible ducts having porous inner cores shall ~~not be used~~have a non-porous layer or air barrier between the inner core and the outer vapor barrier.

CHANGE SIGNIFICANCE: This change allows flexible ducts with porous inner cores to be installed if they have an internal air barrier or non-porous layer between the inner core and the outer vapor barrier.

The 2016 Energy Standards prohibited the use of porous inner core flex ducts, without exceptions. The flex duct exclusion was first introduced in the 2005 Energy Code. The prohibition was based on the perception that the outer jacket was the only air barrier. The presence of only one air barrier increases the potential for leakage during installation, and throughout the life of the duct system. To minimize this risk, the prohibition was adopted.

Porous inner core flex ducts are essential for certain HVAC applications — particularly small-duct high-velocity systems. The Energy Commission was asked to determine if porous inner core flex duct, with a non-porous layer between the inner core and outer jacket, complied with Section 150.0(m)10. The Executive Director then issued an interpretation, using his authority under Section 10-107(b). The interpretation concluded that "flexible ducts having a non-porous layer between the porous inner core and the outer vapor barrier satisfies the intent of §150.0(m)10." The determination was published in the Energy Commission's Blueprint Newsletter, Issue #114 (May – June 2016), and then added to the 2019 Energy Code.



Porous Inner Core Flex Duct – Flexible ducts having a non-porous layer between the porous inner core and the outer vapor barrier satisfy the intent of Section 150.0(m)10 and can be used for compliance with the Energy Code.
Source: Jose Perez, California Energy Commission, Blueprint Newsletter – Issue 114

150.0(m)12

Air-Distribution and Ventilation System Ducts, Plenums, and Fans; Air Filtration

CHANGE TYPE: Modifications

CHANGE SUMMARY: Ventilation system requirements were modified to address concerns about indoor air quality and performance efficiency.

2019 CODE:

(m) **Air-Distribution and Ventilation System Ducts, Plenums, and Fans.**

12. **Air Filtration.**

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

i. Mechanical space conditioning systems that supply air to an occupiable space through ductwork exceeding 10 ft (3 m) in length. ~~and through a thermal conditioning component, except evaporative coolers, shall be provided with air filter devices in accordance with the following:~~

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

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

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

~~A~~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 ~~the~~ any system's thermal conditioning components.

EXCEPTION 1 to Section 150.0(m)12Bi: For heat recovery ventilators and energy recovery ventilators the location of the filters required by Section 150.0(m)12 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. ~~The~~ All systems shall be designed to accommodate the clean-filter pressure drop imposed by the system air filter ~~device~~(s). The design airflow rate, and maximum allowable clean-filter pressure drop at the design airflow rate applicable to each air filter device shall be determined and reported on labels according to subsection iv below.

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

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

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

$$A_{face} = Q_{filter} / V_{face} \qquad \textbf{(Equation 150.0-A)}$$

where

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

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

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

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

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

~~B~~C. **Air Filter ~~Media~~ Efficiency.** The system shall be provided with air filter(s) ~~media~~ having a designated efficiency equal to or greater than MERV 6 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 ~~3.0–10 µm range~~ when tested in accordance with AHRI Standard 680.

~~C~~D. **Air Filter ~~Media~~ Pressure Drop.** ~~The~~ All systems shall be provided with air-filter(s) ~~media~~ that conforms to the applicable maximum allowable clean-filter pressure drop specified in subsections i, ii, iii, or iv below ~~determined according to Section 150.0(m)12Aii~~, when tested using ASHRAE Standard 52.2, or as rated using AHRI Standard 680, for the applicable design airflow rates for the system air filter(s) devices.

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

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

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

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

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

[…]

TABLE 150.0-B Return Duct Sizing for Single Return Duct Systems

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

Return grill devices shall be labeled in accordance with the requirements in Section 150.0(m)12Biv~~A~~ to disclose the grille's design airflow rate and a maximum allowable clean-filter pressure drop of ~~12.5~~25 Pa (~~0.05~~0.1 inches water) for the air filter ~~media~~ 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 ~~Return Duct~~ Diameter (inch)	Minimum Total Return Filter Grille ~~Gross~~ Nominal Area ($inch^2$)
1.5	16	500
2.0	18	600
2.5	20	800

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

TABLE 150.0-C Return Duct Sizing for Multiple Return Duct Systems

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

Return grille devices shall be labeled in accordance with the requirements in Section 150.0(m)12Biv~~A~~ to disclose the grille's design airflow rate and a maximum allowable clean-filter pressure drop of 25 Pa (~~0.05~~0.1 inches water) for the air filter when tested using ASHRAE Standard 52.2, or media as rated in accordance with AHRI Standard 680 for the design airflow rate for the return grille.

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

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

CHANGE SIGNIFICANCE: The term space conditioning systems was added to clarify that systems with thermal conditioning components are subject to Section 150.0(m)12 requirements. New numbering and nonsubstantive edits were added to improve clarity, and an exception for evaporative coolers was moved to the end of section A for clarity.

This section now requires increased air filtration (Minimum Efficiency Reporting Value (MERV) 13 rated filter), and specifies 2-inch depth filters, but allows 1-inch depth filters when the system design meets Energy Code specifications. The 2019 Energy Code was developed considering new information about the effects of indoor particulate pollutants. Filters meeting the 2016 Energy Code's MERV 6 requirements are only moderately effective at filtering out airborne particulates (PM10), and are unable to capture or filter out fine particulates (PM2.5).

Most regions of California do not meet healthy outdoor air requirements for fine and ultra-fine particles. The particulates are brought into the home by ventilation, creating a feedback loop that substantially increases the amount of ventilation needed to improve indoor concentrations of PM10 and PM2.5. Increasing filtration is more energy efficient than increasing ventilation rates. A MERV 13 filter, when compared to a MERV 6 rated filter, effectively filters out PM2.5 with a negligible effect on pressure drop.

In addition to the filtration requirements for ducted space conditioning systems, two ventilation system types now must also meet air filtration requirements: (1) supply-only ventilation systems, and (2) the supply side of balanced ventilation systems.

There are significant relationships and interactions between building insulation and air tightness requirements, ventilation requirements, and indoor air quality. The Energy Commission is directed in statute to consider the impacts of building standards on indoor air pollution problems. By considering energy efficiency measures alone, indoor air quality could be impacted. Indoor air quality should not be addressed alone because some approaches to indoor air quality can waste energy. Federal and State law directs the Energy Commission to either directly incorporate or to exceed requirements in national model energy codes (such as ASHRAE 62.1, 62.2, and 90.1), and all nationally recognized model codes that address both energy efficiency and indoor air quality.

Increasing ventilation rates increase energy use, due to increased fan use and loss of conditioned air. Increased filtration has a negligible impact on the performance of HVAC equipment, with no loss of conditioned air.

The 2019 Energy Code also ensures that HVAC systems can accommodate above-code MERV filters. Occupants can improve filtration without inadvertently harming their system's energy efficiency, lifespan, or overall performance. When occupants install higher-MERV filters, they can potentially increase system pressure drop and reduce system energy efficiency. While some 1-inch MERV 13 filters have pressure drop comparable to 1-inch MERV 6 filters, this is not true for all MERV 13 or higher filters. Filters with greater surface area specifically address pressure drop. By increasing filter depth and number of pleats, the total surface area is increased and the effects on system pressure is decreased. Compliant filters with a two-inch depth are widely available to consumers.

The purpose of the changes to Table 150.0-B and Table 150.0-C is to add a reference to ASHRAE 52.2 to mirror the same specification that is referenced in Section 150.0(m)12D. A reference was also updated to 150.0(m)12iv to reflect the updated location for the same information previously referenced. The clean filter pressure drop specification has been relaxed from 0.05 to 0.1 inch water which is a more attainable value according to newly published performance information made available due to the Title 20 air filter label requirements. The change is necessary to ensure that compliance with the clean pressure drop specification regulation is reasonably attainable using current commercially available air filter stock.

Other modifications were made to headers for grammar, and to clarify that values in the table are nominal values.

150.0(m)13B

Air-Distribution and Ventilation System Ducts, Plenums, and Fans; Single Zone Central Forced Air Systems; Airflow Rate and Fan Efficacy

CHANGE TYPE: Addition and Modification

CHANGE SUMMARY: The changes establish new fan efficacy and airflow rates for single zone central forced air systems.

2019 CODE:

(m) **Air-Distribution and Ventilation System Ducts, Plenums, and Fans.**

[…]

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

[…]

B. **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 i or ii 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.

i. ~~0.58~~0.45 W/CFM for gas furnace air-handling units.

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

~~as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.~~

[…]

EXCEPTION 1 to Section 150.0(m)13B and D: Standard ducted systems (without zoning dampers) may comply by meeting the applicable requirements in TABLE 150.0-B or 150.0-C 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 ~~of~~ Section 150.0(m)12Div~~C~~ for the system air filter ~~device~~(s) shall conform to the requirements given in TABLES 150.0-B and 150.0-C.

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

~~**EXCEPTION 3 to Section 150.0(m)13B:** The Executive Director may approve alternate airflow and fan efficacy requirements for small duct high velocity systems.~~

CHANGE SIGNIFICANCE: The new and modified requirements for single zone gas furnace air handlers establish a more stringent efficiency requirement. This new efficiency requirement was found to be achievable because of more stringent fan requirements for residential gas furnaces at the federal level. Gas furnace air handling units can feasibly and cost effectively achieve a maximum 0.45 watts per CFM fan efficacy, an improvement on the prior requirement. The changes also clarify the application of field verification requirements.

Exception 1 to Section 150.0(m)13B – This exception incorporates alternate airflow and fan efficacy requirements for Small Duct High Velocity (SDHV) forced air systems. These new targets are achievable by all certified SDHV air conditioners and heat pump combinations. These changes ensure SDHV systems can be installed in California and the efficiency requirements are appropriate for the unique features of this equipment.

Exception 3 to Section 150.0(m)13B of the 2016 Energy Code is no longer needed because of the new SDHV requirements and has been deleted.

The new Exception 3 to Section 150.0(m)13B directly addresses enforcement. Compliance is not based on the date that a building permit is issued. The exception references the date of manufacture of the equipment, due to federal fan requirements. The change prevents this requirement from unintentionally creating stranded inventory.

150.0(m)13C

Air-Distribution and Ventilation System Ducts, Plenums, and Fans; Space Conditioning System Airflow Rate and Fan Efficacy; Zonally Controlled Central Forced Air Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: The changes establish a more stringent efficiency requirement for gas furnace air-handling units and clarify field verification requirements.

2019 CODE:

(m) **Air-Distribution and Ventilation System Ducts, Plenums, and Fans.**

[…]

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

    […]

    C. **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 i or ii 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.

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

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

    ~~as confirmed by field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.3.~~

    […]

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

CHANGE SIGNIFICANCE: These changes to the zonally controlled central forced air system requirements establish a more stringent efficiency requirement for gas furnace air-handling units, and clarify the application of field verification requirements. Gas furnace air-handling units can feasibly and cost effectively achieve a 0.45 watts per CFM fan efficacy. The specification for nongas units is 0.58 watts per CFM. Field verification and diagnostic procedures are performed by a HERS rater and are specified in Reference Residential Appendix RA3.3.

Exception 2 to Section 150.0(m)13C directly addresses enforcement. Fan efficacy rates are not based on the date that a building permit is issued. The exception references the date of manufacture of the equipment due to federal fan requirements. The change prevents this requirement from unintentionally creating stranded inventory.

150.0(m)13D

Air-Distribution and Ventilation System Ducts, Plenums, and Fans; Space Conditioning System Airflow Rate and Fan Efficacy; Small Duct High Velocity Forced Air Systems

CHANGE TYPE: Addition

CHANGE SUMMARY: New airflow and fan efficacy requirements specifically address the capabilities of Small Duct High Velocity (SDHV) forced air systems.

2019 CODE:

(m) **Air-Distribution and Ventilation System Ducts, Plenums, and Fans.**

[…]

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

[…]

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

EXCEPTION 1 to Section 150.0(m)13B and D: Standard ducted systems (without zoning dampers) may comply by meeting the applicable requirements in Table 150.0-B or 150.0-C 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 ~~of~~ Section 150.0(m)12Div~~C~~ for the system air filter ~~device~~(s) shall conform to the requirements given in Tables 150.0-B and 150.0-C.

EXCEPTION 2 to Section 150.0(m)13B and D: Multispeed compressor systems or variable speed compressor systems shall verify air flow (cfm/ton) and fan efficacy (Watt/cfm) for system operation at the maximum compressor speed and the maximum air handler fan speed.

CHANGE SIGNIFICANCE: Section 150.0(m)13D has been added to incorporate appropriate alternate airflow and fan efficacy requirements for SDHV forced air systems. These values are achievable by all certified SDHV air conditioners and heat pump combinations. The change removes the burden of SDHV from having to comply with the airflow and fan watt values in the 2016 Energy Code via an exception, which was unachievable by this technology.

Exceptions 1 and 2 to Section 150.0(m)13B and D – These exceptions have been updated to include SDHV systems in their application. These changes ensure SDHV systems can be installed legally in California and held to efficiency standards that are appropriate for the unique features of the equipment. The changes recognize that the same situations and concerns about single zone central forced air systems can occur with SDHV systems.

150.0(n)

Water Heating System

CHANGE TYPE: Modification and Addition

CHANGE SUMMARY: Updates were made to electrical specifications for gas or propane water heater systems serving individual dwelling units, ensuring homes are "heat pump water heater ready," allowing for a more streamlined transition to a greenhouse gas free appliance in the future.

2019 CODE:

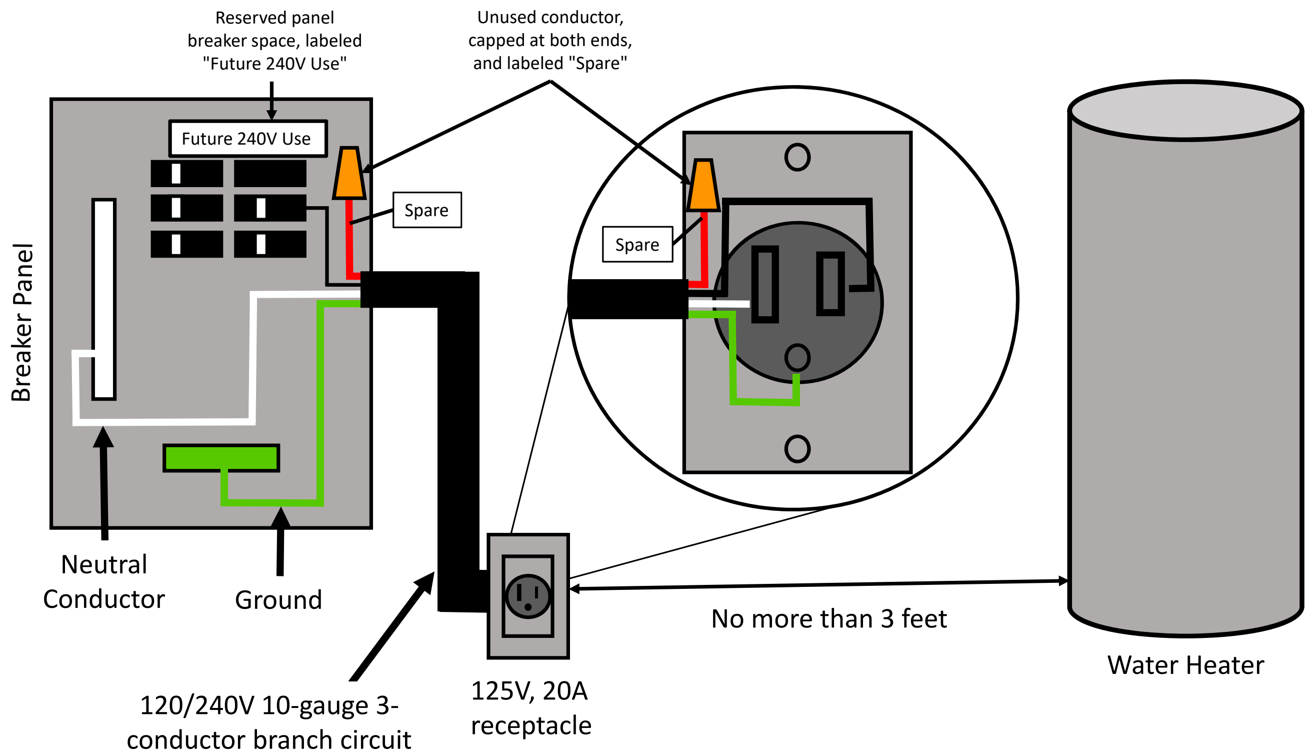
(n) **Water Heating System.**

1. Systems using gas or propane water heaters to serve individual dwelling units shall include the following components:
   - A. A dedicated ~~120V~~ 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:
     - i. Both ends of the unused conductor shall be labeled with the word "spare" and be electrically isolated; and
     - ii. 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
   - B. 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
   - C. 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
   - D. A gas supply line with a capacity of at least 200,000 Btu/hr.
2. Water heating recirculation loops serving multiple dwelling units shall meet the requirements of Section 110.3(c)5.
3. 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.
4. Instantaneous water heaters with an input rating greater than 6.8 kBTU/hr (2kW) shall meet the requirements of Section 110.3(c)7.

CHANGE SIGNIFICANCE: Section 150.0(n) applies to gas or propane water heater systems that serve individual dwelling units. Virtually all high efficiency gas water heaters require an electrical connection. The requirements make it easier to switch to a heat pump water heater or high efficiency gas water heater in the future. The changes ensure that suitable circuitry is safely installed and appropriately labeled. Installing this infrastructure during the initial construction stage is significantly less costly than retrofitting at a later time.

Section 150.0(n)1A updates the specifications for the electric panel receptacle and its connection, the conductor, and the circuit breaker space. The change ensures the circuit will be compatible with future energy efficient heat pump water heater installations. It also clarifies the requirements for installing a spare, available electrical path that would minimize the cost of installing electric equipment in the future.

Section 150.0(n)3 states that solar water heating systems and collectors must be certified and rated by an entity approved by the Energy Commission's Executive Director. The International Association of Plumbing and Mechanical Officials, Research and Testing (IAPMO R&T) has been added to this section because they are now approved to perform rating and certification.



Heat Pump Water Heater Ready Requirements – This diagram illustrates how to satisfy the heat pump ready requirements of the 2019 Energy Code for newly constructed low-rise residential buildings. When designed with natural gas water heaters, these buildings must have the infrastructure to switch to an electric heat pump water heater in the future.
Source: Allen Wong, California Energy Commission, Blueprint Newsletter – Issue 130

150.0(o)1

Requirements for Ventilation Systems and Indoor Air Quality, Amendments to ASHRAE 62.2

CHANGE TYPE: Addition

CHANGE SUMMARY: New design and performance specifications were added for ventilation systems in single family and multifamily residences in accordance with ASHRAE Standard 62.2-2016.

2019 CODE:

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

1. Amendments to ASHRAE 62.2 requirements.

   A. Window operation is not a permissible method of providing the dwelling unit~~Whole-Building~~ v~~V~~entilation airflow ~~required in Section 4 of ASHRAE Standard 62.2~~specified in subsections C, E, or F below.

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

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

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

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

      where

      Q_{tot} = total required ventilation rate, cfm

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

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

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

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

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

Q_{50} = $V_{du} \times 2\ ACH_{50}$ / 60 min

(Equation 150.0-C)

where

Q_{50} = leakage rate at 50 Pa.

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

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

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

Q_{50} = $V_{du} \times$ *Verified* ACH_{50} / 60 min

(Equation 150.0-D)

where

Q_{50} = leakage rate at 50 Pa.

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

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

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

Q_{inf} = $0.052 \times Q_{50} \times wsf \times [H/H_r]^z$.

(Equation 150.0-E)

where

Q_{inf} = effective annual infiltration rate, cfm (L/s).

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

wsf = weather and shielding factor from Table 150.0-D.

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

H_r = reference height, 8.2 ft (2.5 m).

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

iii. **Required Mechanical Ventilation Rate [ASHRAE 62.2:4.1.2]**

The Required Mechanical Ventilation Rate (Q_{fan}) shall be calculated using Equation 150.0-F.

$$Q_{fan} = Q_{tot} - \Phi\,(Q_{inf} \times A_{ext}) \qquad \textbf{(Equation 150.0-F)}$$

where

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

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

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

A_{ext} = 1 for single-family detached homes, or the ratio of exterior envelope surface area that is not attached to garages or other dwelling units to total envelope surface area for attached dwelling units not sharing ceilings or floors with other dwelling units, occupiable spaces, public garages, or commercial spaces.

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

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

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

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

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

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

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

EXCEPTION to Section 150.0(o)1G–Kitchen range hoods may be rated for sound at a static pressure determined at working speed as specified in HVI 916 section 7.2.

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

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

CHANGE SIGNIFICANCE: The new requirements in Section 150.0(o) focus on health and safety for occupants of dwelling units. The changes are consistent with statutes and policies that protect and enhance the indoor air quality in California's buildings.

Section 150.0(o) – This section now incorporates ASHRAE 62.2-2016 "Ventilation and Indoor Air Quality in Residential Buildings" by reference. It also adds "amendments" that augment and/or replace ASHRAE specifications in A, B, C, D, E, F, G, H, and I. A new numbering scheme improves clarity, and the ASHRAE term "whole building" has been replaced with "dwelling unit" in this subsection. Although the 2016 version of ASHRAE 62.2 uses the term 'whole-building,' the 2019 Energy Code uses the term "dwelling unit" throughout for consistency.

Section 150.0(o)1C – This section introduces a simplified method for calculating the mechanical ventilation airflow rate for single-family and various types of attached dwelling units. The simplified calculation relieves the responsibility of measuring a dwelling's enclosure leakage in the field. The test is required when verifying enclosure leakage values less than 2 ACH_{50}. Subsections i, ii, iii include the ASHRAE 62.2 calculations for clarity. Section 150.0(o)1D references the air filtration specifications in Section 150.0(m)12 instead of those in ASHRAE 62.2. It applies to supply ventilation systems and the supply side of balanced ventilation systems. In addition, the filtration particle size efficiency has increased from MERV 6 to MERV 13. The change also clarifies that compliance with Sections 6.7 (Minimum Filtration) and 6.7.1 (Filter Pressure Drop) of ASHRAE 62.2 is not required.

Section 150.0(o)1E specifies two "compartmentalization" options to reduce pollutant transfer between attached multifamily dwelling units. Only one of the two options can be used for compliance. Building designs that use different types of ventilation systems can be less effective and less energy efficient. Balancing the ventilation system throughout the building provides the intended benefits to a multifamily dwelling that shares walls with other units and indoor spaces. The reason for this requirement is that pressurizing a space pushes depleted or polluted air into the adjacent spaces, and depressurizing a space pulls depleted or polluted air in from adjacent spaces.

Option 1 requires a balanced ventilation system that supplies the same amount of outside air as the exhaust air, minimizing pressure differences between multifamily dwellings that could transfer contaminated air between units. Using a balanced strategy ensures that air is exchanged with the outside and not with adjacent indoor spaces.

Option 2 requires the dwelling to be sealed to minimize leakage between adjacent units. A HERS Rater must verify the enclosure leakage is less than 0.3 cubic feet per minute at 50 Pa per square feet of enclosed area.

Getty Images

Kitchen Range Hood – Under the 2019 Energy Code, kitchen range hoods must continue to meet maximum sone ratings, and a minimum CFM rating. In addition to these requirements, the Energy Code now requires that these values be verified by a third-party HERS Rater.

Section 150.0(o)1F applies to multifamily buildings where central ventilation systems serve multiple dwelling units. The airflow rate for every dwelling unit must be greater than or equal to the specified rate in Table 150.0-B (but cannot exceed 20% of the specified rate). The ventilation system designer may choose equipment such as constant air regulation devices, orifice plates, and variable speed central fans. This change limits the impact of high differential pressures throughout the building and prevents inadvertent indoor air quality impacts.

Section 150.0(o)1G requires that kitchen range hoods comply with the sound rating specification in ASHRAE 62.2 Section 7.2. These rating specifications were first adopted by reference to ASHRAE 62.2 in the 2008 Energy Code. It also includes an exception that allows an alternate test method and rate specification. About 50% of the kitchen range hood models listed in the HVI directory complied when the 2019 Energy Code was adopted in May of 2018, and will not need additional testing.

Section 150.0(o)1H clarifies that compliance with ASHRAE 62.2 Section 6.5.2 (Space Conditioning System Ducts) is not required. The change eliminates a conflict between the ASHRAE 62.2 duct leakage requirements and the duct leakage requirements in Sections 150.0(m)11 and 150.2(b)1D and E.

Section 150.0(o)1I requires a label with specified wording for the mandatory mechanical ventilation fan control. The label addresses concern that IAQ ventilation fans are often turned off by occupants who do not understand that the fans must be operated to protect their indoor air quality.

150.0(o)2

Requirements for Ventilation Systems and Indoor Air Quality, Field Verification and Diagnostic Testing

CHANGE TYPE: Addition

CHANGE SUMMARY: HERS raters must verify compliance with airflow and sound ratings for kitchen range hoods.

2019 CODE:

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

[…]

~~1~~2. **Field Verification and Diagnostic Testing.**

A. **Airflow Performance.** The ~~Whole-Building Ventilation~~ dwelling unit ventilation airflow required by Sections 150.0(o)1C, 150.0(o)1E, and 150.0(o)1F ~~Section 4 of ASHRAE Standard 62.2~~ shall be confirmed through field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.7.

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

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

ii The maximum sound rating as specified in Section 150.0(o)1G.

CHANGE SIGNIFICANCE: Ventilation systems waste energy when indoor air quality is not improved by their operation. These measures recognize the value of checking for proper installation and certification verification before the occupants move in. To assist with code enforcement, the measures in Section 150.0(o)2 require field verification and diagnostic testing by requiring third-party HERS inspection. A HERS rater must verify the airflow of dwelling unit ventilation systems, and the certification of kitchen range hoods.

Section 150.0(o)2A – This section now specifies the equations in Sections 150.0(o)1C, 150.0(o)1E, and 150.0(o)1F for airflow performance verification. A third-party HERS rater must confirm compliance with the ventilation system airflow requirements for each dwelling unit.

Section 150.0(o)2B introduces a new HERS verification requirement. It requires HERS verification that the hood's airflow and sound ratings meet the requirements of Section 5 of ASHRAE 62.2. Currently, the Home Ventilation Institute (HVI) and the Association of Home Appliance Manufacturers (AHAM) are the two approved programs for certifying and maintaining directories for these products.

For AHAM's certified range hood directory, visit https://www.aham.org/AHAM/What_We_Do/Kitchen_Range_Hood_Certification.

For HVI's certified rated product directory, visit https://www.hvi.org/hvi-certified-products-directory/.

PART 8

Low-Rise Residential Buildings—Performance and Prescriptive Compliance Approaches

Subchapter 8

Subchapter 8 defines the prescriptive and performance compliance approaches and establishes prescriptive requirements that are applicable low-rise residential buildings. This subchapter consists solely of Section 150.1.

Section 150.1(a) reiterates that all mandatory sections applicable to these buildings must be met, in addition to the performance and prescriptive measures of Section 150.1 where applicable. Section 150.1(b) defines the performance standards for these buildings, identifying how compliance and energy budgets are measured differently depending on the scope of work for the building. Section 150.1(c) defines all prescriptive requirements for single-family and multifamily low-rise residential buildings. These requirements are summarized in Tables 150.1-A for single-family buildings, and Table 150.1-B for multifamily buildings. ■

150.1

Performance and Prescriptive Compliance Approaches for Low-Rise Residential Buildings

150.1(b)

Performance Standards

150.1(b)1 and 2

Newly Constructed Buildings, and Additions and Alterations to Existing Buildings

150.1(b)3B

Compliance Demonstration Requirements for Performance Standard; Field Verification

150.1(c)

Prescriptive Standards/Component Packages

150.1(c)1A

Insulation

150.1(c)1B

Walls

150.1(c)1E
Quality Insulation Installation

150.1(c)3
Fenestration

150.1(c)5
Doors

150.1(c)7A
Space Heating and Space Cooling; Refrigerant Charge

150.1(c)8
Domestic Water Heating

150.1(c)10
Central Fan Integrated Ventilation Systems

150.1(c)12
Ventilation Cooling

150.1(c)14
Photovoltaic Requirements

TABLE 150.1-A
Component Package – Single Family Standard Building Design

TABLE 150.1-B
Component Package – Multifamily Standard Building Design

150.1(b)1 and 2

Performance Standards; Newly Constructed Buildings; and Additions and Alterations to Existing Buildings

CHANGE TYPE: Addition and Modification

CHANGE SUMMARY: The performance approach has been modified for newly constructed buildings to include a new metric for demonstrating compliance called the Energy Design Rating.

2019 CODE:

(b) **Performance Standards.** A building complies with the performance standards if the energy consumption ~~budget~~ calculated for the Proposed Design Building ~~under Subsection 2~~ is no greater than the energy budget calculated for the Standard Design Building ~~under Subsection 1~~ using Commission-certified compliance software as specified by the Alternative Calculation Methods Approval Manual.

1. **Newly Constructed Buildings.** The Energy Budget for newly constructed buildings is expressed in terms of the Energy Design Rating, which is based on time-dependent valuation (TDV) energy. The Energy Design Rating (EDR) has two components, the Energy Efficiency Design Rating, and the Solar Electric Generation and Demand Flexibility Design Rating. The Solar Electric Generation and Demand Flexibility Design Rating shall be subtracted from the Energy Efficiency Design Rating to determine the Total Energy Design Rating. The Proposed Building shall separately comply with the Energy Efficiency Design Rating and the Total Energy Design Rating.

   EXCEPTION to Section 150.1(b)1. 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 Energy Design Rating required to comply with the Standards, as calculated according to methods established by the Commission in the Residential ACM Reference Manual.

2. **Additions and Alterations to Existing Buildings.** The Energy Budget for additions and alterations is expressed in terms of TDV energy.

   ~~1. **Energy Budget for the Standard Design Building**. The energy budget for a Standard Design Building is determined by applying the mandatory and prescriptive requirements to the Proposed Design Building. The energy budget is the sum of the TDV energy for space conditioning, mechanical ventilation and water heating~~

   ~~2. **Energy Budget for the Proposed Design Building**. The energy budget for a Proposed Design Building is determined by calculating the TDV energy for the Proposed Design Building. The energy budget is the sum of the TDV energy for space-conditioning, mechanical ventilation and water heating. The energy budget for the Proposed Design Building is~~

~~reduced if on-site renewable energy generation is installed, according to methods established by the Commission in the Residential ACM Reference~~

~~3. **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 are documented in the Residential ACM Approval Manual.~~

CHANGE SIGNIFICANCE: The purpose of the changes to this section is to incorporate the use of the Energy Design Rating (EDR) concept, including component EDRs for energy efficiency, solar electric generation and design flexibility, and their combination into a total EDR for each newly constructed building.

The previous three subsections were replaced by two new subsections, one for newly constructed buildings, and one for additions and alterations to existing buildings to improve clarity and accuracy. The EDR expands the previous scope of the Energy Code to not only address building energy efficiency measures, but also to incorporate other means to reduce building energy consumption, including the major amount of energy used by plug loads (resulting from equipment and devices brought into homes by occupants that are plugged into electrical outlets), through onsite renewable energy generation and demand response/flexibility measures.

The EDR score enables a comprehensive focus that maximizes the ability for newly constructed buildings to be designed and built to be harmonized with California's electricity grid, consistent with the policies of the Commission's sister agencies, the California Independent System Operator, The California Public Utilities Commission, and the Air Resources Board, to contribute to achievement of California's climate change goals at lowest cost. For the first time this EDR metric is incorporated into the Energy Code for newly constructed, low-rise buildings.

An EDR score of 100 represents a building that consumes the amount of energy that a building built to the 2006 *International Energy Conservation Code*® (IECC®) would have consumed. A score of 0 represents a building that produces at least the same amount of energy it consumes over one year, making it a zero net energy building.

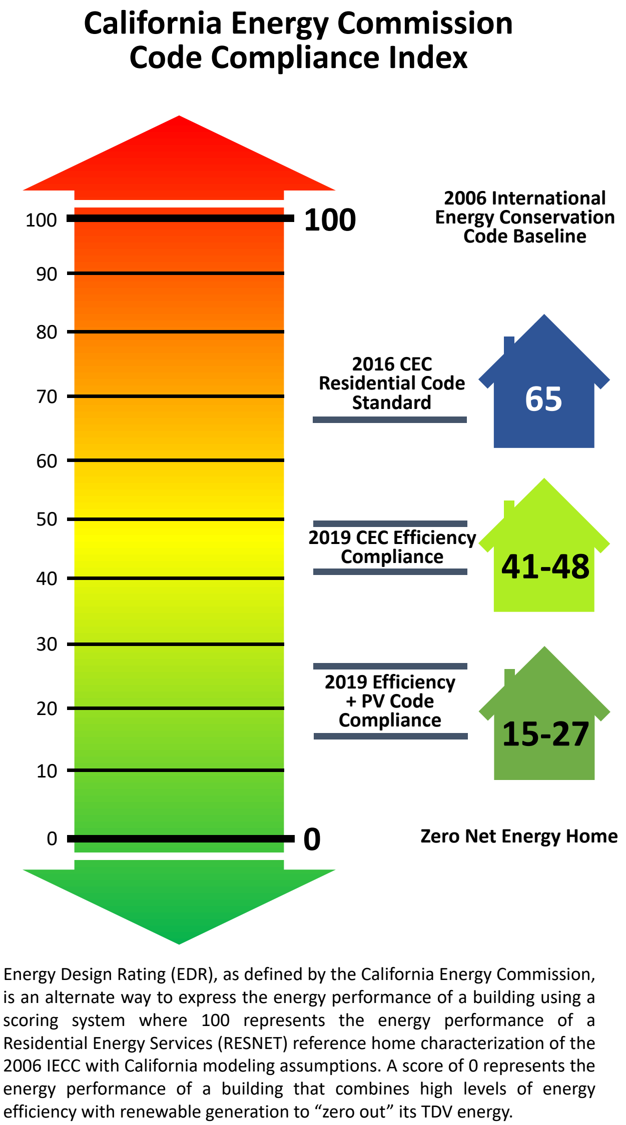
For compliance with the 2019 Energy Code, two EDR scores must be met independently:

1. **Efficiency EDR**, which represents that EDR score of 100, minus energy savings for space heating, cooling, ventilation, water heating, plus a limited credit for battery.
2. **Total EDR**, which represents the Efficiency EDR minus a compliance credit for a photovoltaic system (PV), battery, and other demand flexibility measures if modeled.

The Efficiency EDR score will generally be in the range of 41–48 and will vary by climate zone and building size. Once PV is added into the equation, the Total EDR score will generally be in the range of 15–27.

For the first time, the Energy Code is also recognizing the installation of a battery system and demand flexibility measures. These options can assist with achieving the maximum EDR scores for the buildings they're designed in.

An exception from the PV requirements was also added for newly constructed buildings which are served by a community shared solar electric system, or other community renewable electric generation system. These systems must be approved by the Energy Commission, as explained in Section 10-115 of the Administrative Code (Title 24, Part 1). A similar variance is also provided in this exception for homes served by a community shared battery system.



California's Energy Design Rating Sample Scale – An EDR score of 100 represents a low-rise residential building built to the 2006 *International Energy Conservation Code.* A low-rise residential building built to the 2019 Energy Code, including the addition of photovoltaic system requirements, will generally have an EDR score between 15 and 27.
Source: California Energy Commission

150.1(b)3B

Performance Standards; Compliance Demonstration Requirements for Performance Standard; Field Verification

CHANGE TYPE: Addition and Modification

CHANGE SUMMARY: Section references were added to the verification procedures for HERS verification measures when credit is taken for them via the performance approach.

2019 CODE:

(b) **Performance Standards.** A building complies with the performance standards if the energy consumption ~~budget~~ calculated for the Proposed Design Building ~~under Subsection 2~~ is no greater than the energy budget calculated for the Standard Design Building ~~under Subsection 1~~ using Commission-certified compliance software as specified by the Alternative Calculation Methods Approval Manual.

[…]

4~~3~~. **Compliance Demonstration Requirements for Performance Standards.**

[…]

B. **Field Verification.** When performance of installed features, materials, components, manufactured devices ~~and~~ or systems ~~performance~~ above the minimum specified in Section 150.1(c) is necessary for the building to comply with Section 150.1(b), 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. ~~, in accordance with the following requirements when applicable:~~

i. **SEER Rating.** When performance compliance requires installation of a space ~~a~~ conditioning system with a SEER rating that is greater than the minimum SEER rating required by TABLE 150.1-A or B, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.

ii. **EER Rating.** When performance compliance requires installation of a space conditioning system ~~that meets or exceeds a specified~~ with an EER rating greater than the standard design value for EER, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.

iii. **Low Leakage Air Handler.** When performance compliance requires installation of a low leakage air-handling unit ~~that meets the qualifications in Reference Joint Appendix JA9~~, the installed air-handling unit shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.1.4.3.9.

iv. **HSPF Rating.** When performance compliance requires installation of a heat pump system with an HSPF rating that is greater than the minimum Heating Seasonal Performance Factor (HSPF) rating required by TABLE 150.1-A or B, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.

v. **Heat Pump - Rated Heating Capacity.** When performance compliance requires installation of a heat pump system, the heating capacity values at 47°F and 17°F shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.2.

vi. **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.

vii. **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.

viii. **Building Enclosure Air Leakage.** When performance compliance requires a building enclosure leakage rate that is lower than the standard design, the building enclosure shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.8.

ix. **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.

CHANGE SIGNIFICANCE: The purpose of the change to this section is to identify appropriate field verification methods for several third-party HERS verification measures. The requirements for each field verification procedure are described in the referenced sections of Reference Residential Appendix RA3 (RA3). Third-party field verification requirements are necessary to ensure that the potential energy efficiency benefits of installed equipment are realized. These measures are not required but can be selected as part of a building's overall compliance, and when selected, must be verified by a HERS rater.

HERS Verified Blower Door Test – Envelope leakage, when modeled, must be verified by a third party HERS rater.
Source: California Energy Commission

Project Status Report — CalCERTS, Inc — 1 of 2

GENERAL INFORMATION

Code Year Standards	2013
Project Name	Shoemaker Performance Demo
Project Type	New Construction SFR
Address	1516 9th Street
City / State / Zip	Sacramento / CA / 95814
Enforcement Agency	City of Sacramento
Permit Number	123456789
HERS VERIFIABLE MEASURES	NOT COMPLETE
OVERALL STATUS	NOT COMPLETE

Easy to verify @ calcerts.com

CF1R INFORMATION - Certificate of Compliance

Certificate Type	Compliance
Registered Form	CF1R-PRF-01-E
Registered Date	04/05/2016 08:30
Registration Number	[illegible]

ADDITIONAL CF1Rs

System	Form	Registered Date	Registration Number
	CF1R-SRA-01		[illegible]

CF2R INFORMATION - Certificate of Installation

System	Form	Registered Date	Registration Number
	CF2R-ENV-01 (Fenestration Installation)		[illegible]
	CF2R-ENV-02 (Envelope Air Sealing)		[illegible]
	CF2R-ENV-03 (Insulation Installation)		[illegible]
	CF2R-ENV-04 (Roofing-Radiant Barrier)		[illegible]
	CF2R-MCH-01 (Space Conditioning Systems, Ducts and Fans)	04/05/2016 09:40	[illegible]
System 1	CF2R-MCH-20 (Duct Leakage)	04/05/2016 09:40	[illegible]
System 1	CF2R-MCH-23 (Airflow)	04/05/2016 09:40	[illegible]
System 1	CF2R-MCH-22 (Fan Efficacy)	04/05/2016 09:40	[illegible]
System 1	CF2R-MCH-25 (Refrigerant Charge)	04/05/2016 09:40	[illegible]
	CF2R-MCH-27 (IAQ and MV)	04/05/2016 09:40	[illegible]
	CF2R-PLB-02 (SD HWS Distribution)	04/05/2016 09:40	[illegible]

CF3R INFORMATION - Certificate of Verification

System	Form	Registered Date	Registration Number
	CF3R-MCH-27 (IAQ and MV)		[illegible]
System 1	CF3R-MCH-20 (Duct Leakage)	04/11/2016 12:52	[illegible]

CA Building Energy Efficiency Standards — 2013 Residential Compliance — HERS Provider: CalCERTS Inc.

HERS Project Status Report (PSR) – This report is generated within the HERS registries for every low-rise residential project that has HERS verification measures. It lists all applicable forms for the project and indicates whether they are complete or incomplete. It is an excellent resource and can be used by the enforcement agency at the final stage of a project to ensure that all applicable forms have been completed and registered. Both CalCERTS and CHEERS generate a PSR.
Source: CalCERTS Data Registry

150.1(c)1A

Prescriptive Standards – Insulation

CHANGE TYPE: Modification

CHANGE SUMMARY: The above-roof-deck insulation option used for prescriptive compliance with the high-performance attic option was removed.

2019 CODE:

(c) **Prescriptive Standards/Component Packages.** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE 150.1-A or B. In TABLE 150.1-A and TABLE 150.1-B, NA (not allowed) means that feature is not permitted in a particular Climate Zone and 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:

1. **Insulation.**

   A. Roof and Ceiling insulation shall be installed in a ventilated attic with an *R*-value equal to or greater than that shown in ~~Table~~ TABLE 150.1-A or B meeting options ii through or iii below.

      i. Option ~~A~~A: RESERVED.

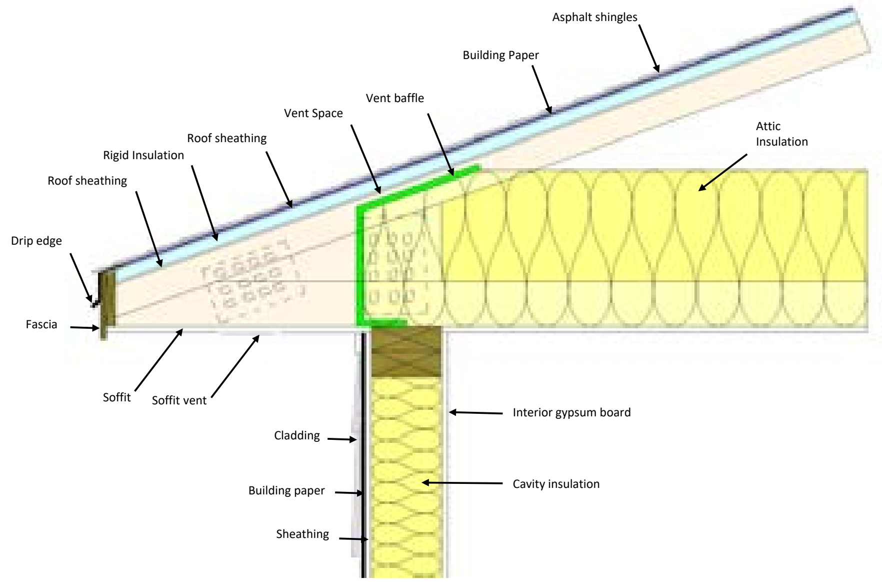
      ii. Option B: A minimum *R*-value of ~~continuous~~ insulation installed ~~above~~ between the roof rafters in contact with the roof deck and an additional layer of ceiling insulation located between the attic and the conditioned space when meeting Section 150.1(c)9A; or

      iii. Option ~~B~~C: A minimum *R*-value of ceiling insulation located between the attic and the conditioned space when meeting Section 150.1(c)9B. ~~A minimum R-value of insulation installed between the roof rafters in contact with the roof deck and an additional layer of ceiling insulation located between the attic and the conditioned space when meeting Section 150.1(c)9A; or~~

      ~~iii. Option C: A minimum R-value of ceiling insulation located between the attic and the conditioned space when meeting Section 150.1(c)9B.~~

   NOTE: Low rise residential single family and ~~multi-family~~multi-family buildings with the ducts and air handler located in the conditioned space, as specified by Section 150.1(c)9B, need only comply with insulation requirements of Option C.

CHANGE SIGNIFICANCE: The purpose of the modification to Section 150.1(c)1A is to remove high performance attic option A from the prescriptive package. Above roof deck insulation may still be installed to comply with roof and ceiling insulation requirements under the performance compliance approach. This change is necessary to prevent discrepancies between prescriptive alternatives, where equivalency is not guaranteed without building modeling.



High-Performance Attic with Insulation Above Rafters – This prescriptive option for compliance with the high-performance attic requirements has been removed from the 2019 Energy Code. When complying via the performance approach, installing insulation above the roof rafters is still acceptable, and can be modeled for compliance.
Source: California Energy Commission, 2019 Residential Compliance Manual

150.1(c)1B

Prescriptive Standards – Walls

CHANGE TYPE: Clarification

CHANGE SUMMARY: The purpose of the clarification to this section is to provide consistency in phrasing and add a reference to the multifamily Table 150.1-B.

2019 CODE:

(c) **Prescriptive Standards/Component Package.** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE 150.1-A or B. In TABLE 150.1-A and TABLE 150.1-B, NA (not allowed) means that feature is not permitted in a particular Climate Zone and 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:

1. **Insulation.**

[…]

B. **Walls.**

~~i. Walls (including heated basements and crawl spaces) shall be insulated such that the opaque wall has an assembly U-factor equal to or less than shown in Table 150.1-A, or walls shall be insulated between wood framing with an R-value equal to or greater than shown in TABLE 150.1-A. The U-factors shown are maximum U-factors for the opaque wall assembly. Alternatively, for mass walls above grade and for below grade walls with insulation installed on the interior, the R-values shown are the minimum R-values for insulation installed between wood-framing members; and for below grade walls with exterior insulation, the R-values shown are the minimum R-values for continuous insulation.~~ Framed exterior walls shall be insulated such that the exterior wall has an assembly *U*-factor equal to or less than that shown in TABLE 150.1-A or B. The *U*-factors shown are maximum *U*-factors for the exterior wall assembly.

ii. Mass walls above grade and below grade shall be insulated such that the wall has an assembly *U*-factor equal to or less than that shown in TABLE 150.1-A or B, or walls shall be insulated with continuous insulation that has an R-value equal to or greater than that shown in TABLE 150.1-A or B. "Interior" denotes continuous insulation installed on the inside surface of the wall, and "exterior" denotes continuous insulation installed on the outside surface of the wall.

iii. Other unframed exterior walls, excluding mass walls, shall meet the requirements for framed walls shown in TABLE 150.1-A or B.

CHANGE SIGNIFICANCE: The purpose of the change to Section 150.1(c)1B is to simplify language relating to insulation requirements and use consistent terminology. Language was also added to the mass wall insulation requirements. This language was added to clarify that insulation *R*-values found in the prescriptive tables for mass walls are for continuous insulation.

TABLE 150.1-A Component Package—Single-Family Standard Building Design

Single Family			Climate Zone															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation																		
Walls	Above Grade	Framed[3]	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.065	U 0.065	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048
		Mass Wall Interior[4,5]	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 17
		Mass Wall Exterior[4,5]	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.077 R 13
	Below Grade	Below Grade Interior[6]	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.077 R 13	U 0.067 R 15
		Below Grade Exterior[6]	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.100 R 10	U 0.100 R 10	U 0.053 R 19

Table 150.1-A Excerpt – Prescriptive wall insulation requirements vary by climate zone, assembly type, and for mass walls, location of insulation. Climate Zone 16, California's coldest climate, has higher prescriptive wall insulation requirements when compared with the rest of California.
Source: California Energy Commission

150.1(c)1E

Prescriptive Standards – Quality Insulation Installation

CHANGE TYPE: Addition

CHANGE SUMMARY: HERS Quality Insulation Installation (QII) verification was added to the prescriptive compliance requirements.

2019 CODE:

(c) **Prescriptive Standards/Component Package.** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE 150.1-A or B. In TABLE 150.1-A and TABLE 150.1-B, NA (not allowed) means that feature is not permitted in a particular Climate Zone and 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:

1. **Insulation.**

   [...]

   E. All buildings shall comply with the Quality Insulation Installation (QII) requirements shown in TABLE 150.1-A or B. When QII is required, insulation installation shall meet the criteria specified in Reference Appendix RA3.5.

CHANGE SIGNIFICANCE: The purpose of the addition of Section 150.1(c)1E is to require HERS Quality Insulation Installation (QII) verification measures as a part of prescriptive compliance. QII was found to provide a substantial benefit in low-residential buildings in excess of its cost over the economic life of the building, except for multifamily buildings in Climate Zone 7.

QII requires HERS third-party inspection to verify that an air barrier and insulation are installed correctly. This eliminates or reduces common problems associated with poor installation. These QII HERS verification requirements include inspections at the framing stage before insulation is installed, and at the insulation stage before the walls are enclosed. The HERS verification requirements and procedures for QII verification can be found in Section RA3.5 of the 2019 Reference Residential Appendices.

Wall Insulation – Third-party HERS verification of Quality Insulation Installation (QII) is now a prescriptive requirement for low-rise residential buildings.
Source: California Energy Commission

150.1(c)3

Prescriptive Standards – Fenestration

CHANGE TYPE: Clarification

CHANGE SUMMARY: Grammar was corrected, phrasing was improved, and a reference to glazed doors was added.

2019 CODE:

(c) **Prescriptive Standards/Component Package.** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE 150.1-A or B. In TABLE 150.1-A and TABLE 150.1-B, NA (not allowed) means that feature is not permitted in a particular Climate Zone and 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:

[…]

3. **Fenestration.**

   A. Installed fenestration products, including glazed doors, shall have an area-weighted average *U*-factor and Solar Heat Gain Coefficient (SHGC) ~~no greater than the~~meeting the applicable fenestration value~~s~~ in TABLE 150.1-A or B and shall be determined in accordance with Sections 110.6(a)2 and 110.6(a)3.

   EXCEPTION 1 to Section 150.1(c)3A: For each dwelling unit up to 3 square feet of new glazing area installed in doors and up to 3 square feet of new tubular skylights area with dual-pane diffusers shall not be required to meet the *U*-factor and SHGC requirements of TABLE 150.1-A or B.

   EXCEPTION 2 to Section 150.1(c)3A: 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.

   EXCEPTION 3 to Section 150.1(c)3A For fenestration containing chromogenic type glazing:

   i. ~~t~~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;

   ii. ~~c~~Chromogenic glazing shall be considered separately from other fenestration; and

   iii. ~~a~~Area-weighted averaging with other fenestration that is not chromatic shall not be permitted and shall be determined in accordance with Section 110.6(a).

   EXCEPTION 4 to Section 150.1(c)3A: For dwelling units containing unrated site-built fenestration that meets the maximum area restriction, the *U*-factor and SHGC can be determined in accordance with the Nonresidential Reference Appendix NA6 or use default values in TABLE 110.6-A and TABLE 110.6-B.

   […]

CHANGE SIGNIFICANCE: The purpose of the changes to Section 150.1(c)3A are to correct capitalization, provide consistency in phrasing, add a reference to glazed doors, and update references to Table 150.1-A and Table 150.1-B, consistent with changes to those tables and changes to Section 150.1(c)5.

150.1(c)5

Prescriptive Standards – Doors

CHANGE TYPE: Addition

CHANGE SUMMARY: New prescriptive efficiency requirements were added for doors that separate conditioned space from unconditioned spaces, or the outdoors.

2019 CODE:

(c) **Prescriptive Standards/Component Package.** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE 150.1-A or B. In TABLE 150.1-A and TABLE 150.1-B, NA (not allowed) means that feature is not permitted in a particular Climate Zone and 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:

[…]

5. ~~**RESERVED**~~**Doors.** Installed swinging door products separating conditioned space from outside or adjacent unconditioned space, but not including glazed door products, shall have an area-weighted average *U*-factor no greater than the applicable door value in TABLE 150.1-A or B and shall be determined in accordance with Section 110.6(a)2. Glazed door products are treated as fenestration products in Sections 150.1(c)3 and 150.1(c)4.

   EXCEPTION to Section 150.1(c)5: Swinging doors between the garage and conditioned space that are required to have fire protection are not required to meet the applicable door value in TABLE 150.1-A or B.

CHANGE SIGNIFICANCE: The purpose of the change to Section 150.1(c)5 is to introduce prescriptive requirements for doors that separate conditioned spaces from and unconditioned spaces or the outdoors. These doors now must meet a prescriptive maximum *U*-factor of 0.20 and must be rated by the National Fenestration Rating Council (NFRC) for their efficiencies to be recognized by the Energy Code. If a door is not NFRC rated, it must use default ratings, as described in Table 4.5.1 of Section JA4.5 of the 2019 Reference Joint Appendices. As with all prescriptive requirements, this measure can be traded away via the performance approach.

An exception was also added to this new requirement for doors that are required to have fire protection. This was added to prevent conflict with fire safety requirements.

Getty Images

Doors – Doors separating conditioned spaces from unconditioned spaces or the outdoors are subject to a prescriptive maximum *U*-factor of 0.20. Doors that are required to have fire protection are exempt from this requirement.

Table 4.5.1 of the 2019 Reference Appendices – This table assigns default values for doors that are not rated by the NFRC.

TABLE 4.5.1 Doors

~~**Table 4.5.1 of the 2019 Reference Appendices – This table assigns default values for doors that are not rated by the NFRC**~~.

Description		U-factor (Btu/°F ft^2 A
Uninsulated single-layer metal swinging doors or non-swinging doors, including single-layer uninsulated access hatches and uninsulated smoke vents.	1	1.45
Uninsulated double-layer metal swinging doors or non-swinging doors, including double-layer uninsulated access hatches and uninsulated smoke vents.	2	0.70
Insulated metal swinging doors including fire rated doors, insulated access hatches and insulated smoke vents.	3	0.50
Wood doors, minimum nominal thickness of 1 $^3/_4$ in. (44 mm), including panel doors with minimum panel thickness of 1 $^1/_8$ in. (28mm), and solid core flush doors, and hollow core flush doors	4	0.50
Any other wood door	5	0.60
Uninsulated single layer metal roll up doors including fire rated door	6	1.45
Insulated single layer metal sectional doors, minimum insulation nominal thickness of $^3/_8$ inch; expanded polystyrene (R-4 per inch)	7	0.179

Source: ASHRAE 90.1-2007, Section A7

150.1(c)7A

Prescriptive Standards – Space Heating and Space Cooling – Refrigerant Charge

CHANGE TYPE: Modification

CHANGE SUMMARY: Airflow requirements for small duct high velocity (SDHV) air conditioners and heat pumps were added to the refrigerant charge verification requirements and a reference to Reference Joint Appendix JA5 was changed to Section 110.12.

2019 CODE:

(c) **Prescriptive Standards/Component Package.** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE 150.1-A or B. In TABLE 150.1-A and TABLE 150.1-B, NA (not allowed) means that feature is not permitted in a particular Climate Zone and 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:

[…]

7. **Space Heating and Space Cooling.** All space heating and space cooling equipment shall comply with minimum Appliance Efficiency Regulations as specified in Sections 110.0 through 110.2 and meet all applicable requirements of Sections 150.0 and 150.1(c)7A.

   A. **Refrigerant Charge.** When refrigerant charge verification or fault indicator display is shown as required by TABLE 150.1-A or B, the system shall comply with either Table 150.1(c)7Ai or 150.1(c)7Aii:

      i. 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 a, b and c, unless the system is of a type that cannot be verified using the specified procedures:

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

         EXCEPTION to Section 150.1(c)7Aia: 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.

         b. System airflow rate ~~greater than or equal to 350 cfm per ton~~ in accordance with Subsection I or II, shall be confirmed through field verification and diagnostic testing in accordance with all applicable procedures specified in ~~shall be demonstrated by the installer and be verified by the HERS rater as specified by~~ Reference Residential Appendix Section RA3.3 or an approved alternative procedure as specified by Section RA1~~.~~; and

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

II. For all other air-cooled air conditioner or air-source heat pump systems the system airflow rate shall be greater than or equal to 350 cfm per ton.

EXCEPTION to Section 150.1(c)7Aib: Standard ducted systems without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in TABLE-150.0-B or 150.0-C as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Section RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12DC for the system air filter device(s) shall conform to the requirements given in TABLES 150.0-B and 150.0-C.

c. The installer shall charge the system according to manufacturer's specifications. Refrigerant charge shall be verified according to one of the following options, as applicable:

I. The installer and rater shall perform the standard charge procedure as specified by Reference Residential Appendix Section RA3.2.2 or an approved alternative procedure as specified by Section RA1; or

II. The system shall be equipped with a fault indicator display (FID) device that meets the specifications of Reference Joint Appendix JA6. The installer shall verify the refrigerant charge and FID device in accordance with the procedures in Reference Residential Appendix Section RA3.4.2. The HERS Rater shall verify FID device in accordance with the procedures in Section RA3.4.2; or

III. The installer shall perform the weigh-in charging procedure as specified by Reference Residential Appendix Section RA3.2.3.1 provided the system is of a type that can be verified using the Section RA3.2.2 standard charge verification procedure and Section RA3.3 airflow rate verification procedure or approved alternatives in Section RA1. The HERS Rater shall verify the charge using RA3.2.2 and RA3.3 or approved alternatives in Section RA1.

~~**EXCEPTION to Section 150.1(c)7Aia:** 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 1 to Section 150.1(c)7Aib:** The Executive Director may approve alternate airflow rate requirements for small duct high velocity systems.~~

EXCEPTION 1 to Section 150.1(c)7Aic: 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 ~~Reference Joint Appendix JA5~~<u>Section 110.12.</u> Ducted systems shall comply with minimum system airflow rate requirement in Section 150.1(c)7Aib.

ii. Air-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted packaged systems, <u>small duct high-velocity systems</u> and mini-split systems, which are of a type that cannot comply with the requirements of <u>Section</u> 150.1(c)7Ai shall comply with subsections a and b, as applicable.

a. The installer shall confirm the refrigerant charge using the weigh-in charging procedure specified in Reference Residential Appendix Section RA3.2.3.1, as verified by a HERS Rater according to the procedures specified in Reference Residential Appendix Section RA3.2.3.2; and

b. Systems that utilize forced air ducts shall comply with the minimum system airflow rate requirement in Section 150.1(c)7Aib provided the system is of a type that can be verified using the procedures in <u>Section</u> RA3.3 or an approved alternative procedure in <u>Section</u> RA1.

EXCEPTION to Section 150.1(c)7A: Packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.1(c)7Aib, provided that the system is of a type that can be verified using the procedure specified in Section RA3.3 or an approved alternative in Section RA1.

CHANGE SIGNIFICANCE: A requirement for SDHV system airflow rate was added to this section and the section was reorganized accordingly. Section 150.1(c)7AibI was added for the SDHV airflow rate requirement, and Section 150.1(c)7AibII was added for the airflow rate requirement of all other systems. With the addition of the airflow requirements to this section, Exception 1 to Section 150.1(c)7Aib in the 2016 Energy Code allowing SDHV airflow rates to be approved by the Executive Director was no longer necessary and was removed.

Reorganization of the 2019 Energy Code demand response measures required the reference to Reference Joint Appendix JA5 (JA5) in Exception 1 to Section 150.1(c)7Aic to be changed to reference Section 110.12. The 2016 Energy Code demand response requirements were reorganized into a new section, Section 110.12, in the 2019 Energy Code. This new section also directs users to the requirements in JA5 when applicable. Exceptions were also relocated to their appropriate sections, rather than at the end of the parent section.

150.1(c)8

Prescriptive Standards – Domestic Water Heating

CHANGE TYPE: Clarification, Addition, and Modification

CHANGE SUMMARY: Changes were made to the residential water heating prescriptive options to reflect changes at the federal level and to allow a prescriptive all-electric pathway for residential buildings.

2019 CODE:

(c) **Prescriptive Standards/Component Package.** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE 150.1-A or B. In TABLE 150.1-A and TABLE 150.1-B, NA (not allowed) means that feature is not permitted in a particular Climate Zone and 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:

[…]

8. **Domestic Water-Heating Systems.** Water-heating systems shall meet the requirements of ~~either~~ A, B, or C. For recirculation distribution systems serving individual dwelling unit, only Demand Recirculation Systems with manual on/off control pumps as specified in the Reference Appendix RA4.4.9 shall be used:

   A. For systems serving individual dwelling units, the water heating system shall meet the requirement of ~~either~~ i, ii, ~~or~~ iii, iv, or v:

      i. ~~A single~~One or more gas or propane instantaneous water heater with an input of 200,000 Btu per hour or less and no storage tank~~, and that meets the requirements of Sections 110.1 and 110.3 shall be installed.~~ .

      ii. A single gas or propane storage-type water heater with an input of 75,000 Btu per hour or less, rated volume less than or equal to 55 gallons and that meets the requirements of Sections 110.1 and 110.3. The dwelling unit shall have installed fenestration products with a weighted average *U*-factor no greater than 0.24, and in addition one of the following shall be installed:

         a. A compact hot water distribution system that is field verified as specified in the Reference Appendix RA4.4.16; or

         b. A drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9.

      ~~ii. A single gas or propane storage type water heater with an input of 105,000 Btu per hour or less, rated volume less than or equal to 55 gallons and that meets the requirements of Sections 110.1 and 110.3. The dwelling unit shall meet all of the requirements for Quality Insulation Installation (QII) as specified in the Reference Appendix RA3.5, and in addition one of the following shall be installed:~~

a. ~~A compact hot water distribution system that is field verified as specified in the Reference Appendix RA4.4.16; or~~

b. ~~All domestic hot water piping shall be insulated and field verified as specified in the Reference Appendix RA4.4.1, RA4.4.3 and RA4.4.14.~~

iii. A single gas or propane storage type water heater with an input of ~~105~~75,000 Btu per hour or less, rated volume of more than 55 gallons.~~, and that meets the requirements of Sections 110.1 and 110.3, and in addition one of the following shall be installed:~~

a. ~~A compact hot water distribution system that is field verified as specified in the Reference Appendix RA4.4.16; or~~

b. ~~All domestic hot water piping shall be insulated and field verified as specified in the Reference Appendix RA4.4.1, RA4.4.3 and RA4.4.14.~~

iv. A single heat pump water heater. The storage tank shall be located in the garage or conditioned space. In addition, one of the following:

a. A compact hot water distribution system as specified in the Reference Appendix RA4.4.6 and a drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9. ~~or~~

b. For Climate Zones 2 through 15, a photovoltaic system capacity of 0.3 kWdc larger than the requirement specified in Section 150.1(c)14. ~~or~~

c. For Climate Zones 1 and 16, a photovoltaic system capacity of 1.1 kWdc larger than the requirement specified in Section 150.1(c)14.

v. A single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher. The storage tank shall be located in the garage or conditioned space. In addition, for Climate Zones 1 and 16, a photovoltaic system capacity of 0.3 kWdc larger than the requirement specified in Section 150.1(c)14 or a compact hot water distribution system as specified in the Reference Appendix RA4.4.6.

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

i. Gas or propane ~~water heaters, boilers or other~~ water heating ~~equipment~~system. ~~that meet the minimum efficiency requirements of Sections 110.1 and 110.3; and~~

ii. A ~~water heating~~ recirculation ~~loop~~ system that meets the requirements of Sections 110.3(c)2 and 110.3(c)5, includes two or more separate recirculation loops serving separate dwelling units, and is ~~equipped with an~~

~~automatic control system that~~capable of automatically controllings~~s~~ the recirculation pump operation based on measurement of hot water demand and hot water return temperature. ~~and has two recirculation loops each serving half of the building; and~~

EXCEPTION to Section 150.1(c)8~~C~~Bii: Buildings with eight or fewer dwelling units ~~are exempt from the requirement for two recirculation loops~~may use a single recirculation loop.

iii. A solar water-heating system meeting the installation criteria specified in Reference Residential Appendix RA4 and with a minimum solar savings fraction of either a or b: ~~of 0.20 in Climate Zones 1 through 9 or a minimum solar savings fraction of in Climate Zones 10 through 16. The solar savings fraction shall be determined using a calculation method approved by the Commission~~.

a. 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.

b. 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.

C. A water-heating system serving multiple dwelling units determined by the Executive Director to use no more energy than the one specified in subsection B.

CHANGE SIGNIFICANCE: Section 150.1(c)8Ai – References to Sections 110.1 and 110.3 were removed to reduce redundancy. The requirements of Section 110.1 and 110.3 apply regardless of their inclusion in this section.

Section 150.1(c)8Aii – The 2016 Energy Code prescriptively allowed a storage water heater less than or equal to 55 gallons to be installed when Quality Insulation Installation (QII) measures were met, along with other energy efficient options. QII is now a prescriptive requirement for all newly constructed low-rise residential buildings under the 2019 Energy Code. As a result of this, new alternatives were added which when combined with a storage water heater of 55 gallons or less, equating to the same level of energy savings as an instantaneous water heater that satisfies the requirements of Option i.

Section 150.1(c)8Aiii – The US Department of Energy now requires that residential gas storage water heaters with a volume greater than 55 gallons meet the efficiency levels of condensing type water heaters. These water heaters are as efficient as meeting Option i, and for this reason, all additional requirements have been removed for these water heaters.

Section 150.1(c)8iv – The purpose of adding this section is to add an option to meet the water heating prescriptive requirement by installing an electric heat pump water heater, with either additional photovoltaic system capacity, or with both compact hot water distribution and Drain Water Heat Recovery systems. The 2019 Energy Code added all-electric compliance options for low-rise residential buildings, and this section and the next were introduced to give flexibility to the prescriptive options without changing the stringency of the current requirements.

Section 150.1(c)8Av – The purpose of adding this section is to add an option to meet the water heating prescriptive requirement by installing an electric heat pump water heater that meets the requirement of Northwest Energy Efficiency Alliance (NEEA) Advanced Water Heater Specification Tier 3 or higher. Heat pump water heaters meeting this efficiency requirement do not have to install any additional features unless they are installed in the colder climate zones of California in Climate Zones 1 and 16.

Section 150.1(c)8Bi and Bii – The purpose of the changes to these sections is to simplify code language and reduce redundancy.

Section 150.1(c)8Biii – The purpose of the change in this section is to add an option for central water heating systems to meet a reduced solar savings fraction requirement by using Drain Water Heat Recovery devices. This change is necessary to add flexibility to the prescriptive options without changing the stringency of the current requirements.

Section 150.1(c)8C – This section was added for consistency with a similar provision in Section 150.2(a)1Diii. These changes are necessary to ensure the availability of electric prescriptive options for newly constructed residential buildings which may be approved in between code cycles (e.g., central heat pump water heaters).

CHANGE TYPE: Modification

CHANGE SUMMARY: Residential gas furnace air-handler fan efficacy was increased from 0.58 W/cfm to 0.45 W/cfm for units manufactured on or after July 3, 2019.

150.1(c)10

Prescriptive Standards – Central Fan Integrated Ventilation Systems

2019 CODE:

(c) **Prescriptive Standards/Component Package.** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE 150.1-A <u>or B.</u> In TABLE 150.1-A <u>and</u> TABLE 150.1-B, NA (not allowed) means that feature is not permitted in a particular Climate Zone and 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:

[…]

10. **Central Fan Integrated Ventilation Systems.** Central forced air system fans used to provide outside air~~,~~ shall have an air-handling unit fan efficacy less than or equal to <u>the maximum W/CFM specified in A or B. 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.</u>

    <u>A. 0.45 W/CFM for gas furnace air-handling units; or</u>

    <u>B. 0.58 W/CFM for air-handling units that are not gas furnaces.</u>

    <u>**EXCEPTION to Section 151.0(c)10A:** Gas furnace air-handling units manufactured prior to July 3, 2019 shall comply with a fan efficacy value less than or equal to 0.58 w/cfm as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.</u>

    ~~0.58 W/CFM as 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.~~

CHANGE SIGNIFICANCE: The US Department of Energy has established minimum efficiency requirements for residential furnace fans. These regulations require residential furnace fans manufactured on or after July 3, 2019, to provide a minimum efficiency equivalent to constant torque brushless permanent magnet (BPM) type motors used in multistaged furnaces. As a result of this, the Energy Code has increased the fan efficacy requirements for gas furnace air handlers from 0.58 W/cfm to 0.45 W/cfm, while the fan efficacy for all other air-handlers remains at 0.58 W/cfm. As a result of these changes, this section was reorganized to reflect the change with the addition of Section 150.1(c)10A for gas furnace air-handler fan efficacy and the addition of Section 150.1(c)10B for all other air-handlers.

The fan efficacy of central fan integrated (CFI) systems must be verified using the same methods as required for furnaces and air handlers (see Reference Residential Appendix RA3.3). The central system air handler must be operating in ventilation mode with the outdoor air damper open and with ventilation air flowing into the return plenum from outside the building. Furthermore, the airflow that must be measured is the total airflow through the air handler (system airflow), which is the sum of the return airflow, and the outside air ducted to the return plenum (ventilation airflow).

An exception to Section 151.0(c)10A was also added to allow gas furnace air-handling units manufactured prior to July 3, 2019, to comply with a fan efficacy value less than or equal to 0.58 w/cfm instead of 0.45 W/cfm. The exception is necessary to avoid the possibility that manufacturer inventory would be stranded and unable to comply with the new 0.45 W/cfm standard.

CHANGE TYPE: Clarification

CHANGE SUMMARY: These changes clarify the flow rate and free attic vent area requirements for ventilation cooling whole house fans.

150.1(c)12

Prescriptive Standards – Ventilation Cooling

2019 CODE:

(c) **Prescriptive Standards/Component Package.** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE 150.1-A or B. In TABLE 150.1-A and TABLE 150.1-B, NA (not allowed) means that feature is not permitted in a particular Climate Zone and 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:

[…]

12. **Ventilation Cooling.** Single family homes shall comply with the Whole-house fan ~~House Fan~~ (WHF) requirements shown in TABLE 150.1-A. When a WHF is required, comply with Subsections A. through C~~.~~ below:

A. Have installed one or more WHFs whose total Air Flow CFM ~~as listed in the CEC Directory is at least~~ is equal to or greater than 1.5 CFM/ft^2 of conditioned floor area. Airflow CFM for WHF's shall be determined based on the Airflow listed in the Energy Commission's database of certified appliances, which is available at www.energy.ca.gov/appliances/database; and

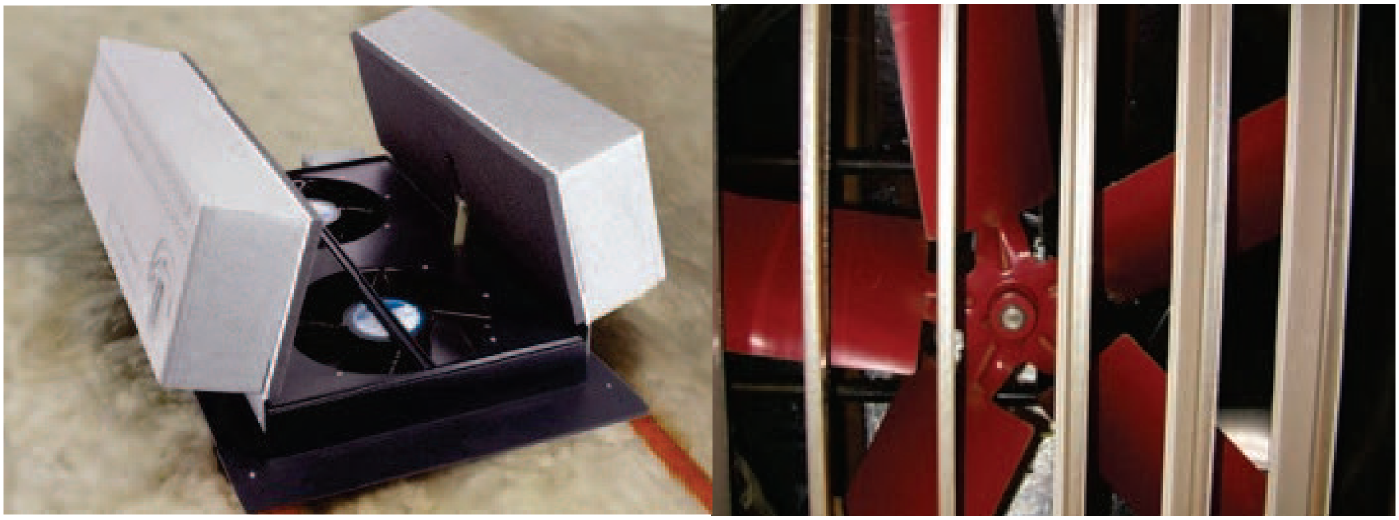
B. Have at least 1 square foot of attic vent free area for each 750 CFM of rated whole-house fan Airflow~~Air Flow~~ CFM, or if the manufacturer has specified a greater free vent area, the manufacturers' free vent area specifications; and

EXCEPTION to Section 150.1(c)12B: WHFs that are directly vented to the outside.

C. Provide homeowners who have WHFs with a one page "How to operate your whole-house fan" informational sheet.

CHANGE SIGNIFICANCE: Language was added to this section that clarifies how to determine the minimum required airflow rate of whole house fans (WHF). The minimum required airflow rate of 1.5 CFM/ft^2 of conditioned floor area must be determined by using the listed WHF airflow CFM listed in the Energy Commission's Modernized Appliance Efficiency Database System (MAEDbS), also known as the Title 20 database.

An exception to the minimum attic vent free area was also added. Homes with WHFs that are directly vented to the outside (instead of venting into the attic) are not required to meet the free attic vent area requirement.



Whole House Fans – These fans are an excellent way to reduce the temperature of a home in climates where there are large differences between daytime and morning/evening temperatures. Whole house fans are a prescriptive requirement for newly constructed single family low-rise residential buildings in Climate Zones 8–14.
Source: California Energy Commission, 2019 Residential Compliance Manual

150.1(c)14

Prescriptive Standards – Photovoltaic Requirements

CHANGE TYPE: Addition

CHANGE SUMMARY: A new measure requiring photovoltaic systems for all newly constructed low-rise residential buildings was added.

2019 CODE:

(c) **Prescriptive Standards/Component Package.** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements for the appropriate Climate Zone shown in TABLE 150.1-A or B. In TABLE 150.1-A and TABLE 150.1-B, NA (not allowed) means that feature is not permitted in a particular Climate Zone and 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:

[…]

14. **Photovoltaic Requirements.** All low-rise residential buildings shall have a photovoltaic (PV) system meeting the minimum qualification requirements as specified in Joint Appendix JA11, with annual electrical output equal to or greater than the dwelling's annual electrical usage as determined by Equation 150.1-C:

EQUATION 150.1-C ANNUAL PHOTOVOLTAIC ELECTRICAL OUTPUT

kW_{PV} = (CFA x A)/1000 +(NDwell x B)

where:

kW_{PV} = kWdc size of the PV system

CFA = Conditioned floor area

NDwell = Number of dwelling units

A = Adjustment factor from Table 150.1-C

B = Dwelling adjustment factor from Table 150.1-C

EXCEPTION 1 to Section 150.1(c)14: No PV system is required if the effective annual solar access is restricted to less than 80 contiguous square feet by shading from existing permanent natural or manmade barriers external to the dwelling, including but not limited to trees, hills, and adjacent structures. The effective annual solar access shall be 70 percent or greater of the output of an unshaded PV array on an annual basis.

EXCEPTION 2 to Section 150.1(c)14: In climate zone 15, the PV system size shall be the smaller of a size that can be accommodated by the effective annual solar access or a PV system size required by the Equation 150.1-C, but no less than 1.5 Watt DC per square foot of conditioned floor area.

EXCEPTION 3 to Section 150.1(c)14: In all climate zones, for dwelling units with two habitable stories, the PV system size shall be the smaller of a size that can be accommodated by the effective annual solar access or a PV system size required by the Equation 150.1-C, but no less than 1.0 Watt DC per square foot of conditioned floor area

EXCEPTION 4 to Section 150.1(c)14: In all climate zones, for low-rise residential dwellings with three habitable stories and single-family dwellings with three or more habitable stories, the PV system size shall be the smaller of a size that can be accommodated by the effective annual solar access or the PV system size required by the Equation 150.1-C, but no less than 0.8 Watt DC per square foot of conditioned floor area.

EXCEPTION 5 to Section 150.1(c)14: For a dwelling unit plan that is approved by the planning department prior to January 1, 2020 with available solar ready zone between 80 and 200 square feet, the PV system size is limited to the lesser of the size that can be accommodated by the effective annual solar access or the size that is required by the Equation 150.1-C.

EXCEPTION 6 to Section 150.1(c)14: PV system sizes from Equation 150.1-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 capacity of 7.5 kWh.

TABLE 150.1-C CFA and Dwelling Adjustment Factors

Climate Zone	A - CFA	B - Dwelling Units
1	0.793	1.27
2	0.621	1.22
3	0.628	1.12
4	0.586	1.21
5	0.585	1.06
6	0.594	1.23
7	0.572	1.15
8	0.586	1.37
9	0.613	1.36
10	0.627	1.41
11	0.836	1.44
12	0.613	1.40
13	0.894	1.51
14	0.741	1.26
15	1.56	1.47
16	0.59	1.22

CHANGE SIGNIFICANCE: 150.1(c)14 – The purpose of the addition of this section is to add a prescriptive requirement for installation of a photovoltaic (PV) system that has an annual electrical output equal to the dwelling's annual electrical usage, not including any electricity for space heating or water heating. This means that any electricity used for water heating or space heating will not count towards the required PV system size. The primary reason for this was that the Commission did not want to disincentivize all-electric homes. There were concerns during the rulemaking process that if electrifying a building would mean more PV system generation would be required, then builders may decide to forgo constructing all-electric buildings. Net Energy Metering rules also played a factor in this decision. Builders can still size their PV system to offset all electric loads, including water heating and space heating, but the Energy Code will not require bigger systems to offset the electric consumption of those components. Additionally, an increased PV system size is not allowed to be traded off for decreased building component efficiencies.

This requirement is applicable to all newly constructed low-rise residential buildings, including single family buildings, and multifamily buildings with 3 habitable stories or less, unless an exception is met. Additions and alterations to existing low-rise residential buildings are not subject to the PV system requirements of the Energy Code.

The size of the PV system required to comply with the Energy Code varies depending on the building's conditioned floor area, number of dwelling units, and climate zone. Bigger homes require bigger cooling systems (assuming they're in a cooling-dependent climate), and have bigger plug loads to offset. With regards to cooling, the PV system size will vary drastically depending on climate. Homes in hotter climate zones will have higher cooling loads than those in cooler climates, and the size of the PV system needed will vary as a result. Equation 150.1-C calculates the minimum PV system size requirement for a home complying via the prescriptive approach.

When demonstrating compliance via the performance approach, an approved computer modeling program must be used to determine the necessary PV system size needed to satisfy the requirements of the Energy Code. For example, a building with a highly efficient envelope will require less cooling, and in turn will require a smaller PV system compared to a building designed with a poor building envelope.

This is the first time the Energy Code has required energy generation. Previous iterations have included credits for PV systems. This change is necessary to continue to pursue the State's goals relating to greenhouse gas emission reductions and combatting climate change.

Exception 1 to Section 150.1(c)14 exempts buildings from the PV system requirements if the effective annual solar access is restricted to less than 80 contiguous square feet. For example, buildings where excessive shading exists like trees, or adjacent structures, that would make adding a PV system no longer meet cost-effective requirements are exempt from the PV system requirements.

Exception 2 to Section 150.1(c)14 allows a reduction of the PV system size required in Climate Zone 15 when the effective annual solar access is too restrictive to meet the calculated required PV system size. This exception limits the installed PV system size to no less than 1.5 Watts DC per square foot of conditioned floor area.

Exception 3 to Section 150.1(c)14 allows a reduction of the PV system size required for dwelling units with two habitable stories. This allows the system size to be the smaller of what can be accommodated by the effective annual solar access, or what the equation requires. This exception limits the installed PV system size to no less than 1.0 Watts DC per ft^2 of conditioned floor area.

Exception 4 to Section 150.1(c)14 allows a reduction in size of the PV system needed for compliance for buildings with three habitable stories, and single family buildings with three or more habitable stories. This allows the system size to be the smaller of what can be accommodated by the effective annual solar access, or what the equation requires. This exception limits the installed PV system size to no less than 0.8 Watts DC per square foot of conditioned floor area.

Exception 5 to Section 150.1(c)14 allows a reduction in PV size for dwelling unit plans that were approved by planning departments prior to January 1, 2020, with solar ready zones between 80 and 200 square feet. In these scenarios the PV size can be the smaller of what the equation requires, or the size that can be accommodated by the effective annual solar access.

Exception 6 to Section 150.1(c)14 allows a reduction in PV system size by 25 percent if a battery storage system is installed. The minimum capacity of the battery system installed for compliance with this exception is 7.5kWh. The qualification requirements for the installed battery system can be found in Reference Joint Appendix JA12.

Solar Panels Installed on a Low-Rise Residential Building – Solar photovoltaic systems are prescriptively required for all newly constructed low-rise residential buildings under the 2019 Energy Code.
Source: California Energy Commission

PV System Shading Exception – Buildings with an effective annual solar access that is restricted to less than 80 contiguous square feet due to external shading are exempt from the PV system requirements of the Energy Code.

Table 150.1-A

Prescriptive Standards — Single Family Standard Building Design

CHANGE TYPE: Addition and Modification

CHANGE SUMMARY: Efficiency measures were increased, and multifamily requirements were separated from single-family buildings, leaving Table 150.1-A strictly for single-family buildings.

2019 CODE:

TABLE 150.1-A Component Package—Single-Family Standard Building Design

SINGLE FAMILY			CLIMATE ZONE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation																		
Building Envelope: Roofs/Ceilings	Option B (meets 150.1(c)9A)	Below Roof Deck Insulation[1,2] (With Air Space)	NR	NR	NR	R-19	NR	NR	NR	R-19	R-19	R-19	R-19	R-19	R-19	R-19	R-19	R-19
		Ceiling Insulation	R-38	R-38	R-30	R-38	R-30	R-30	R-30	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38
		Radiant Barrier	NR	REQ	REQ	NR	REQ	REQ	REQ	NR	NR	NR	NR	NR	NR	NR	NR	NR
	Option C (meets 150.1(c)9B)	Ceiling Insulation	R-38	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-38	R-38	R-38	R-38	R-38	R-38
		Radiant Barrier	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
Walls	Above Grade	Framed[3]	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.065	U 0.065	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048
		Mass Wall Interior[4,5]	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.059 R-17
		Mass Wall Exterior[4,5]	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.077 R-13
	Below Grade	Below Grade Interior[6]	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.067 R-15
		Below Grade Exterior[8]	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.100 R-10	U 0.100 R-10	U 0.053 R-19
Floors		Slab Perimeter	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R-7.0
		Raised	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19
		Concrete Raised	U 0.092 R-8.0	U 0.092 R-8.0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.092 R-8.0	U 0.138 R-4.0	U 0.092 R-8.0	U 0.092 R-8.0	U 0.138 R-4.0	U 0.092 R-8.0
Quality Insulation Installation (QII)			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	0.63	NR
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR
	Steep-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0. 75	0.75	0.75	0.75	0.75	0.75	NR
Fenestration		Maximum U-factor	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
		Maximum SHGC	NR	0.23	NR	0.23	NR	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	NR
		Maximum Total Area	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
		Maximum West Facing Area	NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	NR
Door		Maximum U-factor	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

TABLE 150.1-A Component Package—Single-Family Standard Building Design—continued

SINGLE FAMILY				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
				CLIMATE ZONE — Building Envelope Insulation															
HVAC-SYSTEM	Space Heating[9]		Electric-Resistance allowed	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
HVAC-SYSTEM	Space Heating[9]		If gas, AFUE	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
HVAC-SYSTEM	Space Heating[9]		If Heat Pump, HSPF7	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
HVAC-SYSTEM	Space Cooling		SEER	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
HVAC-SYSTEM	Space Cooling		Refrigerant Charge Verification or Fault Indicator Display	NR	REQ	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
HVAC-SYSTEM	Space Cooling		Whole House Fan8	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	0.RE Q	REQ	NR	NR
HVAC-SYSTEM	Central System Air Handlers		Central Fan Integrated Ventilation System Fan Efficacy	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
HVAC-SYSTEM	Ducts[10]	Roof/Ceiling Option B	Duct Insulation	R-8	R-8	R-6	R-8	R-6	R-6	R-6	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8
HVAC-SYSTEM	Ducts[10]	Roof/Ceiling Option B	§150.1(c)9A	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
HVAC-SYSTEM	Ducts[10]	Roof/Ceiling Option C	Duct Insulation	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6
HVAC-SYSTEM	Ducts[10]	Roof/Ceiling Option C	§150.1(c)9B	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
WATER-HEATING	All Buildings			System shall meet Section 150.1(c)8															

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 ~~meet~~ to be less than or equal to the required maximum *U*-factor.
4. Mass wall has a ~~thermal~~ heat capacity greater than or equal to 7.0 Btu/h-ft². ~~"Interior" denotes insulation installed on the inside surface of the wall.~~
5. "Interior" denotes insulation installed on the inside surface of the wall. "Exterior" denotes insulation installed on the exterior surface of the wall.
6. Below grade "interior" denotes insulation installed on the inside surface of the wall; and below grade "exterior" denotes insulation installed on the outside surface of the wall.
7. HSPF means "heating seasonal performance factor."
8. When whole-house fans are required (REQ), only those whole-house fans that are listed in the Appliance Efficiency Directory may be installed. Compliance requires installation of one or more WHFs whose total airflow CFM is capable of meeting or exceeding a minimum 1.5 cfm/square foot of conditioned floor area as specified by Section 150.1(c)12.
9. 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.
10. For duct and air handler location: REQ denotes location in conditioned space. When the table indicates ducts and air handlers are in conditioned space, a HERS verification is required as specified by Reference Residential Appendix RA3.1.4.3.8.

CHANGE SIGNIFICANCE: Table 150.1-A was reformatted and separated from the multifamily low-rise residential requirements. As a result of changes described in the previous change summaries of Section 150.1(c), efficiencies were updated.

Prescriptively, the option for meeting the high-performance attic requirements without an airspace between the roofing and the roof deck was removed, and the corresponding footnote as removed. Other modifications were made to the footnotes to increase clarity and readability of the Energy Code.

Table 150.1-B

Prescriptive Standards — Multifamily Standard Building Design

CHANGE TYPE: Addition and Modification

CHANGE SUMMARY: Table 150.1-B was created to separate the prescriptive requirements for multifamily buildings from those for single-family buildings.

2019 CODE:

TABLE 150.1-B Component Package—Multifamily Standard Building Design

MULTIFAMILY			CLIMATE ZONE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation																		
Roofs/Ceilings	Option B (meets 150.1(c)9A)	Below Roof Deck Insulation[1,2] (With Air Space)	NR	NR	NR	R-19	NR	NR	NR	R-19	R-19	R-13	R-19	R-19	R-19	R-19	R-19	R-13
		Ceiling Insulation	R-38	R-38	R-30	R-38	R-30	R-30	R-30	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38
		Radiant Barrier	NR	REQ	REQ	NR	REQ	REQ	REQ	NR	NR	NR	NR	NR	NR	NR	NR	NR
	Option C (meets 150.1(c)9B)	Ceiling Insulation	R-38	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-38	R-38	R-38	R-38	R-38	R-38
		Radiant Barrier	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
Walls	Above Grade	Framed[3]	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.065	U 0.065	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051
		Mass Wall Interior[4,5]	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.059 R-17
		Mass Wall Exterior[5]	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.077 R-13
	Below Grade[6]	Below Grade Interior	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.077 R-13	U 0.067 R-15
		Below Grade Exterior	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.100 R-10	U 0.100 R-10	U 0.053 R-19
Floors		Slab Perimeter	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R-7.0
		Raised	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19
		Concrete Raised	U 0.092 R-8.0	U 0.092 R-8.0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.092 R-8.0	U 0.138 R-4.0	U 0.092 R-8.0	U 0.092 R-8.0	U 0.138 R-4.0	U 0.092 R-8.0
Quality Insulation Installation (QII)			Yes	Yes	Yes	Yes	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	0.63	NR
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR
	Steep-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0. 75	0.75	0.75	0.75	0.75	0.75	NR
Fenestration		Maximum *U*-factor	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
		Maximum SHGC	NR	0.23	NR	0.23	NR	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	NR
		Maximum Total Area	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
		Maximum West Facing Area	NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	NR
Door		Maximum *U*-factor	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

Building Envelope Insulation

TABLE 150.1-B **Component Package—Multifamily Standard Building Design—continued**

Multifamily			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			CLIMATE ZONE															
			Building Envelope Insulation															
HVAC-SYSTEM	Space Heating[9]	Electric-Resistance allowed	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
		If gas, AFUE	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
		If Heat Pump, HSPF[7]	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
	Space Cooling	SEER	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
		Refrigerant Charge Verification or Fault Indicator Display	NR	REQ	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
	Central System Air Handlers	Central Fan Integrated Ventilation System Fan Efficacy	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
	Ducts[9]	Roof/Ceiling Option B: Duct Insulation	R-8	R-8	R- 6	R-8	R- 6	R- 6	R- 6	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8
		Roof/Ceiling Option B: §150.1(c)9A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Roof/Ceiling Option C: Duct Insulation	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R- 6	R-6	R-6	R- 6	R- 6	R- 6
		Roof/Ceiling Option C: §150.1(c)9B	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
WATER-HEATING		All Buildings	System shall meet Section 150.1(c)8															

1. Install the specified R-value with an air space present between the roofing and the roof deck. Such as standard installation of concrete or clay tile.
2. R-values shown for below roof deck insulation are for wood-frame construction with insulation installed between the framing members. Alternatives including insulation above rafters or above roof deck shall comply with the performance standards.
3. Assembly U-factors for exterior framed walls can be met with cavity insulation alone or with continuous insulation alone, or with both cavity and continuous insulation that results in an assembly U-factor equal to or less than the U-factor shown. Use Reference Joint Appendices JA4 Table 4.3.1, 4.3.1(a), or Table 4.3.4 to determine alternative insulation products to be less than or equal to the required maximum U-factor.
4. Mass wall has a heat capacity greater than or equal to 7.0 Btu/h-ft^2.
5. "Interior" denotes insulation installed on the inside surface of the wall. "Exterior" denotes insulation installed on the exterior surface of the wall.
6. Below grade "interior" denotes insulation installed on the inside surface of the wall, and below grade "exterior" denotes insulation installed on the outside surface of the wall.
7. HSPF means "heating seasonal performance factor."
8. A supplemental heating unit may be installed in a space served directly or indirectly by a primary heating system, provided that the unit thermal capacity does not exceed 2 kilowatts or 7,000 Btu/hr and is controlled by a time-limiting device not exceeding 30 minutes.
9. For duct and air handler location: REQ denotes location in conditioned space. When the table indicates ducts and air handlers are in conditioned space, a HERS verification is required as specified by Reference Residential Appendix RA3.1.4.3.8.

NOTE: Authority: Sections 25213, 25218, 25218.5, 25402, 25402.1, and 25605, Public Resources Code. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, 25605, and 25943, Public Resources Code.

CHANGE SIGNIFICANCE: Table 150.1-B was created to isolate the low-rise multifamily prescriptive requirements. This was done because some requirements did not meet all requirements necessary for them to apply to both single-family and multifamily buildings.

For multifamily buildings it was found that the HERS verified measure for Quality Insulation Installation (QII) was not cost-effective for multifamily buildings in Climate Zone 7. For this reason, climate zone 7 has no QII requirement for low-rise multifamily buildings.

Similarly, the 2019 Energy Code's prescriptive baseline for high-performance walls for low-rise multifamily buildings remains the same as the 2016 Energy Code. This means wall assembly *U*-factors (0.051) for these multifamily buildings will be equivalent 2 × 6 wood framed walls with R-19 cavity insulation, and R-5 continuous insulation in all climate zones except 6 and 7. Single family walls assume R-21 cavity insulation.

The whole house fan ventilation cooling requirement was only applicable to single-family buildings in previous code cycles, and this continues with the 2019 Code. As a result, Table 150.1-B does not have a row for whole house fans.

PART 9

Low-Rise Residential Buildings—Additions and Alterations to Existing Low-Rise Residential Buildings

Subchapter 9

Subchapter 9 is comprised solely of Section 150.2. This section identifies which other sections of the Energy Code apply to additions and alterations to existing low-rise residential buildings. It also identifies specific variances from the previous sections of the Energy Code for additions and alterations to these buildings and systems. All requirements for additions and alterations to these existing buildings are defined within Section 150.2, and this section references other applicable sections of the Energy Code depending on the scope of work. ■

150.2

Energy Efficiency Standards for Additions and Alterations to Existing Low-Rise Residential Buildings

150.2(a)

Additions

150.2(a) EXCEPTION 1

Additions, Dwelling Unit Ventilation Exception

150.2(a) EXCEPTION 7

Additions, Photovoltaic System Exception

150.2(a) NOTE

Additions

150.2(a)1A

Prescriptive Approach, Additions Greater Than 700 ft^2

150.2(a)1C

Prescriptive Approach, Mechanical Ventilation for Indoor Air Quality

150.2(a)1D

Prescriptive Approach, Water Heater

150.2(a)2C

Performance Approach, Mechanical Ventilation for Indoor Air Quality

150.2(b)

Alterations

150.2(b)1B

Prescriptive Approach, Replacement Fenestration

150.2(b)1C

Prescriptive Approach Entirely New or Complete Replacement Space-Conditioning Systems

150.2(a) Exception 1

Additions, Dwelling Unit Ventilation Exception

CHANGE TYPE: Modification

CHANGE SUMMARY: The language in Exception 1 was changed to align with the changes made to low-rise residential indoor air quality (IAQ) requirements found in Section 150.0(o)1.

2019 CODE:

(a) **Additions.** Additions to existing low-rise residential buildings shall meet the requirements of Sections 110.0 through 110.9, Sections 150.0(a) through (q), and either Section 150.2(a)1 or 2.

> **EXCEPTION 1 to Section 150.2(a):** Additions 1,000 square feet or less are exempt from the ~~ASHRAE Standard 62.2 Section 4~~ requirements to provide ~~whole-building~~dwelling unit mechanical ventilation airflow as ~~referenced~~ specified by Section 150.0(o)1C, 150.0(o)1E, or 150.0(o)1F; however all other applicable requirements ~~of ASHRAE Standard 62.2 as referenced~~ specified by Section 150.0(o) shall be met by the addition.

CHANGE SIGNIFICANCE: The 2019 Energy Code incorporates the requirements of ASHRAE 62.2, in total, except for specific deviations that have been added to Section 150.0(o)1. The reference to ASHRAE 62.2 was removed and replaced with specific Energy Code sections in Section 150.0(o)1. This change maintains the exemption for additions of 1,000 square feet or less from ventilation airflow requirements while eliminating exemptions from other IAQ requirements in Section 150.0(o) and ASHRAE 62.2 such as filtration and kitchen range hood requirements.

The reference to “whole building” in the 2016 Energy Code was changed to “dwelling unit” in the 2019 Energy code. This change is needed to maintain consistency with ASHRAE 62.2 terminology.

It is important to note that new dwelling units, regardless of size, are now subject to the mandatory whole building ventilation requirements, as described in the new Section, 150.2(a)1C.

150.2(a) Exception 7

Additions, Photovoltaic System Exception

CHANGE TYPE: Addition

CHANGE SUMMARY: An exception was added to exclude residential additions from the photovoltaic system requirements of the Energy Code.

2019 CODE:

(a) **Additions.** Additions to existing low-rise residential buildings shall meet the requirements of Sections 110.0 through 110.9, Sections 150.0(a) through (q), and either Section 150.2(a)1 or 2.

[…]

> <u>**EXCEPTION 7 to Section 150.2(a):** Photovoltaic systems, as specified in Section 150.1(c)14, are not required for additions.</u>

CHANGE SIGNIFICANCE: An exception was added to exclude additions to low-rise residential buildings from the photovoltaic (PV) system requirements of the 2019 Energy Code. The PV system requirements only apply to newly constructed low-rise residential buildings.

150.2(a) Note

Additions

CHANGE TYPE: Modification

CHANGE SUMMARY: A note about changes of occupancy was removed because it was deemed to be unnecessary.

2019 CODE:

(a) **Additions.** Additions to existing low-rise residential buildings shall meet the requirements of Sections 110.0 through 110.9, Sections 150.0(a) through (q), and either Section 150.2(a)1 or 2.

[…]

~~**NOTE:** For alterations that change the occupancy classification of the building, the requirements specified in Section 150.2(b) apply to the occupancy after the alterations.~~

CHANGE SIGNIFICANCE: The purpose of the change to this section is to remove an explanatory note that did not possess any regulatory effect. The occupancy type, by definition, is what determines which requirements apply. This note was not necessary, and this change clarifies without materially altering the requirements of the Energy Code.

Changes of occupancy alone do not trigger code requirements, but if components are altered as part of that change of occupancy, those components are subject to the alteration requirements of the Energy Code. Similarly, if part of the change of occupancy increases the building's conditioned floor area and conditioned volume, that is subject to the requirements for additions. While a change of occupancy alone does not trigger requirements, meeting indoor air quality requirements is strongly recommended.

150.2(a)1A

Prescriptive Approach, Additions Greater Than 700 ft^2

CHANGE TYPE: Addition and Modification

CHANGE SUMMARY: The prescriptive requirements for additions greater than 700 square feet were updated to increase efficiency and clarify when specific requirements are triggered.

2019 CODE:

(a) **Additions.** Additions to existing low-rise residential buildings shall meet the requirements of Sections 110.0 through 110.9, Sections 150.0(a) through (q), and either Section 150.2(a)1 or 2.

[...]

1. **Prescriptive approach.** Additions to existing buildings shall meet the following additional requirements:

   A. Additions that are greater than 700 square feet shall meet the ~~prescriptive~~ requirements of Section 150.1(c), ~~except~~with the following modifications:

      i. Extensions of existing wood-framed walls may retain the dimensions of the existing walls and shall install cavity insulation of R-15 in a 2 × 4 framing and R-~~19~~21 in a 2 × 6 framing.

      ii. The maximum allowed fenestration area shall be the greater of 175 square feet or 20 percent of the addition floor area, and the maximum allowed west-facing fenestration area shall be the greater of 70 square feet or the requirements of Section 150.1(c).

      iii. When existing siding of a wood-framed wall is not being removed or replaced, cavity insulation of R-15 in a 2 × 4 framing and R-21 in a 2 × 6 framing shall be installed and continuous insulation is not required.

      iv. Additions that consist of the conversion of existing spaces from unconditioned to conditioned space shall not be required to perform the following as part of QII:

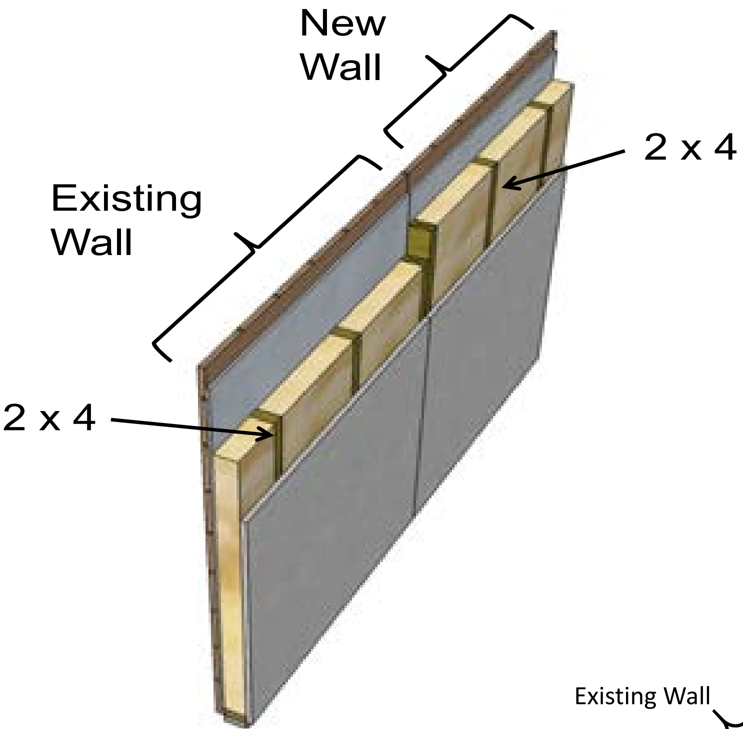
         a. Existing window and door headers shall not be required to be insulated.

         b. Air sealing shall not be required when the existing air barrier is not being removed or replaced.

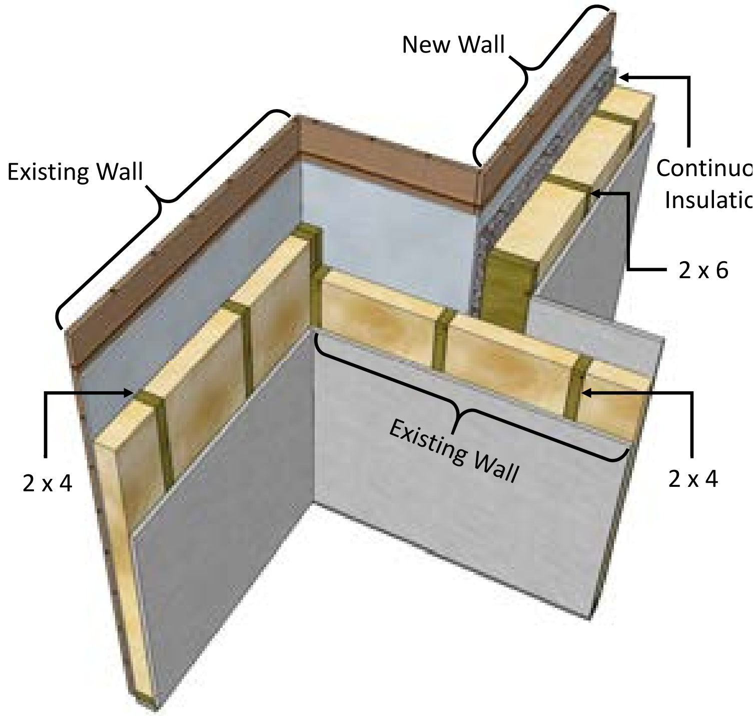
CHANGE SIGNIFICANCE: Section 150.2(a)1Ai – The purpose of the change to this section is to require R-21 cavity insulation in a 2 × 6 wall extension. This change is necessary to provide consistency with the move towards higher efficiency wall systems. Wall extensions do not require continuous insulation.

Section 150.2(a)1Aiii – This section was added to require R-15 insulation in existing 2 × 4 wall cavities, and R-21 in existing 2 × 6 cavities for additions in which the existing exterior siding is neither being replaced or removed. This change is necessary to provide a compliance pathway for additions involving the conversion of previously unconditioned space to conditioned space.

Section 150.2(a)1Aiv – The purpose of the addition is to clarify additions that consist of the conversion of existing spaces from unconditioned to conditioned space shall not be required to meet the window and door header insulation requirements relating to, and that air sealing shall not be required, when the existing air barrier is not being removed. These are measures related to HERS verified Quality Insulation Installation, which is now applicable for low-rise residential additions over 700 square feet.



Wall Extension – Extensions of walls in additions can retain existing framing dimensions. In a 2 × 4 wall extension, the cavity must have R-15 insulation.
Source: Hamed Amouzgar, California Energy Commission, Blueprint Newsletter, Issue 118



Not A Wall Extension – In this example, the new wall extends perpendicular from an existing wall. This is not a wall extension and is subject to more stringent requirements.
Source: Hamed Amouzgar, California Energy Commission, Blueprint Newsletter, Issue 118

150.2(a)1C

Additions, Prescriptive Approach, Mechanical Ventilation for Indoor Air Quality

CHANGE TYPE: Addition and Modification

CHANGE SUMMARY: The changes to this section clarify code section applicability and ventilation rate calculation requirements for additions larger than 1,000 square feet, and add ventilation requirements for new dwelling units that are additions, regardless of size.

2019 CODE:

(a) **Additions.** Additions to existing low-rise residential buildings shall meet the requirements of Sections 110.0 through 110.9, Sections 150.0(a) through (q), and either Section 150.2(a)1 or 2.

[…]

1. **Prescriptive approach.** Additions to existing buildings shall meet the following additional requirements:

   […]

   C. **Mechanical Ventilation for Indoor Air Quality.**

   i. Additions ~~larger~~ to an existing dwelling unit that increase the conditioned floor area of the existing dwelling unit by more than 1,000 square feet shall ~~meet the ASHRAE Standard 62.2 Section 4 requirement to provide~~have ~~whole-building~~ mechanical ventilation airflow in accordance with Sections 150.0(o)1C, 150.0(o)1E, or 150.0(o)1F as applicable. The ~~whole-building~~ 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.

   ii. New dwelling units that are additions to an existing building shall have mechanical ventilation airflow provided in accordance with Sections 150.0(o)1C, 150.0(o)1E, or 150.0(o)1F as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the new dwelling unit.

CHANGE SIGNIFICANCE: The 2019 Energy Code incorporates the requirements of ASHRAE 62.2, in total, except for specific deviations that have been added to Section 150.0(o)1. The reference to ASHRAE 62.2 was removed and replaced with specific Energy Code sections to ensure that the deviations from ASHRAE 62.2 are applied to additions.

The changes to this section establish separate requirements for additions to existing dwelling units and completely new dwelling unit additions to existing buildings under the prescriptive approach. For additions to existing dwelling units, the addition must be larger than 1,000 square feet for the ventilation rates of Sections 150.0(o)1C, 150.0(o)1E, or 150.0(o)1F to be applicable. For new dwelling units added to an existing building, like accessory dwelling units (ADUs), the ventilation requirements of Sections 150.0(o)1C, 150.0(o)1E, or 150.0(o)1F are applicable regardless of the size of the new dwelling unit.

In both cases, the whole building ventilation rate is based on the entire dwelling unit's conditioned floor area, and all sections of Section 150.0(o) are applicable. Also, all sections of ASHRAE 62.2 are applicable where the Energy Code Section 150.0(o)1 does not deviate from ASHRAE 62.2.

Accessory Dwelling Unit – An accessory dwelling unit that shares a common wall with an existing structure on a residential site is considered an addition.
Source: Elizabeth Ferris, California Energy Commission, Blueprint Newsletter, Issue 122

150.2(a)1D

Additions, Prescriptive Approach, Water Heater

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: Water heater language was simplified and updated to reflect changes in referenced sections of the 2019 Energy Code.

2019 CODE:

(a) **Additions.** Additions to existing low-rise residential buildings shall meet the requirements of Sections 110.0 through 110.9, Sections 150.0(a) through (q), and either Section 150.2(a)1 or 2.

[…]

1. **Prescriptive approach.** Additions to existing buildings shall meet the following additional requirements:

   […]

   D. **Water Heater.** When a second water heater is installed as part of the addition, one of the following types of water heaters shall be installed ~~and assumed to comply~~:

      i. A ~~natural gas or propane~~ water-heating system that meets the requirements of Section 150.1(c)8; or

      ~~ii. If no natural gas is connected to the building, an electric water heater that has an energy factor equal to or greater than required under the Appliance Efficiency Regulations. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used; or~~

      ii~~iii.~~ A water-heating system determined by the Executive Director to use no more energy than the one specified in Item ~~1~~ i. ~~above; or if no natural gas is connected to the building, a water-heating system determined by the Executive Director to use no more energy than the one specified in Item 2 above; or~~

      ~~iv. Using the existing building plus addition compliance or addition alone compliance as defined in Section 150.2(a)2 demonstrate that the proposed water heating system uses no more energy than the system defined in Item 1 above regardless of the type or number of water heaters installed.~~

CHANGE SIGNIFICANCE: Section 150.2(a)1Di – The purpose of the change to this section is to remove the phrase "natural gas or propane," because the prescriptive options under Section 150.1(c)8 of the 2019 Energy Code now include water heating systems other than natural gas or propane. This change clarifies without materially altering the requirements of the Energy Code.

Sections 150.2(a)1Dii and iii – The purpose of the changes to these sections is to remove provisions that related to natural gas availability. This change is necessary to accommodate electrification of existing buildings and for consistency with proposed options for newly constructed buildings. If a new water heater is installed to serve an addition, it is subject to the prescriptive requirements for newly constructed buildings found in Section 150.1(c)8. Note that if a water heater is replaced as part of an addition, that replacement of the water heater is considered an alteration and is subject to the alteration requirements of Section 150.2(b)1H of the 2019 Energy Code.

Section 150.2(a)1Div – The purpose of removing this section is to eliminate redundant and potentially confusing language. The option specified in this section is a performance approach and is not a prescriptive requirement. As such, this section is redundant with Section 150.2(b)2. This change clarifies without materially altering the requirements of the Energy Code.

150.2(a)2C

Additions, Performance Approach, Mechanical Ventilation for Indoor Air Quality

CHANGE TYPE: Addition and Modification

CHANGE SUMMARY: The changes to this section clarify code section applicability and ventilation rate calculation requirements for additions larger than 1,000 square feet and add ventilation requirements for new dwelling units that are additions, regardless of size.

2019 CODE:

(a) **Additions.** Additions to existing low-rise residential buildings shall meet the requirements of Sections 110.0 through 110.9, Sections 150.0(a) through (q), and either Section 150.2(a)1 or 2.

[…]

2. **Performance approach.** Performance calculations shall meet the requirements of Section 150.1(a) through (c), pursuant to the applicable requirements in Items A, B, and C below.

[…]

C. Mechanical Ventilation for Indoor Air Quality.

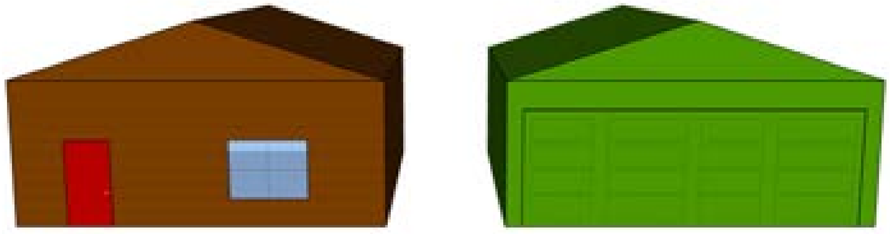
i. Additions to an existing dwelling unit that increase the conditioned floor area of the existing dwelling unit by more ~~larger~~ than 1,000 square feet shall ~~meet the ASHRAE Standard 62.2 Section 4 requirement to provide~~ have ~~whole-building~~ mechanical ventilation airflow in accordance with Section 150.0(o)1C, 150.0(o)1E, or 150.0(o)1F as applicable. The ~~whole-building~~ 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.

ii. New dwelling units that are additions to an existing building shall have mechanical ventilation airflow provided in accordance with Section 150.0(o)1C, 150.0(o)1E, or 150.0(o)1F as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the new dwelling unit.

CHANGE SIGNIFICANCE: The 2019 Energy Code incorporates the requirements of ASHRAE 62.2, in total, except for specific deviations that have been added to Section 150.0(o)1. The reference to ASHRAE 62.2 was removed and replaced with specific Energy Code sections to ensure the deviations from ASHRAE 62.2 are applied to additions.

The changes to this section establish separate requirements for additions to existing dwelling units and completely new dwelling unit additions to existing buildings under the performance approach. For additions to existing dwelling units, the addition must be larger than 1,000 square feet for the ventilation rates of Sections 150.0(o)1C, 150.0(o)1E, or 150.0(o)1F to be applicable. For new dwelling units added to an existing building, like accessory dwelling units, the requirements of Sections 150.0(o)1C, 150.0(o)1E, or 150.0(o)1F are applicable regardless of the size of the new dwelling unit.

In both cases, the whole building ventilation rate is based on the entire dwelling unit conditioned floor area and all sections of Section 150.0(o) are applicable. Also, all sections of ASHRAE 62.2 are applicable where the Energy Code Section 150.0(o)1 does not deviate from ASHRAE 62.2.



Accessory Dwelling Unit – Existing detached unconditioned structures (like garages) that are converted into accessory dwelling units are considered additions. Source: Elizabeth Ferris, California Energy Commission, Blueprint Newsletter, Issue 122

150.2(b)1B

Alterations, Prescriptive Approach, Replacement Fenestration

CHANGE TYPE: Clarification

CHANGE SUMMARY: Language pertaining to fenestration alterations was reworked to provide consistency in phrasing for replacement fenestration in alteration projects.

2019 CODE:

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

1. **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 Sections 150.0(a) through (l), 150.0(m)1 through 150.0 (m)10, and Section 150.0(o) through (q); and

[…]

B. **Replacement Fenestration.** ~~Replacement of fenestration, where existing fenestration area in an existing wall or roof is replaced with a new manufactured fenestration product and up to the total fenestration area removed in the existing wall or roof, the replaced~~New manufactured fenestration products installed to replace existing fenestration products of the same total area shall meet the U-factor and Solar Heat Gain Coefficient requirements of Sections 150.1(c)3A, and 150.1(c)4.

EXCEPTION 1 to Section 150.2(b)1B: Replacement of vertical fenestration no greater than 75 square feet with a *U*-factor no greater than 0.40 in Climate Zones 1–16, and a SHGC value no greater than 0.35 in Climate Zones 2, 4, and 6–16~~6~~5.

EXCEPTION 2 to Section 150.2(b)1B: Replaced skylights must meet a *U*-factor no greater than 0.55, and a SHGC value no greater than 0.30.

NOTE: Glass replaced in an existing sash and frame or ~~replacement of~~ sashes replaced in an existing frame are considered repairs, provided that the replacement is at least equivalent to the original in performance.

CHANGE SIGNIFICANCE: This language was restructured to better capture which fenestration alterations are subject to the replacement fenestration requirements. The intent is to have the replacement fenestration requirements of Section 150.2(b)1B only apply to new fenestration installed in existing openings. Increasing the size of the opening, or creating a new opening, is not considered "replacement fenestration." In that scenario, the new fenestration is subject to the requirements of Section 150.2(b)1A of the 2019 Energy Code.

Getty Images

Replacement Windows – New manufactured fenestration products installed to replace existing fenestration products of the same size are subject to the fenestration replacement requirements of Section 150.2(b)1B of the 2019 Energy Code.

150.2(b)1C

Alterations, Prescriptive Approach, Entirely New or Complete Replacement Space-Conditioning Systems

CHANGE TYPE: Addition and Modification

CHANGE SUMMARY: Section references were updated, and an exception was added to prescriptively allow the switch from gas space conditioning systems to heat pumps.

2019 CODE:

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Section 150.0(a) through (l); 150.0(m)1 through 150.0 (m)10, Section 150.0(o) through (q); and

   […]

   C. **Entirely New or Complete Replacement Space-Conditioning Systems** installed as part of an alteration, shall include all the system heating or cooling equipment, including but not limited to condensing unit and cooling or heating coil for split systems; or complete replacement of a package unit; plus entirely new or replacement duct system (Section 150.2(b)1Diia); plus a new or replacement air handler.

   Entirely ~~N~~new or complete replacement space-conditioning systems shall:

   i. Meet the requirements of Sections 150.0(h), 150.0(i), 150.0(j)2, 150.0(j)3, 150.0(m)1 through 150.0(m)10; 150.0(m)12; 150.0(m)13, 150.1(c)6, 150.1(c)7, and 150.1(c)10, and ~~Table~~ TABLE 150.2-A; and

   ii. Be limited to natural gas, liquefied petroleum gas, or the existing fuel type. ~~unless it can be demonstrated that the TDV energy use of the new system is more efficient than the existing system.~~

   EXCEPTION to Section 150.2(b)1Cii: When the fuel type of the replaced heating system was natural gas or liquefied petroleum gas, the new or complete replacement space-conditioning system may be a heat pump.

CHANGE SIGNIFICANCE: A reference to the duct leakage testing requirements of Section 150.0(m)11 was removed from this section for new or complete replacements of space conditioning systems. Removal of the reference eliminates conflicting requirements found in the duct alteration, Section 150.2(b)1D. Section 150.2(b)1D specifies the requirements for altered duct systems and duct sealing which deviate from the requirements of Section 150.0(m)11. Section 150.0(m)11 is only applicable to newly installed duct systems in new construction.

Language requiring TDV equivalent systems when changing fuel types was also removed. This language is already addressed via the performance approach, and this correctly separates the prescriptive and performance methods of compliance. TDV Energy use is only determined using the approved computer modeling programs with the performance compliance approach.

Lastly, an exception was added to allow electrification projects to use the prescriptive method of compliance to switch from gas space conditioning systems to electric heat pumps.

150.2(b)1D

Alterations, Prescriptive Approach, Altered Duct Systems – Duct Sealing

CHANGE TYPE: Addition and Modification

CHANGE SUMMARY: Duct sealing requirements were added for ducts and space conditioning components located inside garages and requirements for multifamily duct sealing were also added.

2019 CODE:

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Section 150.0(a) through (l); 150.0(m)1 through 150.0 (m)10, Section 150.0(o) through (q); and

   […]

   D. **Altered Duct Systems – Duct Sealing:** In all Climate Zones, when more than 40 feet of new or replacement space-conditioning system ducts are installed, the ducts shall comply with the applicable requirements of subsections i and ii below.~~:~~ Additionally, when altered ducts, air-handling units, cooling or heating coils, or plenums are located in garage spaces, the system shall comply with subsection 150.2(b)1Diic regardless of the length of any new or replacement space-conditioning ducts installed in the garage space.

      i. New ducts located in unconditioned space shall meet the applicable requirements of Sections 150.0(m)1 through 150.0(m)11, and the duct insulation requirements of TABLE 150.2-A; and

TABLE 150.2-A Duct Insulation *R*-Value

Climate Zone	1 through 10, 12&13	11, 14 through 16
Duct *R*-Value	R-6	R-8

      ii. The altered duct system, regardless of location, shall be sealed as confirmed through field verification and diagnostic testing in accordance with all applicable procedures for duct sealing of altered existing duct systems as specified in the Reference Residential Appendix Section RA3.1, utilizing the leakage compliance criteria specified in ~~Reference Residential Appendix TABLE RA3.1-2, and conforming to either~~ Subsection a or b below.:

         a. **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:

I. For single-family dwellings, the measured duct leakage shall be equal to or less than 5 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1.

II. For multifamily dwellings, regardless of duct system location,

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

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

Entirely new or complete replacement duct systems installed as part of an alteration shall be constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the dwelling unit's existing duct system, including but not limited to registers, grilles, boots, air handler, coil, plenums, duct material; if the reused parts are accessible and can be sealed to prevent leakage.

Entirely new or complete replacement duct systems shall also conform to the requirements of Sections 150.0(m)12 and 150.0(m)13.

b. **Extension of an Existing Duct System.** If the new ducts are an extension of an existing duct system serving single-family or multifamily dwellings, the combined new and existing duct system shall meet one of the following requirements:

~~1~~I. The measured duct leakage shall be equal to or less than 15 percent of nominal system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

~~2~~II. The measured duct leakage to outside shall be equal to or less than 10 percent of nominal system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or

~~3~~III. If it is not possible to meet the duct sealing requirements of either Section 150.2(b)1DiibI~~1~~, or 150.2(b)1DiibII~~2~~, then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

EXCEPTION to Section 150.2(b)1Diib: Duct Sealing. Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos.

c. **Altered Ducts and Duct System Components in Garage Spaces.** When new or replacement space-conditioning ducts, air-handling units, cooling or heating coils, or plenums are located in a garage space, compliance with either I or II below is required.

I. The measured system duct leakage shall be less than or equal to 6 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1, or

II. All accessible leaks located in the garage space shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

CHANGE SIGNIFICANCE: There are two main changes to this section. Duct sealing requirements for components located in garages were added, as well as multifamily duct sealing requirements. The duct sealing requirements in this section are only applicable when the duct system is altered. For duct sealing requirements where the duct system is not altered but other space conditioning system components are altered, see Section 150.2(b)1E.

When ducts of any length are altered and any space conditioning system components (such as ducts of any length, coils, air handlers, or plenums) are located inside a garage space, special duct sealing protocols now apply. This aligns the Energy Code with the requirements of ASHRAE 62.2. Duct sealing compliance for these alterations can be shown by a duct leakage test in accordance with the procedure in Reference Residential Appendices Section RA3.1.4.3.1 with a duct leakage of 6 percent or less. If this maximum duct leakage target cannot be met, a smoke test can be performed in accordance with the procedure in Reference Residential Appendices Section RA3.1.4.3.5, and all accessible leaks in the garage must be sealed. Note that the smoke test procedure in Reference Appendices Section RA3.1.4.3.5 requires a leak test to be performed before the smoke test is performed. These tests must be verified by a HERS rater.

The 2016 Energy Code references Table RA3.1-2 in the Reference Residential Appendices for duct leakage requirements for entirely new or complete replacement of the duct system. The 2019 Energy Code has since been simplified by incorporating the leakage requirements for entirely new or replacement duct systems into Section 150.2(b)1Da and eliminating the reference to Table RA3.1-2 in the Reference Residential

Appendices. Section 150.2(b)1Diia now has leakage requirements for single-family and multifamily dwellings separated into two new paragraphs.

The duct leakage requirements for the extension of existing ducts are the same for single-family and multifamily dwellings. Language has been added to Section 150.2(b)1Diib to clarify that the requirements apply to both occupancies.

Duct Alteration Triggers – If more than 40 linear feet of new or replacement space-conditioning ducts are installed, then duct leakage testing and prescriptive insulation requirements are required. When 75 percent or more of the duct system is replaced, this is considered a complete replacement of the duct system, which has more stringent requirements as described in Section 150.2(b)1Diia of the Energy Code.
Source: California Energy Commission

150.2(b)1E

Alterations, Prescriptive Approach, Altered Space-Conditioning System – Duct Sealing

CHANGE TYPE: Modification

CHANGE SUMMARY: Duct sealing requirements were added for alterations of space conditioning system components located inside garages.

2019 CODE:

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Section 150.0(a) through (l); 150.0(m)1 through 150.0 (m)10, Section 150.0(o) through (q); and

   [...]

   E. **Altered ~~S~~space-~~C~~conditioning ~~S~~system—~~D~~duct ~~S~~sealing.~~:~~** In all Climate Zones, when a space-conditioning system serving a single-family or multifamily dwelling is altered by the installation or replacement of space-conditioning system equipment, including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, or cooling or heating coil, the duct system that is connected to the altered space-conditioning system equipment shall be sealed, as confirmed through field verification and diagnostic testing in accordance with the applicable procedures for duct sealing of altered existing duct systems as specified in Reference Residential Appendix RA3.1 and the leakage compliance criteria specified in Subsection i, ii, or iii below. Additionally, when altered ducts, air-handling units, cooling or heating coils, or plenums are located in garage spaces, the system shall comply with Section 150.2(b)1Diic regardless of the length of any new or replacement space-conditioning ducts installed in the garage space. ~~Reference Residential Appendix Table RA3.1-2, conforming to one of the following requirements:~~

   i. The measured duct leakage shall be equal to or less than 15 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

   ii. The measured duct leakage to outside shall be equal to or less than 10 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or

   iii. If it is not possible to meet the duct sealing requirements of either Section 150.2(b)1Ei or Section 150.2(b)1Eii, 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 Section RA3.1.4.3.5.

   EXCEPTION 1 to Section 150.2(b)1E: Duct ~~S~~sealing. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in the Reference Residential Appendix RA3.1.

EXCEPTION 2 to Section 150.2(b)1E: Duct Ssealing. Duct systems with less than 40 linear feet as determined by visual inspection.

EXCEPTION 3 to Section 150.2(b)1E: Duct Ssealing. Existing duct systems constructed, insulated or sealed with asbestos.

CHANGE SIGNIFICANCE: Duct sealing requirements for alterations to components located in garages were added to the 2019 Energy Code. The duct leakage requirements in this section apply when space conditioning components are altered and do not apply when the duct system is altered. For alterations that include duct system alterations see Section 150.2(b)1D.

When altered space conditioning components such as coils, air handlers or plenums are located inside a garage space, special protocols for duct leakage for the ducts connected to these components now apply and can be found in Section 150.2(b)1Diic of the Energy Code.

Duct sealing compliance for alterations (not including those with components in garages) can be shown by a total duct leakage test in accordance with the procedure in Reference Residential Appendices Section RA3.1.4.3.1 with a duct leakage of 15 percent or less. Alternatively, a duct leakage to the outdoors test may be performed in accordance with the procedure in Reference Residential Appendices Section RA3.1.4.3.4 with a duct leakage of 10 percent or less. If these duct leakage requirements cannot be met, a smoke test in accordance with the procedure in Reference Residential Appendices Section RA3.1.4.3.5 can be performed and all accessible leaks in the garage must be sealed. These tests must be verified by a HERS rater.

Language was also added to clarify that the requirements apply to both single-family and multifamily occupancies.

150.2(b)1F

Alterations, Prescriptive Approach, Altered Space-Conditioning System – Mechanical Cooling

CHANGE TYPE: Modification

CHANGE SUMMARY: The purpose of this change is to separately identify airflow rate requirements for Small Duct High Velocity (SDHV) systems that supply space cooling from other types of air-cooled air conditioners and air-source heat pumps.

2019 CODE:

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Section 150.0(a) through (l); 150.0(m)1 through 150.0 (m)10, Section 150.0(o) through (q); and

   [...]

   F. **Altered ~~S~~space-~~C~~conditioning ~~S~~system—~~M~~mechanical ~~C~~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:

   [...]

   ii. In Climate Zones 2, 8, 9, 10, 11, 12, 13, 14, and 15, air-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted package systems, small duct high velocity air systems, and minisplit systems, shall comply with Subsections a and b, unless the system is of a type that cannot be verified using the specified procedures. Systems that cannot comply with the requirements of Section 150.2(b)1Fii shall comply with Section 150.2(b)1Fiii.

   EXCEPTION to Section 150.2(b)1Fii: Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.2(b)1Fiia, 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.

a. Minimum system airflow rate shall comply with the applicable Subsection I or II below as confirmed through field verification and diagnostic testing in accordance with ~~greater than or equal to 300 cfm per ton shall be demonstrated by the installer and be verified by the HERS Rater accordingto~~ the procedures specified in Reference Residential Appendix Section RA3.3 or an approved alternative procedure as specified in Section RA1.~~;~~

   I. 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

   II. 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 150.2(b)1Fiia: Systems unable to comply with the minimum ~~300 cfm per ton~~ 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 ~~Reference Joint Appendix JA5~~Section 110.12.

   EXCEPTION 2 to Section 150.2(b)Fiia: Entirely new or complete replacement space conditioning systems, as specified by section 150.2(b)1C, without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in TABLE-150.0-B or 150.0-C as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Section RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12C for the system air filter device(s) shall conform to the requirements given in TABLES 150.0-B and 150.0-C.

b. The installer shall charge the system according to manufacturer's specifications. Refrigerant charge shall be verified according to one of the following options, as applicable.

   I. The installer and rater shall perform the standard charge verification procedure as specified in Reference Residential Appendix Section RA3.2.2, or an approved alternative procedure as specified in Section RA1; or

II. The system shall be equipped with a fault indicator display (FID) device that meets the specifications of Reference Joint Appendix JA6. The installer shall verify the refrigerant charge and FID device in accordance with the procedures in Reference Residential Appendix Section RA3.4.2. The HERS Rater shall verify FID device in accordance with the procedures in Section RA3.4.2; or

III. The installer shall perform the weigh-in charging procedure as specified by Reference Residential Appendix Section RA3.2.3.1 provided the system is of a type that can be verified using the RA3.2.2 standard charge verification procedure and RA3.3 airflow rate verification procedure or approved alternatives in RA1. The HERS Rater shall verify the charge using RA3.2.2 and RA3.3 or approved alternatives in RA1.

~~**EXCEPTION 1 to Section 150.2(b)1Fiia:** Systems unable to comply with the minimum 300 cfm per ton 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 Reference Joint Appendix JA5Section 110.12.~~

~~**EXCEPTION 2 to Section 150.2(b)1Fiia:** The Executive Director may approve alternate airflow and fan efficacy requirements for small duct high velocity systems.~~

~~**EXCEPTION 32 to Section 150.2(b)Fiia:** Entirely new or complete replacement space conditioning systems, as specified by section 150.2(b)1C, without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in TABLE-150.0-B or 150.0-C as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Section RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12C for the system air filter device(s) shall conform to the requirements given in TABLES 150.0-B and 150.0-C.~~

~~**EXCEPTION 1 to Section 150.2(b)1Fiib:** 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 Reference Joint Appendix JA5Section 110.12. Ducted systems shall comply with~~

~~the minimum system airflow rate requirements in Section 150.2(b)1Fiia.~~

~~**EXCEPTION to Section 150.2(b)1Fii:** Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was precharged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.2(b)1Fiia, 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.~~

iii. In climate Zones 2, 8, 9, 10, 11, 12, 13, 14, and 15, air-cooled air conditioners or air-source heat pumps, including but not limited to ducted split systems, ducted package systems, small duct high-velocity, and minisplit systems, which are of a type that cannot comply with the requirements of 150.2(b)1Fiib shall comply with subsections a and b, as applicable.

a. The installer shall confirm the refrigerant charge using the weigh-in charging procedure specified in Reference Residential Appendix Section RA3.2.3.1, as verified by a HERS Rater according to the procedures specified in Reference Residential Appendix RA3.2.3.2; and

b. Systems that utilize forced air ducts shall comply with the minimum system airflow rate requirement in Section 150.2(b)1Fiia provided the system is of a type that can be verified using the procedures in Section RA3.3 or an approved alternative procedure in Section RA1.

EXCEPTION to Section 150.2(b)1Fiii: Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.2(b)1Fiiib, provided that the system is of a type that can be verified using the procedure specified in Section RA3.3 or an approved alternative in Section RA1.

CHANGE SIGNIFICANCE: Airflow requirements for SDHV systems that supply space cooling were added and separated from other air-cooled air conditioner and heat pump airflow requirements. This change clarifies that SDHV systems are categorized separately from other air-sourced air conditioners and heat pumps.

SDHV systems operate differently than other air-cooled air conditioners and heat pumps. For this reason, SDHV systems have a different airflow rate target. The airflow target specified in this change applies to all certified SDHV air conditioners and heat pumps that supply cooling to a space and is consistent with other sections of the Energy Code. This change requires the new SDHV airflow value to be used when performing the SDHV refrigerant charge testing. The exceptions were changed accordingly to reflect the addition of the new airflow rate target for SDHV systems.

The reference in the exceptions for the thermostat to comply with the requirements in Reference Joint Appendix JA5 of the 2019 Reference Appendices was changed to reference Section 110.12 of the 2019 Energy Code instead. The 2019 Energy Code compiled all the requirements for demand response into Section 110.12, and when applicable, Section 110.12 directs users to Reference Joint Appendix JA5.

Exceptions were also relocated to better align them with the sections that they apply to.

150.2(b)1G

Alterations, Prescriptive Approach, Altered Space-Conditioning System

CHANGE TYPE: Modification

CHANGE SUMMARY: Heat pumps are now allowed to replace natural gas or liquefied petroleum gas furnaces prescriptively in alterations.

2019 CODE:

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Section 150.0(a) through (l); 150.0(m)1 through 150.0 (m)10, Section 150.0(o) through (q); and

   […]

   G. **Altered Space-Conditioning System.** Replacement space-conditioning systems shall be limited to natural gas, liquefied petroleum gas, or the existing fuel type.

      EXCEPTION to Section 150.2(b)1G: When the fuel type of the replaced heating system was natural gas or liquefied petroleum gas, the replacement space-conditioning system may be a heat pump.

CHANGE SIGNIFICANCE: Adding this new exception allows electrification projects of existing buildings to use the prescriptive method of compliance and guarantees the use of efficient equipment. This change allows the replacement of a natural gas or liquefied petroleum gas furnace with an electric heat pump in an alteration of a space conditioning system.

150.2(b)1H

Alterations, Prescriptive Approach, Water Heating System

CHANGE TYPE: Clarification and Addition

CHANGE SUMMARY: Language was simplified, and a prescriptive option allowing replacement heat pump water heaters to be installed was added.

2019 CODE:

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Section 150.0(a) through (l); 150.0(m)1 through 150.0 (m)10, Section 150.0(o) through (q); and

[…]

H~~G.~~ **Water-Heating System**. Altered or ~~R~~replacement service water-heating systems or components shall meet the applicable requirements below:

i. **Pipe Insulation.** For newly installed piping, the insulation requirements of Section 150.0(j)2 shall be met. For existing accessible piping the applicable requirements of Section 150.0(j)2Ai, iii, and iv shall be met.

ii. **Distribution System.** 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 installed.

iii. **Water heating system.** The replacement water heating system shall meet one of the following requirements:

a. A natural gas or propane water-heating system ~~that meets the requirements of Section 110.1 and 110.3. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used;~~ or

b. For Climate Zones 1 through 15, a single heat pump water heater. The storage tank shall not be located outdoors and be placed on an incompressible, rigid insulated surface with a minimum thermal resistance of R-10. The water heater shall be installed with a communication interface that meets either the requirements of 110.12(a); or

c. For Climate Zones 1 through 15, a single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher. The storage tank shall not be located outdoors; or

~~b~~d. If no natural gas is connected to the ~~building~~existing water heater location, ~~an~~ consumer electric water heater; or ~~that meets the requirements of Section 110.1 and 110.3. For electric resistance storage type water heaters, the capacity shall not exceed 60 gallons. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used; or~~

~~c~~e. A water-heating system determined by the executive director to use no more energy than the one specified in Item ~~1~~ a above; or if no natural gas is connected to the ~~building~~existing water heater location, a water-heating system determined by the executive director to use no more energy than the one specified in Item d~~2~~ above.; or

~~d. Using the existing building plus addition compliance approach as defined in Section 150.2(b)2 demonstrate that the proposed water heating system uses no more energy than the system defined in Item 1 above regardless of the type or number of water heaters installed.~~

CHANGE SIGNIFICANCE: Section 150.2(b)1H – The term "altered" was added to this parent section for consistency within Section 150.2(b).

Section 150.2(b)1Hii – This section was added to consolidate previous sections 150.2(b)1Hiiia and 150.2(b)1Hiiib, and it was reworded for clarity. In addition, this section now specifies that it applies only to recirculation systems serving individual dwelling units, not systems serving multiple dwelling units.

Section 150.2(b)1Hiiia – This language was modified for clarity. References to Sections 110.1 and 110.3 were redundant because of references in its parent section, Section 150.2(b). Also, language pertaining to recirculating systems were moved to 150.2(b)1Hii.

Section 150.2(b)1Hiiib – This section was one of two options introduced to allow a prescriptive compliance pathway for heat pump water heaters (HPWHs) installed in Climate Zones 1–15. The 2019 Energy Code has introduced multiple measures to address and facilitate the electrification of buildings, while as with all measures, meeting cost effectiveness criteria, and establishing technically feasible efficiency targets. This option does not establish a minimum efficiency requirement for HPWHs, but instead has additional installation criteria to ensure the system works efficiently. The water heater must be installed inside the building. This allows installation anywhere within the building, including but not limited to unconditioned spaces (e.g., garage, attic, basement, etc.). Rigid insulation must also be installed at the base of the water heater to limit heat loss to the ground.

Section 150.2(b)1Hiiic – This is the second of two options introduced to allow a prescriptive compliance pathway for HPWHs installed in Climate Zones 1–15. Unlike Section 150.2(b)1Hiiib above, this option has a minimum efficiency requirement for the HPWH, requiring that it be a NEEA Advanced Water Heater Specification Tier 3 or higher. This is consistent with the proposed inclusion of this prescriptive option in Section 150.1(c)8 for newly constructed buildings. These systems were found to be very efficient. Additionally, as with Option b above, the water heater must be installed inside of the building.

HPWHs installed in Climate Zone 16 are much less efficient than other climate zones because of its colder climate. For new construction, prescriptively, HPWHs are allowed in Climate Zone 16 as described in Section 150.1(c)8, but that section requires a compact hot water distribution system, or increased PV capacity. During the rulemaking process it was determined that adding a compact hot water distribution system or PV requirement to a water heater alteration was unfeasible. As with any prescriptive requirement, complying via the performance approach allows these limitations to be traded away for other efficiency measures. HPWHs installed as part of alterations in Climate Zone 16 must demonstrate compliance via the performance approach.

Sections 150.2(b)1Hiiid and e – The 2016 Energy Code prescriptively disallowed replacements of electric water heaters if the building had natural gas connected to it. This created complications when gas was connected for space heating or cooking appliances, but not piped to the water heater location. For this reason, this language was modified to prescriptively allow replacement electric water heaters when the existing fuel type was electric, and when no gas is connected to the existing water heater location. Language pertaining to recirculating systems was also relocated to Section 150.2(b)1Hii.

Section 150.2(b)1Hiiid (removed) – This section was removed to eliminate redundant and potentially confusing language. The option specified in this section is a performance approach to compliance and is not a prescriptive requirement. This is redundant with Section 150.2(b)2.

150.2(b)1I

Alterations, Prescriptive Approach, Roofs

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: This section was modified from H to I, and the roof alteration language was modified for clarity.

2019 CODE:

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Section 150.0(a) through (l); 150.0(m)1 through 150.0 (m)10, Section 150.0(o) through (q); and

[…]

~~H~~I. **Roofs.** Replacements of the exterior surface of existing roofs, including adding a new surface layer on top of the existing exterior surface, shall meet the requirements of Section 110.8 and the applicable requirements of Subsections i and ii where more than 50 percent of the roof is being replaced:.

i. Low-rise residential buildings with steep-sloped roofs. in Climate Zones 10 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 to~~TO~~ Section 150.2(b)1~~H~~Ii: The following shall be considered equivalent to Subsection i:

a. Air-space of 1.0 inch (25 mm) is provided between the top of the roof deck to the bottom of the roofing product; or

b. The installed roofing product has a profile ratio of rise to width of 1 to 5 for 50 percent or greater of the width of the roofing product; or

c. Existing ducts in the attic are insulated and sealed according to Section 150.1(c)9; or

d. Buildings with at least R-38 ceiling insulation; or

e. Buildings with a radiant barrier in the attic meeting the requirements of Section 150.1(c)2; or

f. Buildings that have no ducts in the attic; or

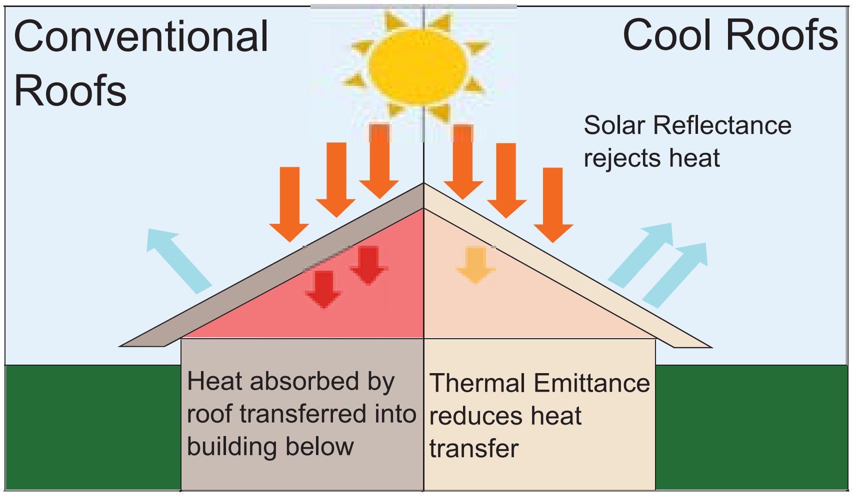
g. In Climate Zones 10–15, R-2 or greater insulation above the roof deck.

ii. Low-sloped roofs. In Climate Zones 13 and 15 shall have a 3-year aged solar reflectance equal or greater than 0.63 and a thermal emittance equal or greater than 0.75, or a minimum SRI of 75.

EXCEPTION 1 to Section 150.2(b)1~~H~~Iii: Buildings with no ducts in the attic.

EXCEPTION 2 to Section 150.2(b)1HIiii: The aged solar reflectance can be met by using insulation at the roof deck specified in TABLE 150.2-B.

CHANGE SIGNIFICANCE: Language pertaining to roofing alterations was modified to directly identify resurfacing of exterior surfaces of existing roofs as roof alterations. This clarifies the intent of the Energy Code and makes this language consistent with that found in the nonresidential roofing alteration requirements in Section 141.0(b)2B of the 2019 Energy Code. Whether replacing the exterior surface of a roof, or overlaying new material, these are treated as alterations, and must meet the applicable requirements of this section.



Solar Reflectance and Thermal Emittance: Solar reflectance rejects heat, while thermal emittance reduces heat transfer.
Source: California Energy Commission

150.2(b)1J

Alterations, Prescriptive Approach, Lighting

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: The alteration requirements for ceiling-recessed luminaires with screw-base sockets was modified for clarity.

2019 CODE:

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

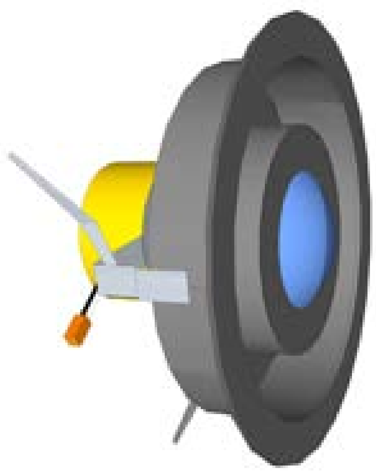
1. **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Section 150.0(a) through (l); 150.0(m)1 through 150.0 (m)10, Section 150.0(o) through (q); and

   […]

   ~~I~~J. **Lighting.** The altered lighting system shall meet the lighting requirements of Section 150.0(k). The altered luminaires shall meet the luminaire efficacy requirements of Section 150.0(k) and TABLE 150.0-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.

CHANGE SIGNIFICANCE: The purpose of this change is to clarify that installation of lighting retrofit products into existing ceiling-recessed luminaires with screw base sockets as part of an alteration are not prohibited by the Energy Code.

The existing language could have been understood to require removal of existing screw base sockets, or to prohibit the use of existing screw-base sockets by new retrofit kits. This change was necessary to avoid prohibiting installation of energy efficient devices or require unneeded alteration of existing sockets. This change clarifies without materially altering the requirements of the Energy Code.



LED Trim Kit – In alteration projects, these light sources can be installed into existing ceiling-recessed luminaires with screw base sockets.
Source: Jose Perez, California Energy Commission, Blueprint Newsletter – Issue 122

150.2(b)2

Alterations, Performance Approach

CHANGE TYPE: Clarification and Modification

CHANGE SUMMARY: This section was rewritten for clarity, and redundant language was removed.

2019 CODE:

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

[…]

2. **Performance approach.**

The altered component(s) and any newly installed equipment serving the alteration shall meet the applicable requirements of Subsections A, B, and C below.~~This performance approach shall only be used for projects that include tradeoffs between two or more altered components that are listed in TABLE 150.2-C.~~

~~**NOTE:** The altered components may be components of the same type, such as a tradeoff between two windows, or components of differing types, such as a tradeoff between a window and an amount of attic insulation.~~

[…]

CHANGE SIGNIFICANCE: This language was rewritten to better organize the section's requirements. The note was found to be redundant and an unnecessary clarification, and as a result was removed.

150.2(b)2A

Alterations, Performance Approach, Altered Components

CHANGE TYPE: Modification

CHANGE SUMMARY: An exception for specific HVAC requirements was reworded and relocated, and this section was restructured for clarity.

2019 CODE:

(b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.

[…]

2. **Performance approach.**

The altered component(s) and any newly installed equipment serving the alteration shall meet the applicable requirements of Subsections A, B, and C below.~~This performance approach shall only be used for projects that include tradeoffs between two or more altered components that are listed in TABLE 150.2-C.~~

[…]

A. The altered components shall meet the applicable requirements of Sections 110.0 through 110.9, ~~and~~ Sections 150.0(a) through (~~q~~l), Sections 150.0(m)1 through 150.0 (m)10, and Sections 150.0(o) through (q). Entirely new or complete replacement space-conditioning systems, and entirely new or complete replacement duct systems, as these terms are used in Sections 150.2(b)1C, and 150.2(b)1Diia, shall comply with the requirements of Sections 150.0(m)12 and 150.0(m)13.

[…]

~~**EXCEPTION 3 to Section 150.2(b):** Space-Conditioning System Ducts. The requirements of Section150.0(m)12, 150.0(m)13, 150.0(m)14 and 150.0(m)15 are not applicable to Section 150.2(b).~~

CHANGE SIGNIFICANCE: The purpose of the change to this section is to incorporate the exception directly into section language by providing a more detailed reference to the applicable portions of Section 150.0(m) for certain space-conditioning system alterations. This change identifies which systems must meet the applicable requirements and reduces some of the need to review other sections to understand its applicability.

GENERAL INFORMATION

The Facility Inspection Tool (FIT) has been developed by the Office of Public School Construction to determine if a school facility is in "good repair" as defined by Education Code (EC) Section 17002(d)(1) and to rate the facility pursuant to EC Section 17002(d)(2). The tool is designed to identify areas of a school site that are in need of repair based upon a visual inspection of the site. In addition, the EC specifies the tool should not be used to require capital enhancements beyond the standards to which the facility was designed and constructed.

Good repair is defined to mean that the facility is maintained in a manner that ensures that it is clean, safe, and functional. As part of the school accountability report card, school districts and county offices of education are required to make specified assessments of school conditions including the safety, cleanliness, and adequacy of school facilities and needed maintenance to ensure good repair. In addition, beginning with the 2005/2006 fiscal year, school districts and county offices of education must certify that a facility inspection system has been established to ensure that each of its facilities is maintained in good repair in order to participate in the School Facility Program and the Deferred Maintenance Program. This tool is intended to assist school districts and county offices of education in that determination.

County superintendents are required to annually visit the schools in the county of his or her office as determined by EC Section 1240. Further, EC Section 1240(c)(2)(I), states the priority objective of the visits made shall be to determine the status of the condition of a facility that poses an emergency or urgent threat to the health or safety of pupils or staff as defined in district policy, or as defined by EC Section 17592.72(c) and the accuracy of data reported on the school accountability report card with the respect to the safety, cleanliness, and adequacy of school facilities, including good repair as required by EC Sections 17014, 17032.5, 17070.75, and 17089. This tool is also intended to assist county offices of education in performing these functions.

The EC also allows individual entities to adopt a local evaluation instrument to be used in lieu of the FIT provided the local instrument meets the criteria specified in EC Section 17002(d) and as implemented in the FIT. Any evaluation instrument adopted by the local educational agency for purpose of determining whether a school facility is maintained in good repair may include any number of additional items but must minimally include the criteria and rating scheme contained in the FIT.

USER INSTRUCTIONS

The FIT is comprised of three parts as follows:

Part I, Good Repair Standard outlines the school facility systems and components, as specified in EC Section 17002(d)(1), that should be considered in the inspection of a school facility to ensure it is maintained in a manner that assures it is clean, safe and functional. Each of the 15 sections in the Good Repair Standard provides a description of a minimum standard of good repair for various school facility categories. Each section also provides examples of clean, safe and functional conditions. The list of examples is not exhaustive. If an evaluator notes a condition that is not mentioned in the examples but constitutes a deficiency, the evaluator can note such deficiency in the applicable category as "other."

Some of the conditions cited in the Good Repair Standard represent items that are critical to the health and safety of pupils and staff. Any deficiencies in these items require immediate attention and, if left unmitigated, could cause severe and immediate injury, illness or death of the occupants. They constitute extreme deficiencies and indicate that the particular building system evaluated failed to meet the standard of good repair at that school site. These critical conditions are identified with underlined text followed by an (X) on the Good Repair Standard. If the underlined statement is not true, then there is an extreme deficiency (to be marked as an "X" on the Evaluation Detail) resulting in a "poor" rating for the applicable category. It is important to note that the list of extreme deficiencies noted in the Good Repair Standard is not exhaustive. Any other deficiency not included in the criteria but meeting the definition above can be noted by the evaluator and generate a poor rating.

Part II, Evaluation Detail is a site inspection template to be used to evaluate the areas of a school on a category by category basis. The design of the inspection template allows for the determination of the scope of conditions across campus. In evaluating each area or space, the user should review each of the 15 categories identified in the Good Repair Standard and make a determination of whether a particular area is in good repair. Once the determination is made, it should be recorded on the Evaluation Detail, as follows:

OK	**No Deficiency - Good Repair:** Mark "OK" if all statements in the Good Repair Standard are true, and there is no indication of a deficiency in the specific category.
D	**Deficiency:** Mark "D" if one or more statement(s) in the Good Repair Standard for the specific category is not true, or if there is other clear evidence of the need for repair.
X	**Extreme Deficiency**: Indicate "X" if the area has a deficiency that is considered an "Extreme Deficiency" in the Good Repair Standard or there is a condition that qualifies as an extreme deficiency but is not noted in the Good Repair Standard.
NA	**Not Applicable:** If the Good Repair Standard category (building system or component) does not exist in the area evaluated, mark "NA".

Below are suggested methods for evaluating various systems and areas:

- **Gas** and **Sewer** are major building systems that may span the entire school campus but may not be evident as applicable building systems in each classroom or common areas. However, because a deficiency in either of these systems could become evident and present a health and safety threat anywhere on campus, the user should not mark "NA" and should instead include an evaluation of these systems in each building space.
- **Roofs** can be easily evaluated for stand alone areas, such as portable classrooms. For permanent buildings containing several areas to be evaluated, roofs should be considered as parts of individual areas in order to accurately account for a scope of any roofing deficiency. For example, a 10 classroom building contains damaged gutters on one side of the building, spanning across five classrooms. Therefore, an evaluator should mark five classrooms as deficient in the roof category and the other five classrooms as in good repair, assuming there are no other visible deficiencies related to roofing.
- **Overall Cleanliness** is intended to be used to evaluate the cleanliness of each space. For example, a user should note a deficiency due to dirty surfaces in Overall Cleanliness, rather than **Interior Surfaces**. At the same time, the user should note such deficiency only in Overall Cleanliness in order to avoid accounting for such deficiency twice, i.e. in two sections.
- The tool is designed to evaluate stand-alone restrooms as separate areas. However, restrooms contained within other spaces, such as a kindergarten classroom or a library, can be evaluated as part of that area under Restrooms. If the area evaluated does not contain a restroom, Restrooms should be marked "NA."
- **Drinking fountains** can exist within individual classrooms or areas, right outside of classrooms or restrooms or other areas, or as stand alone fixtures on playgrounds and sports fields. If a drinking fountain or a set of fountains is located inside a building or immediately outside the area being evaluated, it should be included in the evaluation of that area under Drinking Fountains. If a fountain is located on the school grounds, it should be evaluated as part of that outside space. If there is no drinking fountain in the area evaluated, Drinking Fountains should be marked "NA."
- **Playgrounds/School Grounds**, should be evaluated as separate areas by dividing a campus into sections with defined borders. In this case, several sections of the good repair criteria would not apply to the evaluation, as they do not exist outside of physical building areas, such as **Structural Damage** and **Fire Safety**, for example.

Part III includes the **Category Totals and Ranking**, the **Overall Rating**, and a section for **Comments and Rating Explanation**.

Once the inspector completes the site inspection, he or she must total the number of areas evaluated. The inspector must also count all of the spaces deemed in good repair, deficient, extremely deficient, or not applicable under each of the 15 sections. Next, the evaluator must determine the condition of each section by taking the ratio of the number of areas deemed in good repair to the number of areas being evaluated (after subtracting non-applicable spaces from the total number of areas evaluated). If any of the 15 sections received a rating of extreme deficiency, the ratio (i.e., the percentage of good repair) for that section and the category the section is in should default to zero. The total percent per category (A through H) is determined by the total of all percentages of systems in good repair divided by the number of sections in that category. For example, to determine the total percent for the Structural category, add the percentages for the Structural Damage and Roof sections and divide the result by two.

Next, the overall school site score is determined by computing the average percentage rating of the eight categories (i.e., the total of all percentages divided by eight). Finally, the rater should determine the overall School Rating by applying the Percentage Range in the table provided in Part III to the average percentage calculated and taking into consideration the Rating Description provided in the same table.

*Although the FIT is designed to evaluate each school site within a reasonable range of facility conditions, it is possible that an evaluator may identify critical facility conditions that result in an Overall School Rating that does not reflect the urgency and severity of those deficiencies and/or does not match the rating's Description in Part III. In such instances, the evaluator may reduce the resulting school score by one or more grade categories and describe the reasons for the reduction in the space provided for Comments and Rating Explanation.

When completing Part III of the FIT, the inspector should note the date and time of the inspection as well as weather conditions and any other pertinent inspection information in the specific areas provided and utilize the Comments and Rating Explanation Section if needed.

When completing Part III of the FIT, the school district should be provided the opportunity to provide comments and utilize the Comments and Rating Explanation Section if needed.

PART I: GOOD REPAIR STANDARD

(X): If underlined statement is not true, then this is an extreme deficiency (marked as an "X") on the Evaluation Detail resulting in a "poor" rating for the applicable category.

Gas Leaks
Gas systems and pipes appear safe, functional, and free of leaks.
Examples include but are not limited to the following:

a. <u>There is no odor that would indicate a gas leak.</u> (X)
b. <u>Gas pipes are not broken and appear to be in good working order.</u> (X)
c. Other

Mechanical Systems
Heating, ventilation, and air conditioning systems (HVAC) as applicable are functional and unobstructed. Examples include but are not limited to the following:

a. <u>The HVAC system is operable.</u> (X)
b. The facilities are ventilated (via mechanical or natural ventilation).
c. The ventilation units are unobstructed and vents and grills are without evidence of excessive dirt or dust.
d. There appears to be an adequate air supply to all classrooms, work spaces, and facilities (i.e. no strong odor is present, air is not stuffy)
e. Interior temperatures appear to be maintained within normally accepted ranges.
f. The ventilation units are not generating any excessive noise or vibrations.
g. Other

Sewer
Sewer line stoppage is not evident. Examples include but are not limited to the following:

a. <u>There are no obvious signs of flooding caused by sewer line back-up in the facilities or on the school grounds.</u> (X)
b. The sanitary system controls odors as designed.
c. Other

Interior Surfaces (Floors, Ceilings, Walls, and Window Casings)
Interior surfaces appear to be clean, safe, and functional. Examples include but are not limited to the following:

a. Walls are free of hazards from tears and holes.
b. Flooring is free of hazards from torn carpeting, missing floor tiles, holes.
c. Ceiling is free of hazards from missing ceiling tiles and holes.
d. There is no evidence of water damage (e.g. no condensation, dampness, staining, warping, peeling, mineral deposits, etc.)
e. Other

Overall Cleanliness
School grounds, buildings, common areas, surfaces, and individual rooms appear to have been cleaned regularly. Examples include but are not limited to the following:
a. Restrooms, drinking fountains, and food preparation or serving areas appear to have been cleaned each day that school is in session.
b. An area should appear to be clean with minimal dirt, dust, or buildup. Floors and carpets should appear to have been swept or cleaned within the last week. Light fixtures and all bulbs are working properly. Facilities area adequately stocked and odor free. (OK)
c. An area marked as "Deficiency" would appear to not have been cleaned in the last two weeks and carpet may look dull, matted, or stained. Corners of the room may have a recognizable amount of dirt or grime buildup. Floors do not appear to have been swept or vacuumed in two weeks. Some light fixtures are dirty and fewer than five percent of the bulbs have burned out. Daily trash has not been taken out. (D)
d. An area marked as having an "Extreme Deficiency" would appear to be dirty, dingy, or scuffed with an evident buildup of dust, dirt, stains, or trash. Floors have not been swept or vacuumed in over two weeks. Light fixtures are dirty and more than five percent of the bulbs have burned out. There is trash overflow and the area being evaluated has a foul odor. (X)
e. Area(s) evaluated is free of unabated graffiti.
f. Other

Part IIb (Optional) - The Cleanliness Detail worksheet may be used to evaluate the Overall Cleanliness of each area. Based on Part IIb, use the following to complete Part IIa:
The district may choose how to report maintenance and custodial staff. The district may report staffing at the site or district level. Staffing may be based on assigned staff or represented as Full-Time Equivalent increments.
a. If 75.0 percent or more of the review is "Yes", the area should be rated clean (OK).
b. If 50 - 74.9 percent of the review is "Yes", the area should be rated "Deficient (D)".
c. If 49.9 percent or less of the review is "Yes", the area should be rated Extreme Deficiency (X)

1. Floors swept, vacuumed, and/or mopped. Free of spots stains, and build up.
2. Walls and Doors free of spots and grime.
3. Desk and Counters clean.
4. Furniture dusted and clean.
5. Baseboards and window sills dusted and clean.
6. Light fixtures clean.
7. Sink clean and drains working properly.
8. Trash cans are empty and clean. The ground is free of trash. Floors and furniture are free of gum and/or other food residue.
9. Windows are free from damage, clean, and in working condition.
10. Water fountains, including handles/buttons, are clean and in working condition.
11. Toilets and bathroom sinks are clean and in working condition.
12. Mirrors and Hand Dryers are clean, intact, and in working condition.
13. Bathroom supplies are stocked and in working condition.
14. Area is free of graffitti.
15. Landscaping - Maintained sufficiently to not hinder student and staff.

Pest/Vermin Infestation
Pest or vermin infestation are not evident. Examples include but are not limited to the following:
a. <u>There is no evidence of a major pest or vermin infestation.</u> (X)
b. There are no holes in the walls, floors, or ceilings.
c. Rodent droppings or insect skins are not evident.
d. Odor caused by a pest or vermin infestation is not evident.
e. There are no live rodents observed.
f. Other

Electrical (Interior and Exterior)

1. There is no evidence that any portion of the school has a power failure. (X)

2. Electrical systems, components, and equipment appear to be working properly.
a. There are no exposed electrical wires. Electrical equipment is properly covered and secured from pupil access. (X)
b. Outlets, access panels, switch plates, junction boxes and fixtures are properly covered and secured from pupil access.
c. Other

3. Lighting appears to be adequate and working properly, including exterior lights. Examples include but are not limited to the following:
a. Lighting appears to be adequate.
b. Lighting is not flickering.
c. There is no unusual hum or noise from the light fixtures.
d. Other

Restrooms

Restrooms in the vicinity of the area being evaluated appear to be accessible during school hours, clean, functional and in compliance with SB 892 (EC Section 35292.5) and AB 367 (EC Section 35292.6). The following are examples of compliance with SB 892 and AB 367:

a. Restrooms are maintained and cleaned regularly.
b. Restrooms are fully operational.
c. Restrooms are stocked with toilet paper, menstrual products, soap, and paper towels.
d. Restrooms are open during school hours.
e. Other

Sinks/Fountains (Inside and Outside)

Drinking fountains appear to be accessible and functioning as intended. Examples include but are not limited to the following:
a. Drinking fountains are accessible.
b. Water pressure is adequate.
c. A leak is not evident.
d. There is no moss, mold, or excessive staining on the fixtures.
e. The water is clear and without unusual taste or odor.
f. Other

Fire Safety

The fire equipment and emergency systems appear to be functioning properly. Examples include but are not limited to the following:
a. The fire sprinklers appear to be in working order (e.g., there are no missing or damaged sprinkler heads). (X)
b. Emergency alarms appear to be functional. (X)
c. Emergency exit signs function as designed, exits are unobstructed. (X)
d. Fire extinguishers are current and placed in all required areas.
e. Fire alarms pull stations are clearly visible.
f. Other

Hazardous Materials (Interior and Exterior)

There does not appear to be evidence of hazardous materials that may pose a threat to pupils or staff. Examples include but are not limited to the following:
a. Hazardous chemicals, chemical waste, and flammable materials are stored properly (e.g. locked and labeled properly). (X)
b. Paint is not peeling, chipping, or cracking.
c. There does not appear to be damaged tiles or other circumstances that may indicate asbestos exposure.
d. Surfaces (including floors, ceilings, walls, window casings, HVAC grills) appear to be free of mildew, mold odor and visible mold.
e. Other

Structural Damage

There does not appear to be structural damage that has created or could create hazardous or uninhabitable conditions. Examples include but are not limited to the following:

a. Severe cracks are not evident. (X)
b. Ceilings & floors are not sloping or sagging beyond their intended design. (X)
c. Posts, beams, supports for portable classrooms, ramps, and other structural building members appear to be intact, secure and functional as designed. (X)
d. There is no visible evidence of severe cracks, dry rot, mold, or damage that undermines the structural components. (X)
e. Other

When completing Part III of the FIT, the inspector should note the date and time of the

Roofs (observed from the ground, inside/outside the building)

Roof systems appear to be functioning properly. Examples include but are not limited to the following:
a. Roofs, gutters, roof drains, and down spouts are free of visible damage.
b. Roofs, gutters, roof drains, and down spouts are intact.
c. Other

Playground/School Grounds

The playground equipment and school grounds in the vicinity of the area being evaluated evaluated appear to be clean, safe, and functional. Examples include but are not limited to the following:
a. Significant cracks, trip hazards, holes and deterioration are not found.
b. Open "S" hooks, protruding bolt ends, and sharp points/edges are not found in the playground equipment.
c. Seating, tables, and equipment are functional and free of significant cracks.
d. There are no signs of drainage problems, such as flooded areas, eroded soil, water damage to asphalt, or clogged storm drain inlets.
e. Other

Windows/Doors/Gates/Fences (Interior and exterior)

Conditions that pose a safety and/or security risk are not evident. Examples include but are include but are not limited to the following:
a. There is no exposed broken glass accessible to pupils and staff. (X)
b. Exterior doors and gates are functioning and do not pose a security risk. (X)
c. Windows are intact and free of cracks.
d. Windows are functional and open, close, and lock as designed, unless there is a valid reason they should not function as designed.
e. Doors are intact.
f. Doors are functional and open, close, and lock as designed, unless there is a valid reason they should not function as designed.
g. Gates and fences appear to be functional.
h. Gates and fences are intact and free of holes and other conditions that could present a safety hazard to pupils, staff, or others.
i. Other

PART IIa: EVALUATION DETAIL

Date of Inspection: ________ School Name: ________________________

Building / Area Name	Estimated Square Footage	1 GAS LEAKS	2 MECH/HVAC	3 SEWER	4 INTERIOR SURFACES	5 OVERALL CLEANLINESS	6 PEST/VERMIN INFESTATION	7 ELECTRICAL	8 RESTROOM	9 SINKS/ FOUNTAINS	10 FIRE SAFETY	11 HAZARDOUS MATERIALS	12 STRUCTURAL DAMAGE	13 ROOFS	14 PLAYGROUND/ SCHOOL GROUNDS	15 WINDOWS/ DOORS/ GATES/FENCES
		COMMENTS:														
		COMMENTS:														
		COMMENTS:														
		COMMENTS:														
		COMMENTS:														
		COMMENTS:														
		COMMENTS:														
		COMMENTS:														
		COMMENTS:														
		COMMENTS:														
District's Plan to Address:																
Deficiencies Noted in Prior Year?																

Marks: **OK** = Good Repair; **D** = Deficiency; **X** = Extreme Deficiency; **NA** = Not Applicable
Use additional Area Lines as necessary.

PART III: CLEANLINESS DETAIL

NUMBER OF MAINTENANCE STAFF IN THE DISTRICT OR AT SITE (SPECIFY): ________ Date of Inspection: ________ School Name: ________

NUMBER OF CUSTODIAL STAFF ASSIGNED TO SITE: ________

Building / Area Name	Area Characteristics (Grade level served, events, traffic volume, public usage, etc.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Rating
		Floors	Walls & Doors	Desks & Counters	Furniture	Baseboards /Window Sill	Light Fixtures	Sinks	Trash / Refuse	Windows	Water Fountains	Toilets	Mirrors & Hand Dryers	Bathroom Supplies	Graffiti	Landscaping	
		COMMENTS:															
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		COMMENTS:															
District's Plan to Address:																	
Deficiency Noted in Prior Year?																	

Use additional Area Lines as necessary.

SCHOOL DISTRICT/COUNTY OFFICE OF EDUCATION		COUNTY	
SCHOOL SITE		SCHOOL TYPE (GRADE LEVELS)	NUMBER OF CLASSROOMS ON SITE: NUMBER OF RESTROOMS ON SITE:
INSPECTOR'S NAME	INSPECTOR'S TITLE	NAME OF DISTRICT REPRESENTATIVE ACCOMPANYING THE INSPECTOR(S) (IF APPLICABLE)	
TOTAL ESTIMATED BUILDING VOLUME (CUBIC FEET):	TIME OF INSPECTION	SITE ENROLLMENT	
TOTAL ESTIMATED SITE SQUARE FOOTAGE / ACREAGE: TOTAL ESTIMATED BUILDING SQUARE FOOTAGE:	WEATHER CONDITION AT TIME OF INSPECTION		

PART III: CATEGORY TOTALS AND RANKING (round all calculations to two decimal places)

TOTAL NUMBER OF AREAS EVALUATED	CATEGORY TOTALS	A. SYSTEMS			B. INTERIOR	C. CLEANLINESS		D. ELECTRICAL	E. RESTROOMS/FOUNTAINS		F. SAFETY		G. STRUCTURAL		H. EXTERNAL	
		GAS LEAKS	MECH/HVAC	SEWER	INTERIOR SURFACES	OVERALL CLEANLINESS	PEST/VERMIN INFESTATION	ELECTRICAL	RESTROOMS	SINKS/ FOUNTAINS	FIRE SAFETY	HAZARDOUS MATERIALS	STRUCTURAL DAMAGE	ROOFS	PLAYGROUND/ SCHOOL GROUNDS	WINDOWS/DOORS/ GATES/FENCES
↓	Number of "OK"s:															
	Number of "D"s:															
	Number of "X"s:															
	Number of N/As:															
Percent of System in Good Repair Number of "OK"s divided by (Total Areas - "NA"s)*																
Total Percent per Category (average of above)*																
Rank (Circle one) GOOD = 90%-100% FAIR = 75%-89.99% POOR = 0%-74.99%																

*Note: An extreme deficiency in any area automatically results in a "poor" ranking for that category and a zero for "Total Percent per Category".

OVERALL RATING: **DETERMINE AVERAGE PERCENTAGE OF 8 CATEGORIES ABOVE** → ______ **SCHOOL RATING**** → ______

**For School Rating, apply the Percentage Range below to the average percentage determined above, taking into account the rating Description below.

PERCENTAGE	DESCRIPTION	RATING
99%-100%	The school meets most or all standards of good repair. Deficiencies noted, if any, are not significant and/or impact a very small area of the school.	EXEMPLARY
90%-98.99%	The school is maintained in good repair with a number of non-critical deficiencies noted. These deficiencies are isolated, and/or resulting from minor wear and tear, and/or in the process of being mitigated.	GOOD
75.%-89.99%	The school is not in good repair. Some deficiencies noted are critical and/or widespread. Repairs and/or additional maintenance are necessary in several areas of the school site.	FAIR
0%-74.99%	The school facilities are in poor condition. Deficiencies of various degrees have been noted throughout the site. Major repairs and maintenance are necessary throughout the campus.	POOR

INSPECTOR'S COMMENTS AND RATING EXPLANATION:

DISTRICT'S RESPONSES TO REPORT (Attach additional pages if necessary):

SENATE COMMITTEE ON APPROPRIATIONS
Senator Anthony Portantino, Chair
2021 - 2022 Regular Session

AB 2232 (McCarty) - School facilities: heating, ventilation, and air conditioning systems

Version: June 28, 2022	**Policy Vote:** ED. 4 - 1
Urgency: No	**Mandate:** Yes
Hearing Date: August 1, 2022	**Consultant:** Lenin Del Castillo

Bill Summary: This bill requires a school district, county office of education (COE), charter school, private school, the California Community Colleges (CCC), the California State University (CSU), and requests the University of California (UC), to ensure that classrooms have heating, ventilation, and air conditioning (HVAC) systems that meet minimum ventilation rate requirements and to install filtration that achieves minimum efficiency reporting values (MERV) levels, as specified.

Fiscal Impact: This bill could result in unknown, but potentially significant costs for school districts and community colleges to inspect and ensure that their HVAC systems meet the minimum ventilation rate requirements. However, it is unclear how many school and community college districts statewide need to install new filtration as a result of the inspections. The associated costs for these activities could be deemed to be reimbursable by the state.

This bill could also result in additional, state reimbursable mandated costs for school and community college districts to install new carbon dioxide monitors classrooms. The amount would depend on the number of classrooms that do not already have carbon dioxide monitors installed (that meet the new standards to be adopted) and the extent of the installation costs, but the one-time costs could be in the hundreds of thousands to low millions of dollars of dollars.

The CSU indicates that its campuses have already taken steps to improve filtration on their existing HVAC systems to bring them into compliance with COVID era safety era rules and regulations. Therefore, any additional costs as a result of this measure will be minor and absorbable within existing resources. The bill's costs for UC are also likely to be minor and absorbable within existing resources.

Background: Existing law requires K-12 school facilities to be in "good repair" which is defined as a facility that is maintained in a manner that assures that it is clean, safe, and functional. The law requires the school facility inspection and evaluation instrument and local evaluation instruments to include specified criteria, including the criterion that mechanical systems, including HVAC systems, are functional and unobstructed and appear to supply adequate amount of air to all classrooms, workspaces, and facilities.

Existing law requires the State Allocation Board (SAB) to require school districts to make all necessary repairs, renewals, and replacements to ensure that a project funded by state bond funds is at all times maintained in good repair, working order, and condition. Requires a school district to establish a restricted account within the school district general fund for the purpose of providing moneys for ongoing and major maintenance of school buildings.

Existing law requires the local control and accountability plan (LCAP) to include actions that address eight state priorities, including ensuring that school facilities are maintained in good repair.

Under the Labor Code, the Occupational Safety and Health Standards Board (Board) is authorized to develop health and safety requirements for the protection of workers. Regulations adopted by the Board require HVAC systems to be maintained and operated in accordance with the State Building Standards Code and continuously functioning during working hours with some exceptions (e.g., during scheduled maintenance). The regulations also require the HVAC system to be inspected at least annually and problems found during the inspections to be corrected within a reasonable time. The employer is required to document in writing the name of the individual inspecting or maintaining the system, the date of the inspection and/or maintenance, and the specific findings and actions taken. The records are required to be retained for at least five years and made available for examination and copying, within 48 hours of a request, to the Division of Industrial Relations, any employee of the employer, and to any designated representative of employees.

Proposed Law: This bill requires a covered school to, and the UC is requested to, ensure that facilities, including, but not limited to, classrooms for students, have HVAC systems that meet the minimum ventilation rate requirements set forth in Table 120.1-A of Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate.

This bill requires that, if a school's existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate as proposed to be required, the covered school to, and the UC is requested to, ensure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued.

This bill requires a covered school to, and the UC is requested to, document the HVAC system's inability to meet the current ventilation standards in the annual HVAC inspection report required by Title 8 of the California Code of Regulations Section 5142, and make this information available to the public upon request.

This bill requires covered schools, and request the UC, to install filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system. The bill provides that for existing HVAC systems not designed to achieve MERV levels of 13 or higher, covered schools shall, and the UC is requested to, install filtration that achieves the highest MERV level feasible without reducing the lifespan or performance of the existing HVAC system.

This bill requires, upon the next triennial update of the California Building Standards Code (Title 24 of the California Code of Regulations), the Commission and the DSA to research, develop, and propose for adoption mandatory standards for carbon dioxide monitors in classrooms of a covered school and the UC.

This bill provides that it shall apply to the UC only to the extent that the Regents of the UC, by resolution, make it applicable.

This bill contains the following definitions:

a) "Covered school" means a school district, a COE, a charter school, a private school, the CCCs, or the CSU;

b) "HVAC" means heating, ventilation, and air conditioning; and

c) "MERV" means minimum efficiency reporting values.

-- END --

Office of Senate Floor Analyses
(916) 651-1520 Fax: (916) 327-4478

THIRD READING

Bill No: AB 2232
Author: McCarty (D)
Amended: 6/28/22 in Senate
Vote: 21

SENATE EDUCATION COMMITTEE: 4-1, 6/22/22
AYES: Leyva, Glazer, McGuire, Pan
NOES: Dahle
NO VOTE RECORDED: Ochoa Bogh, Cortese

SENATE APPROPRIATIONS COMMITTEE: 5-1, 8/11/22
AYES: Portantino, Bradford, Laird, McGuire, Wieckowski
NOES: Jones
NO VOTE RECORDED: Bates

ASSEMBLY FLOOR: 59-9, 5/25/22 - See last page for vote

SUBJECT: School facilities: heating, ventilation, and air conditioning systems

SOURCE: Author

DIGEST: This bill requires a school district, county office of education (COE), charter school, private school, the California Community Colleges (CCC), the California State University (CSU), and requests the University of California (UC), to ensure that facilities, including classrooms for students, have heating, ventilation, and air conditioning (HVAC) systems that meet minimum ventilation rate requirements, as specified, and to install filtration that achieves minimum efficiency reporting values (MERV) levels of 13 or higher. Requires the Division of the State Architect (DSA) to propose for adoption mandatory standards for carbon dioxide monitors in classrooms of a covered school and the UC.

ANALYSIS:

Existing law:

1) Defines "good repair" as a facility that is maintained in a manner that assures that it is clean, safe, and functional. Requires the school facility inspection and evaluation instrument and local evaluation instruments to include specified criteria, including the criterion that mechanical systems, including HVAC systems, are functional and unobstructed and appear to supply adequate amount of air to all classrooms, workspaces, and facilities.

2) Requires the State Allocation Board (SAB) to require school districts to make all necessary repairs, renewals, and replacements to ensure that a project funded by state bond funds is at all times maintained in good repair, working order, and condition. Requires a school district to establish a restricted account within the school district general fund for the purpose of providing moneys for ongoing and major maintenance of school buildings.

3) Requires the local control and accountability plan (LCAP) to include actions that address eight state priorities, including ensuring that school facilities are maintained in good repair.

4) Authorizes the Occupational Safety and Health Standards Board to adopt, amend or repeal occupational safety and health standards and orders.

This bill:

1) Establishes the following definitions:

   a) "Covered school" means a school district, a COE, a charter school, a private school, the CCCs, or the CSU;
   b) "HVAC" means heating, ventilation, and air conditioning; and
   c) "MERV" means minimum efficiency reporting values.

2) Requires a covered school to, and the UC is requested to, ensure that facilities, including, but not limited to, classrooms for students, have HVAC systems that meet the minimum ventilation rate requirements set forth in Table 120.1-A of Part 6 (commencing with Section 100.0) of Title 24 of the California Code of Regulations unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate.

3) Requires that, if a school's existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate as proposed to be required, the covered school to, and the UC is requested to, ensure that its HVAC system meets the minimum ventilation rates in effect at the time the building permit for installation of that HVAC system was issued.

4) Requires a covered school to, and the UC is requested to, document the HVAC system's inability to meet the current ventilation standards in the annual HVAC inspection report required by Title 8 of the California Code of Regulations Section 5142, and make this information available to the public upon request.

5) Requires a covered school to, and the UC is requested to, install filtration that achieves MERV levels of 13 or higher where feasible with the existing HVAC system.

6) Requires, during the next triennial update of the California Building Standards Code (Title 24 of the California Code of Regulations), the DSA to research, develop, and propose for adoption mandatory standards for carbon dioxide monitors in classrooms of a covered school and the UC.

7) Specifies that this bill shall apply to the UC only to the extent that the Regents of the UC, by resolution, make it applicable.

Comments

1) *Need for the bill.* According to the author, "Poor air quality in classrooms is a pervasive problem that negatively impacts student health and learning. Despite laws requiring schools to maintain functional HVAC systems to supply adequate ventilation and safe indoor air quality, poor indoor air quality remains an extensive problem. Additionally, poor installment of HVAC systems substantially increase energy costs and fail to maintain good indoor air quality. AB 2232 will require comprehensive HVAC inspections and air monitors in classrooms to ensure the wellbeing and learning of California students are protected from the harmful effects of poor air quality."

2) *HVAC requirements.* Various sections of the law require school facilities to be in good working order and well maintained, including specified inspections. In 2004, the state settled the *Williams v. California* lawsuit and agreed to a number of initiatives intended to provide equal access to instructional materials, safe and decent school facilities, and qualified teachers. The settlement resulted in

an agreement to provide funds to low-performing schools, including $800 million for emergency repair of school facilities. COEs were charged with inspection of the low-performing schools based on criteria of schools in good repair. "Good repair" is defined as a facility that is clean, safe, and functional. The settlement also includes a lengthy list of facilities components required to be inspected, including gas pipes, doors and windows, fences, fire sprinklers, fire extinguishers, alarm systems, electrical systems, lighting, drinking fountains, roofs, gutters, and mechanical systems, which includes HVAC systems.

Under the Labor Code, the Occupational Safety and Health Standards Board (Board) is authorized to develop health and safety requirements for the protection of workers. Regulations adopted by the Board require HVAC systems to be maintained and operated in accordance with the State Building Standards Code and continuously functioning during working hours with some exceptions (e.g., during scheduled maintenance). The regulations also require the HVAC system to be inspected at least annually and problems found during the inspections to be corrected within a reasonable time. The employer is required to document in writing the name of the individual inspecting or maintaining the system, the date of the inspection and/or maintenance, and the specific findings and actions taken. The records are required to be retained for at least five years and made available for examination and copying, within 48 hours of a request, to the Division of Industrial Relations, any employee of the employer, and to any designated representative of employees.

3) *Carbon dioxide monitors.* Studies have found a link between low ventilation rates (supply of outdoor air) in classrooms and attendance, health, and student performance. Adequate ventilation helps students be more alert and focused and is associated with fewer respiratory symptoms and absences due to illness. Ventilation standards are specified in Title 24 regulations. In a 2020 article, researchers at the Lawrence Berkeley National Laboratory and the Western Cooling Efficiency Center at UC Davis reported findings of a study of 11 K-12 schools, monitoring 104 classrooms, with ventilation rates of a majority of the classrooms exceeding the Title 24 level. Carbon dioxide monitors can be used as a proxy for the level of ventilation in a classroom. When classrooms are empty, carbon dioxide levels will be lower. When classrooms are occupied, carbon dioxide levels will be higher as carbon dioxide is exhaled by the people in the room.

The construction of school district, COE, and CCC facilities is required to comply with Title 24 regulations. Beginning January 1, 2023, Title 24 requires carbon dioxide monitors to be installed in all new classrooms. According to the DSA, during the next Title 24 regulatory code cycle, carbon dioxide monitors for existing schools doing repairs or alterations may be considered. Charter and private schools are required to comply with local building codes and not Title 24 regulations.

FISCAL EFFECT: Appropriation: No Fiscal Com.: Yes Local: Yes

According to the Senate Appropriations Committee:

- This bill could result in unknown, but potentially significant costs for school districts and community colleges to inspect and ensure that their HVAC systems meet the minimum ventilation rate requirements. However, it is unclear how many school and community college districts statewide need to install new filtration as a result of the inspections. The associated costs for these activities could be deemed to be reimbursable by the state.

- This bill could also result in additional, state reimbursable mandated costs for school and community college districts to install new carbon dioxide monitors classrooms. The amount would depend on the number of classrooms that do not already have carbon dioxide monitors installed (that meet the new standards to be adopted) and the extent of the installation costs, but the one-time costs could be in the hundreds of thousands to low millions of dollars of dollars.

- The CSU indicates that its campuses have already taken steps to improve filtration on their existing HVAC systems to bring them into compliance with COVID era safety era rules and regulations. Therefore, any additional costs as a result of this measure will be minor and absorbable within existing resources. The bill's costs for UC are also likely to be minor and absorbable within existing resources.

SUPPORT: (Verified 8/12/22)

Bluegreen Alliance
California Energy Alliance
California Faculty Association
California Federation of Teachers
California Teachers Association
Community Action to Fight Asthma

Natural Resources Defense Council
Western States Council Sheet Metal, Air, Rail and Transportation

OPPOSITION: (Verified 8/12/22)

None received

ARGUMENTS IN SUPPORT: The United States Green Building Council states, "Under-ventilated schools are associated with increased transmission of infection, asthma exacerbation, cognitive impairment, and health impacts. This, in turn, affects how students learn. Students who attend schools with poor ventilation rates find it more challenging to learn, perform simple and complex tasks, and make decisions. Setting a minimum ventilation rate requirement would set the expectation that fresh air is not something that is nice to have, but rather is necessary for students and teachers to function at school."

ASSEMBLY FLOOR: 59-9, 5/25/22
AYES: Aguiar-Curry, Arambula, Bauer-Kahan, Bennett, Bloom, Boerner Horvath, Mia Bonta, Bryan, Calderon, Carrillo, Cervantes, Cooley, Cooper, Cunningham, Daly, Mike Fong, Friedman, Gabriel, Cristina Garcia, Eduardo Garcia, Gipson, Gray, Grayson, Haney, Holden, Irwin, Jones-Sawyer, Kalra, Lee, Levine, Low, Maienschein, Mayes, McCarty, Medina, Mullin, Muratsuchi, Nazarian, Petrie-Norris, Quirk, Quirk-Silva, Ramos, Reyes, Luz Rivas, Robert Rivas, Rodriguez, Blanca Rubio, Salas, Santiago, Stone, Ting, Villapudua, Waldron, Ward, Akilah Weber, Wicks, Wilson, Wood, Rendon
NOES: Bigelow, Megan Dahle, Davies, Fong, Gallagher, Kiley, Patterson, Seyarto, Smith
NO VOTE RECORDED: Berman, Chen, Choi, Flora, Lackey, Mathis, Nguyen, O'Donnell, Valladares, Voepel

Prepared by: Ian Johnson / ED. / (916) 651-4105
8/13/22 12:14:58

****** END ******

Overview Title 24 Building Standards Code as Adopted by the Division of the State Architect

Learn about Title 24 of the California Code of Regulations, known as the California Building Standards Code or just "Title 24," which contains the regulations that govern structural safety and sustainability for California's public schools, community colleges and state essential services buildings; sustainability for state buildings; and accessibility for public accommodations of buildings in California.

Visit the California Building Standards Commission' (CBSC) Codes (/en/BSC/Codes)webpage or information regarding where to find or purchase any part of Title 24. All approved supplements and errata are available on the CBSC website. Supplements are applicable to any project submitted to DSA on or after the effective date of the supplement (the effective date is typically six months after the publication date of the supplement).

If you are looking for the CalGreen code, see our CALGreen Code Development (/en/DSA/Resources/Page-Content/Resources-List-Folder/CALGreen-Code-Development) webpage.

Title 24 is composed of 12 "Parts" described below.

PART 1 - CALIFORNIA ADMINISTRATIVE CODE

The California Administrative Code (CAC) contains administrative regulations of the California Building Standards Commission and administrative regulations of all State agencies that implement or enforce building standards.

PART 2 - CALIFORNIA BUILDING CODE

The California Building Code (CBC) contains general building design and construction requirements relating to fire and life safety, structural safety, and access compliance. CBC provisions provide minimum standards to safeguard life or limb, health, property and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location and maintenance of all buildings and structures and certain equipment. Part 2 is pre-assembled with the International Building Code (IBC) with necessary California amendments. This part is published in two volumes:

- Volume 1 contains Chapters 1 through 15.
- Volume 2 contains Chapters 16 through 35, and Appendices A through M.

Matrix Adoption tables are provided at beginning of every chapter in Part 2 to indicate what chapters and sections are adopted by state agencies (for application to their respective occupancies).

Since publication of Part 2 in 2 volumes was done as a convenience, Volume 2 now also contains Parts 8 and 10.

PART 3 - CALIFORNIA ELECTRICAL CODE

The California Electrical Code (CEC) contains electrical design and construction standards. Provisions contained in the CEC provide minimum standards to safeguard life or limb, health, property, and public welfare, and to protect against hazards that may arise from the use of electricity by regulating and controlling the design, construction, installation, quality of materials, location and operation of electrical equipment, wiring, and systems. This volume is pre-assembled with the National Electrical Code of the National Fire Protection Association (NFPA) with necessary California amendments.

PART 4 - CALIFORNIA MECHANICAL CODE

The California Mechanical Code (CMC) contains mechanical design and construction standards. Provisions contained in the CMC provide minimum standards to safeguard life or limb, health, property and public welfare by regulating and controlling the design, construction, installation, quality of materials, location, operation, and maintenance or use of heating, ventilating, cooling, refrigeration systems, incinerators and other miscellaneous heat-producing appliances. This code is pre-assembled with the Uniform Mechanical Code of the International Association of Plumbing and Mechanical Officials (IAPMO) with necessary California amendments.

PART 5 - CALIFORNIA PLUMBING CODE

The California Plumbing Code (CPC) contains plumbing design and construction standards. Provisions contained in the CPC provide minimum standards to safeguard life or limb, health, property and public welfare. It also protects against hazards that may arise from the use of plumbing piping and systems by regulating and controlling the design, construction, installation, quality of materials, location and operation of plumbing piping systems within the State of California. This code is pre-assembled with the Uniform Plumbing Code of the International Association of Plumbing and Mechanical Officials (IAPMO) with necessary California amendments.

PART 6 - CALIFORNIA ENERGY CODE

The California Energy Code contains energy conservation standards applicable to all residential and non-residential buildings throughout California, including schools and community colleges.

PART 8 - CALIFORNIA HISTORICAL BUILDING CODE

The California Historical Building Code (CHBC) contains regulations of the State Historical Building Safety Board (http://www.dgs.ca.gov/dsa/AboutUs/shbsb.aspx). Provisions contained in the CHBC provide for the preservation, restoration, rehabilitation, relocation, or reconstruction of buildings or structures designated as qualified historical buildings or properties. The CHBC contains alternative solutions for the preservation of qualified historical buildings or properties, to provide access for persons with disabilities, to provide a cost effective approach to preservation, and to provide for the reasonable safety of the occupants or users.

PART 9 - CALIFORNIA FIRE CODE

The California Fire Code (CFC) contains regulations consistent with nationally recognized accepted practices for safeguarding, to a reasonable degree, life and property from the hazards of:

- Fire and explosion
- Hazardous conditions in the use or occupancy of buildings or premises
- Dangerous conditions arising from the storage, handling and use of hazardous materials and devices

The CFC also contains provisions to assist emergency response personnel. These fire-safety-related building standards are referenced in other parts of Title 24. This code is pre-assembled with the International Fire Code with necessary California amendments.

PART 10 - CALIFORNIA EXISTING BUILDING CODE

The California Building Standards Commission (CBSC) adopts certain provisions of the International Existing Building Code, Appendix Chapter A1, Seismic Strengthening Provisions for Unreinforced Masonry Bearing Wall Buildings.

Part 11 - CALIFORNIA GREEN BUILDING STANDARDS (CALGreen Code)

The California Green Building Standards Code contains standards applicable to residential and non-residential buildings throughout California, including schools and community colleges.

Part 12 - CALIFORNIA REFERENCE STANDARD CODE

The California Referenced Standards Code (CRSC) contains minimum test and reference standards required by the California Building Standards Code.

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